INSAR
International Society for Autism Research

INSAR 2020 VIRTUAL
ABSTRACT BOOK

JUNE 3, 2020

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Thank you to our Sponsors for their generous support of INSAR. Sponsorship funding made it possible for INSAR 2020 Virtual to be launched. Funding also supports other planned educational events for this year, including the INSAR Institute.

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STRATEGIC INITIATIVES

INSAR Mission Statement

To improve the lives of people affected by autism
by promoting the highest quality research.

BUILDING IDENTITY

Promote INSAR as the premier society for autism researchers.

DIVERSE AND GLOBAL

Represent and serve a diverse and global community.

INTERDISCIPLINARY AND TRANSLATIONAL

Cultivate interdisciplinary and translational research, public-private partnerships, and relationships with industry.

NEXT GENERATION

Foster opportunities for leadership and career development for a diverse next generation of autism researchers.

PARTNERSHIPS

Foster understanding, communication, and collaboration between autism researchers and people affected by autism.

RESEARCH TO PRACTICE

Disseminate scientific knowledge to inform research priorities, policy, practice, and public understanding.

SETTING THE BAR

Increase the quality, diversity, and relevance of research promoted through annual meetings, journal, educational, and other year-round activities.

INSAR Travel Awards 2020

Travel Awardees for 2020 are listed below by category. We want to congratulate and acknowledge these individuals on being selected for these travel awards. Due to the cancellation of the in-person INSAR 2020 Annual Meeting, funding was not provided.

Autistic Researcher Travel Awards

Jacquiline den Houting	Macquarie University
Patrick Dwyer	University of California, Davis
Dena Gassner	Adelphi University
David Mason	King's College London
Lisa Morgan	
Emily Richard	George Mason University
Jacalyn Ryan	University of Alberta
Rachelle Wicks	Griffith University
Zachary Williams	Vanderbilt University School of Medicine

Diversity Travel Awards

Monica Abdul-Chani	University of Alabama at Birmingham
Mary Agyapong	King's College London
Camile Borja	College of William & Mary
Aaron Dallman	UNC Chapel Hill
Lucia Florindez	University of Southern California
Damaris Lorenzo	Univ of North Carolina, Chapel Hill
Magdalena Szura	Medical College of Rzeszow University

Professionals from Low Income Countries Travel Awards

Emmanuel Bonney	University of Makerere
Fei Chen	The Hong Kong Polytechnic University
Marija Čolić	University of Belgrade, Serbia
John-Joe Dawson-Squibb	University of Cape Town
Nazia Jassim	University of Cambridge
Olumuyiwa Kehinde	University of Zululand
Fathima Kodakkadan	Anglia Ruskin University
Flavio Murahara	McGill University
Kritika Nayar	Northwestern University
Liezl Schlebusch	University of Cape Town
Jannatara Shefa	Bangabandhu Sheikh Mujib Medical University
Lin Sun	Indiana University
Suma Suswaram	University of Kansas
Divya Swaminathan	St John's Medical College Hospital
Deepali Taneja	University of Delhi
Cong Tran	Vietnam National University
Qi Wei	University of Oregon
Baishun Zhou	Tsinghua University

Student and Trainee Travel Awards

Yeojin Ahn	University of Miami
Zeena Ammar	Emory University
Stacy Arbuckle	University of Oregon
Armen Bagdasarov	Yale University
Anke Bletsch	Goethe University
Katharina Boegl	Humboldt-Universität zu Berlin
Kaitlyn Breitenfeldt	University of Pittsburgh
Emily Bremer	University of Toronto
Alexis Brewe	University of Alabama
Yael Brukner	Bar-Ilan University
Simone Capp	King's College London
Carter Carlos	Yale University
Merve Çelebi	Acibadem University
Jennifer Chang	Baylor College of Medicine/Texas Children's Hospital
Alison Chavez	University of Massachusetts Boston
Yun-Ju Chen	University of Southern California
Elysha Clark-Whitney	Weill Cornell Medicine
Kevin Cook	Georgetown University
Michal Cook	University of North Carolina at Chapel Hill
Elise Cummings	Yale University
Alexa Curhan	Johns Hopkins Bloomberg School of Public Health
Angela Dahiya-Singh	Virginia Tech
Konnor Davis	University of California, Davis
Simrina Desar	University of California, Los Angeles
Nicholas Fears	University of North Texas Health Science Center
Kyle Frost	Michigan State University
Joseph Giacomantonio	Stony Brook University
Rachel Greene	University of North Carolina
Luke Grosvenor	Johns Hopkins Bloomberg School of Public Health
Gabrielle Gunin	Rutgers University
Rachel Hantman	Boston University
Dorothy Hoang	University of California, Davis
Katie Howard	University of Alberta
Alaa Ibrahim	McGill University
Xiangbin Jia	Central South University
Amandeep Jutla	Columbia University
Shannon Kelly	University of Kansas
So Yoon Kim	Boston College
Kathryn King	University of California, Davis

Claire Klein	Weill Cornell Medicine
Alexis Lafleur	Université du Québec à Montréal
James Lee	University of Illinois
Kaya LeGrand	Emerson College
Kimberly Lin	Emerson College
Xinyue Liu	Indiana University
Stephanie Lung	McGill University
Keren MacLennan	University of Reading
Caroline Mann	Goethe University
Ting Mei	Radboud University
Kelly Mo	University of Toronto
Meredith Pecukonis	Boston University
Mirabel Pelton	Coventry University
Ohad Regev	Ben-Gurion University of the Negev
Charlotte Rimmer	McGill University
Helen Root	University of Alabama at Birmingham
Nicole Rosen	University of California, Los Angeles
Jessica Schwartzman	Palo Alto University
Grace Simmons	University of Alabama
Jennie Sotelo Orozco	University of California, Davis
Gavin Stewart	King's College London
Briana Taylor	Maine Medical Center
Kimberly Tomeny	University of Alabama
Isita Tripathi	University of California, Los Angeles
Bahar Tuncgenc	Johns Hopkins University
Dévina Ung	Icahn School of Medicine at Mount Sinai Hospital
Elizabeth Weir	University of Cambridge
Melina West	University of Connecticut
Molly Winston	Northwestern University
Nichol Wong	King's College London
Rachel Wulff	University of California, Davis
Ivry Zagury-Orly	Harvard Medical School; University of Montreal

Student and Trainee Workshop Travel Awards

Janina Brede	University College London
Teresa Girolamo	University of Kansas
Taylor Halligan	Purdue University
Shashwat Kala	Yale University
Orly Kerub	Ben Gurion University in the Negev
Talia Liu	Vanderbilt University Medical Center
Alana McVey	Marquette University
Hillary Schiltz	Marquette University
Lauren Singer	Yale University
Ellen Wilkinson	Rutgers University

INSAR 2020 Virtual

Launching June 3, 2020

Live Webinars

e-Posters
& Abstracts

On Demand
Content

The INSAR 2020 Annual Meeting to be held May 2020 in Seattle, Washington, USA was cancelled. In efforts to continue sharing and advancement of autism research, INSAR 2020 Virtual was launched on June 3, 2020. Our four planned Keynotes for the in-person event, agreed to present live via webinar with archived recordings to be hosted online for on-demand viewing. In addition to the Keynote Webinar, all individuals with accepted abstracts (Panel, Oral and Poster) were given the opportunity to submit an e-Poster. The abstract and e-Poster online, searchable content also launched on June 3, 2020. To date, we also have various INSAR Committee Chairs developing virtual content from planned INSAR 2020 sessions. Updates for additional webinars and content can be found on the INSAR 2020 Virtual landing page. Some additional content will be available exclusively to current INSAR Members.

Keynote Webinar
June 3, 2020
Recordings available at www.autism-insar.org after June 10, 2020 (open access)

Abstracts and E-Posters
June 3, 2020
Online searchable platform
Opens June 3, 2020 (open access)

Special Interest Groups (SIG) Webinars
(dates to be announced) INSAR Membership Required

Meet the Expert Webinars
(dates to be announced) INSAR Student Membership Required

And More
Additional sessions to be announced.

Visit INSAR 2020 Virtual

for accesss details

www.autism-insar.org/insarvirtual

Keynote Webinar - June 3, 2020

Sven Bölte, PhD
A Pluralistic View of Autism Using the ICF

While there is strong agreement that autism is a heterogeneous condition and requires individualized understanding, traditionally, autism has been looked at predominantly a clinical symptomatology perspective. Still, for autistic individuals, their families and large parts of society, the dimensions of functioning and quality of life are both more significant and accessible. In addition, In recent years, the concept of neurodiversity has challenged the biomedical model of autism, demanding a more balanced view of autism and favoring social and environmental responsibility model of autism. In this keynote lecture, the WHO International Classification of Functioning, Disability and Health (ICF), and the recently developed ICF Core Sets for autism are introduced that allow to integrate different approaches to autism and a pluralistic view of the strengths and weaknesses of autistic individuals and how they emerge in facilitative and hindering environments.

Joshua A. Gordon, MD, PhD
Research Towards the Early Screening and Treatment of Autism

NIMH Director Dr. Joshua Gordon will provide an update on federal support for research towards identifying and treating autism as early in life as possible. He will provide an overview of the Autism Biomarkers Consortium, a public-private partnership aimed at developing new clinical tools for the study of autism, and the Interagency Autism Coordinating Committee, a Federal advisory committee that helps to coordinate research efforts and provides a forum for diverse perspectives. He will also highlight NIMH-supported advances and ongoing research, including clinical tools for the early detection of autism, progress toward understanding the neurobiology of genetic and environmental risk for autism, and increased attention on autism among adults and youth in transition to adulthood.

Keynote Recordings will be available after June 10, 2020
visit www.autism-insar.org/insarvirtual
for details

Lamya Shihabuddin, PhD
Developing Gene therapy for Genetic Neurologic Diseases: Optimizing Targeting and Transgene Expression

Among the most promising new therapeutic innovations are gene-targeted therapies using Adeno-associated viral vectors (AAV). Gene-targeted therapies can be designed to replace the mutant gene in case of loss of function mutations such as spinal muscular atrophy and lysosomal storage diseases or inhibit the expression of a mutant gene in case of mutations leading to toxic gain of function such as Huntington disease, as well as gene modulation by gene editing. The transgene must be delivered to the physiologically relevant target tissue or tissues and cell types, must be stably expresses without interfering with the functional integrity of those cells. The safety and tolerability of chronic expression or regulated expression are also important considerations for all gene targeted therapies. AAV gene therapies are defined by multiple characteristics: (1) the capsid, which determines what cells to target; (2) the transgene, which can be altered and optimized for better translation; (3) the promoter, which regulates gene expression and transcription within the cells; (4) mode of production can impact vector qualities and thus transduction efficiency. In developing gene therapy strategies, matching the specific disease indication to the capsid and route of administration that achieves the biodistribution goal and transduction efficiency required for therapeutic benefit is critical for clinical success.

Emily Simonoff, MD, FRCPsych
Mental Health in Autistic People: Setting a Research Agenda for the Coming Decade

At the end of the last century, our awareness of the great heterogeneity in autism increased and there was a new interest in studying its multi-faceted dimensions. This was partly responsible for conceptualizing the presentation and challenges experienced by autistic people as mental health problems in the early 2000s. While it is now generally accepted that autistic people have higher rates of virtually all psychiatric conditions, we still have a limited understanding of why this is the case, how best to identify and measure mental health problems, what interventions are most promising and what "success" in prevention and intervention would look like. In this keynote, I will explore these issues and suggest some research priorities for the coming decade.

INSAR Recognition Awards 2020-2021:
*These awardees will be officially recognized in Boston at INSAR 2021.

Lifetime Achievement Award
Helen Tager-Flusberg, PhD

Helen Tager-Flusberg received her Bachelors in Science in Psychology from University College London, and her doctorate in Experimental Psychology from Harvard University. Since 2001 she has been at Boston University, where she is now Professor of Psychological and Brain Sciences, and Director of the Center for Autism Research Excellence. She has devoted her lengthy career to conducting research on autism and other neurodevelopmental disorders including children with developmental language disorders and genetic syndromes, exploring variability in phenotypic expression and investigating developmental and intervention-based changes in language and social cognition using behavioral and brain imaging methodologies.

Her research has been funded by the National Institutes of Health and private foundations and she has had the good fortune to lead several multi-site multidisciplinary autism research programs including CPEA, STAART and ACE Centers. She has edited seven books and written over 200 journal articles and book chapters. She is the Past President of INSAR (2011-2013), serves on the editorial board of several professional journals and is Section Editor (Cognition and Behavior) for the Journal of Neurodevelopmental Disorders. She regularly presents her work at scientific and professional conferences and to parent advocacy groups and other stakeholders in the US and in countries around the world.

Advocate Award
John Robison

John Robison is the Neurodiversity Scholar in Residence at The College of William & Mary in Williamsburg, Virginia. He is also a visiting professor of practice at Bay Path University in Longmeadow, MA and is the neurodiversity advisor to Landmark College in Putney, VT. John is an autistic self-advocate and an appointed member of national and international scientific and science policy-making bodies, including the federal government's Interagency Coordinating Committee on Autism, the World Health Organization, and is a part of the Board of Directors for INSAR as the Chair of the Community Advisory Committee.

John is very active in his efforts to support and promote research leading to therapies or treatments that will improve the lives of people who live with autism in all its forms today. He is widely known as an advocate for people with autism and neurological differences. John's service to the community and INSAR has been truly outstanding over the years and is why he was selected for the 2020 INSAR Advocate Award.

Cultural Diversity Research Award
Dr. Waganesh Zeleke

Dr. Waganesh Zeleke was selected for this award due to her significant work with culturally diverse individuals with ASD across the United States and Ethiopia. Dr. Zeleke's work focusses on advancing culturally relevant issues in the epidemiology, diagnosis and treatment of children with autism in Ethiopia and Zimbabwe. She is also engaged in research on disparities in diagnostic, educational and health care services of minority children with autism and children with autism in poverty in the United States. Dr. Zeleke is an Associate Professor at Duquesne University in Pittsburgh.

Young Investigator Awards

Meghan Miller, PhD (UC Davis): "Sibling Recurrence Risk and Cross-aggregation of Attention-Deficit/Hyperactivity Disorder and Autism Spectrum Disorder." *JAMA Pediatr.* 2019;173(2):147-152. doi:10.1001/jamapediatrics.2018.4076

Vanessa H. Bal, PhD (Rutgers University): "Predictors of longer-term development of expressive language in two independent longitudinal cohorts of language-delayed preschoolers with Autism Spectrum Disorder." *J Child Psychol Psychiatry.* 2019 Aug 19. doi: 10.1111/jcpp.13117

Dissertation Awards

Katherine E. Lawrence, PhD (University of Southern California): Dissecting Brain-Based Variability in Autism: Impact of Sex, Polygenic Risk, and Age.

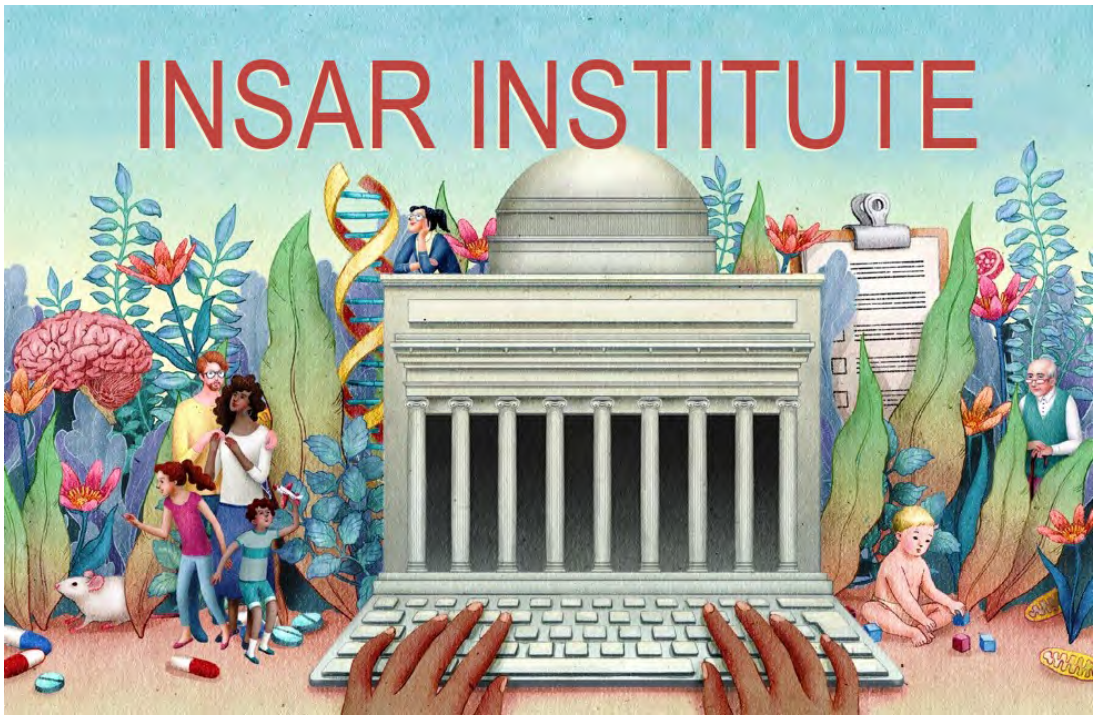
Sophie Schwartz, PhD (Boston University): Characterization Of Central Auditory Processing In Minimally And Low Verbal Adolescents With Autism.

Save the Date for the 2020 INSAR Institute!

(formerly INSAR Summer Institute)

Developmental Stages of Autism through a Research Lens

July 11 - July 16th



This 6-week webinar series takes place on Thursdays from June 11th to July 16th.This series will focus on understanding barriers and facilitators that influence autistic individuals' transition through different life stages, integrating research and clinical practice. Broadening our understanding of autism across the lifespan also has implications for policy making to ensure that autistic individuals reach their full potential in an increasingly neurodiverse society. The initiative to consider autism across the lifespan is reflected by recent INSAR Special Interest Groups (SIGs). In 2018/2019, popular SIGs examined advancing and adapting interventions to aid transition to college for autistic students, understanding gender and sexuality in adulthood, as well as a focus on increasing neurodiversity by engaging directly with autistic individuals in research and clinical practice.

INSAR Institute webinars are designed for students, post-doctoral fellows, early-career investigators, families, service providers, and autistic people and their families. The live sessions of the 2020 Institute are free to attend; pre-registration is required. Each session will be recorded and available to current INSAR Members as a benefit of society membership.

Registration is free and available worldwide to those interested in autism research. Clinicians, established researchers and stakeholders who want to get a snapshot of the current state of science in topics outside their area of expertise may also find these sessions of value.

INSAR
International Society for Autism Research

SAVE THE DATE

INSAR 2021

BOSTON, MASSACHUSETTS, USA

MAY 5-8 HYNES CONVENTION CENTER

Abstracts

Invited, Keynote Speakers, Awards

ORAL SESSION — **INVITED, KEYNOTE SPEAKERS, AWARDS**
101 - Keynote - Sven Bölte, PhD

101.001 *(Oral)* A Pluralistic View of Autism Using the ICF

***S. Bolte**, Center of Neurodevelopmental Disorders (KIND), Centre for Psychiatry Research; Department of Women's and Children's Health, Karolinska Institutet, & Stockholm Health Care Services, Region Stockholm, Stockholm, Sweden*

While there is strong agreement that autism is a heterogeneous condition and requires individualized understanding, traditionally, autism has been looked at predominantly from a clinical symptomatology perspective. Still, for autistic individuals, their families and large parts of society, the dimensions of functioning and quality of life are both more significant and accessible. In addition, in recent years, the concept of neurodiversity has challenged the biomedical model of the condition, demanding a more balanced view of autism and favoring a social and environmental responsibility model of autism. In this keynote lecture, the WHO International Classification of Functioning, Disability and Health (ICF), and the recently developed ICF Core Sets for autism are introduced that allow to integrate different approaches to autism and a pluralistic view of the strengths and weaknesses of autistic individuals and how they emerge in facilitative and hindering environments.

ORAL SESSION — **INVITED, KEYNOTE SPEAKERS, AWARDS**
102 - Keynote - Emily Simonoff, MD, FRCPsych

102.001 *(Oral)* Mental Health in Autistic People: Setting a Research Agenda for the Coming Decade

***E. Simonoff**, King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom*

At the end of the last century, our awareness of the great heterogeneity in autism increased and there was a new interest in studying its multi-faceted dimensions. This was partly responsible for conceptualizing the presentation and challenges experienced by autistic people as mental health problems in the early 2000s. While it is now generally accepted that autistic people have higher rates of virtually all psychiatric conditions, we still have a limited understanding of why this is the case, how best to identify and measure mental health problems, what interventions are most promising and what "success" in prevention and intervention would look like. In this keynote, I will explore these issues and suggest some research priorities for the coming decade.

ORAL SESSION — **INVITED, KEYNOTE SPEAKERS, AWARDS**
103 - Keynote - Lamya Shihabuddin, PhD

103.001 *(Oral)* Developing Gene Therapy for Genetic Neurologic Diseases: Optimizing Targeting and Transgene Expression

***L. Shihabuddin**, Rare and Neurologic Diseases Research TA, Sanofi, Framingham, MA*

Among the most promising new therapeutic innovations are gene-targeted therapies using Adeno-associated viral vectors (AAV). Gene-targeted therapies can be designed to replace the mutant gene in case of loss of function mutations such as spinal muscular atrophy and lysosomal storage diseases or inhibit the expression of a mutant gene in case of mutations leading to toxic gain of function such as Huntington disease, as well as gene modulation by gene editing. The transgene must be delivered to the physiologically relevant target tissue or tissues and cell types, must be stably expresses without interfering with the functional integrity of those cells. The safety and tolerability of chronic expression or regulated expression are also important considerations for all gene targeted therapies. AAV gene therapies are defined by multiple characteristics: (1) the capsid, which determines what cells to target; (2) the transgene, which can be altered and optimized for better translation; (3) the promoter, which regulates gene expression and transcription within the cells; (4) mode of production can impact vector qualities and thus transduction efficiency. In developing gene therapy strategies, matching the specific disease indication to the capsid and route of administration that achieves the biodistribution goal and transduction efficiency required for therapeutic benefit is critical for clinical success.

ORAL SESSION — **INVITED, KEYNOTE SPEAKERS, AWARDS**

104 - Keynote - Joshua A. Gordon, MD, PhD

104.001 *(Oral)* Research Towards the Early Screening and Treatment of Autism

***J. A. Gordon**, National Institute of Mental Health (NIMH), Bethesda, MD*

NIMH Director Dr. Joshua Gordon will provide an update on federal support for research towards identifying and treating autism as early in life as possible. He will provide an overview of the Autism Biomarkers Consortium, a public-private partnership aimed at developing new clinical tools for the study of autism, and the Interagency Autism Coordinating Committee, a Federal advisory committee that helps to coordinate research efforts and provides a forum for diverse perspectives. He will also highlight NIMH-supported advances and ongoing research, including clinical tools for the early detection of autism, progress toward understanding the neurobiology of genetic and environmental risk for autism, and increased attention on autism among adults and youth in transition to adulthood.

Adult Outcome: Medical, Cognitive, Behavioral, Social, Adaptive, Vocational

PANEL SESSION — **ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL**

201 - Capturing the Complexity of Young Adulthood for Individuals with ASD: Considerations for Measuring, Understanding, and Maximizing Outcomes

Panel Chair: Jan Blacher, *Graduate School of Education, University of California Riverside, Riverside, CA*

Research has consistently indicated that, as compared to their typically developing peers, young adults with ASD struggle in young adulthood across multiple domains. This panel aims to expand the current understanding of young adult outcomes through the utilization of multiple methodological approaches and the consideration of less well studied phenomena. The first paper addresses outcome measurement in adulthood across the wide spectrum of abilities in ASD. The second paper explores the role of social-emotional factors in both understanding and predicting adult outcomes. The third paper highlights systems factors in higher education settings that may exacerbate challenges faced by neurodiverse young adults. Finally, the fourth paper addresses moderators of treatment outcomes for young adults with ASD. These varied research questions recognize and illuminate the complexities inherent in how individuals with ASD navigate adulthood, and in how researchers must examine this period. This panel is strengthened by multiple methodological factors. Two papers include longitudinal data with comparison groups of neurotypical individuals, producing insight into universal processes and those specific to young adults with ASD. The other two papers consider contextual factors as important correlates of outcomes, underscoring the ways in which the environment can explain variance in functioning on the individual level.

201.001 *(Panel)* Assessing Longitudinal Adult Outcomes: A Comparison of Three Approaches

***J. B. McCauley**[1], A. Pickles[2] and C. Lord[1], (1)University of California, Los Angeles, Los Angeles, CA, (2)King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom*

Background: There is a great need for supports that enhance the outcomes of adults with autism spectrum disorder (ASD), but defining quality outcomes in a heterogeneous population remains a difficulty. This is an important endeavor, and generating meaningful outcomes from longitudinal studies will help define needs for clinical practice and planning.

Objectives: The current study aims to typify adult outcomes from a longitudinal study of children referred for autism at 2 using three distinct approaches: 1) comparisons of three groups: people who received a diagnosis of ASD at one point with higher IQs (ASD-High IQ), a diagnosis of ASD and lower IQs (ASD-Low IQ), and people who have never been diagnosed (Never ASD), 2) using a latent class approach to identify commonalities in adult profiles, and 3) defining outcome categories by creating an ordinal variable of the number of objective outcomes met, defined separately for higher and lower IQ adults.

Methods: 123 young adults, mean age of 26, referred for neurodevelopmental disorders in early childhood were administered a battery of diagnostic and cognitive measures, as well as standardized interviews and questionnaires assessing employment status, living situation, friendships, affective problems, and well-being.

Results: Using the three groups approach we found marked similarities between the ASD-High IQ group and the Never ASD group across adult outcomes (Work p=.351, Living p=.128, Friends p=.326, Living Skills p=.250), although the Never ASD group had significantly higher well-being and less depressive symptoms than either ASD group. In the latent class approach across all measures of adults, data were reduced to four classes, though these did not account for much of the variation in affective measures (See Figure 1). The classes were predicted accurately from childhood IQ and symptom severity measurement taken at age 2 years to age 9 years. In the ordinal outcome approach, outcomes were defined separately for more and less cognitively able adults (See Figure 2). For more cognitively able adults, higher verbal IQ, higher daily living skills, and higher well-being were significantly associated with increased odds of moving up in the number of positive outcomes met; higher CSS, and higher internalizing symptoms and externalizing symptoms were all significantly associated with decreased odds of moving up in the number of positive outcomes met. Having received a formal ASD diagnosis in the past (in contrast to current ADOS CSS scores) was associated with lower odds of positive outcomes, and higher verbal IQ and well-being (although not after diagnosis and IQ were accounted for) were associated with more positive outcomes for less cognitively able individuals.

Conclusions: Not surprisingly, IQ was a significant predictor of adult outcome in cross-sectional and longitudinal analyses. In addition, ASD diagnosis and symptom severity were significant predictors of outcomes across approaches. Using an objective, ordinal count of outcomes met, defined separately for less and more cognitively able adults, was the only method that demonstrated significant associations between subjective well-being and outcome categories, although not for less cognitively able adults once we accounted for ASD diagnosis and IQ.

201.002 *(Panel)* Understanding and Predicting Young Adult Outcomes for Individuals with ASD: A Focus on Mental Health

C. Moody[1]*, J. Blacher*[2] *and B. L. Baker*[3]*, (1)University of California Los Angeles, Los Angeles, CA, (2)Graduate School of Education, University of California Riverside, Riverside, CA, (3)Psychology, UCLA, Los Angeles, CA*

Background: Previous research has documented pervasively poor outcomes in employment, post-secondary education, and social functioning for individuals with autism spectrum disorder (ASD) during adulthood (Howlin et al., 2004; Shattuck et al., 2012). In explaining these negative outcomes, the literature has largely focused on disability characteristics, such as IQ, autism severity, and language ability, while neglecting the role of social-emotional factors (Magiati et al., 2014; Kirby et al., 2016). However, the study of social-emotional factors is warranted, given that individuals with ASD are at much higher risk for psychopathology than the general population (Eaves & Ho, 2008; Buck et al., 2014).

Objectives: In the current study, we plan to 1) examine the role of mental health in explaining concurrent young adult outcomes, and 2) explore social-emotional predictors in adolescence of mental health outcomes in young adulthood.

Methods: Participants are part of the Collaborative Family Study, a longitudinal study of development. Families of youth with typical development (TD) or ASD completed assessments at 15 (n=162), and are currently being recruited for a follow-up assessment at age 21. Recruitment is ongoing; preliminary data in this abstract draw upon 63 young adults (n_{TD}=33, n_{ASD}=30).

Mental health was assessed through self-report in adolescence and young adulthood through the Youth Self Report (Achenbach & Rescorla, 2001) at age 15 and the complementary Adult Self Report (Achenbach & Rescorla, 2003). A young adult functional outcome composite was created based on level of independence, involvement in professional activities (i.e., paid work, post-secondary education), and quality of peer relationships.

Results: Consistent with prior literature, preliminary results indicate that young adults with ASD are significantly more likely than TD young adults to endorse clinically significant mental health problems, $\chi^2(1)=8.54$, p=.003. In a two-way ANOVA, significant main effects of both diagnostic status, $F(1,58)=41.18$, $p<.001$, and presence of clinical levels of mental health problems, $F(1,58)=6.22$, p=.015, on young adult functional outcome emerged, with no significant interaction. Thus, although young adults with ASD had poorer functional outcomes on average than young adults with TD, clinically significant mental health problems further contributed to reductions in functioning for both groups.

Multiple regression was used to perform an initial examination of adolescent predictors of young adult mental health outcome. Social acceptance in adolescence emerged as a significant predictor, $t(53)=2.04$, p=.046, over and above diagnostic status and adolescent mental health. A non-significant interaction between diagnostic status and social acceptance suggests that this relationship functions similarly for both TD and ASD individuals. However, this relationship was in the unexpected direction, such that greater adolescent social acceptance predicted poorer young adult mental health.

Conclusions: Future analyses will confirm findings with a larger sample and explore additional adolescent predictors of young adult outcomes. Current findings suggest multiple commonalities across TD and ASD populations. Additionally, results may suggest that the transition period is especially risky for youth who developed positive social relationships in adolescence, regardless of diagnosis. For these youth, loss of social support when exiting high school may result in mental health deterioration over the course of this developmental period.

201.003 *(Panel)* Autism and the College Experience: An Empirical Base for Faculty Preparation in Autism

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Background: College students with autism spectrum disorder (ASD) represent increasing neurodiversity in our society. Even though they are attending college at higher rates, they have a lower likelihood of graduating than their neurotypical peers (Volkmar et al., 2017). Yet, engagement with knowledgeable faculty may improve the college experience for these students (Bolourian et al., 2018; Zeedyk et al., 2019), and lead to more positive postsecondary outcomes.

However, in the context of ASD, professors often lack knowledge of, and experience with, students' specific needs and reasonable accommodations (i.e., Americans with Disabilities Act). Precisely how knowledgeable are faculty about students with ASD? This paper will include data from faculty at four major colleges who responded to a survey about ASD and is a follow-up to a series of studies in this area (Bolourian et al., 2018; Zeedyk et al., 2019).

Objectives:

- To gain a broader perspective of faculty experiences with students with ASD.
- To compare these perspectives of faculty at teaching versus research institutions.

Methods: Two California State University campuses (CSU; *n*=123) and one University of California campus (UC; *n*=133) were included. While CSUs are largely teaching institutions, the two samples did not differ on participant demographics, except that the UC contained more Full Professors and fewer Adjunct Professors. Data collection is underway at a third CSU, and will be included in this presentation.

Campus-wide surveys were administered to faculty (Zeedyk et al., 2019), using the online platform, Qualtrics. A series of Yes/No, Likert-type and open-ended items addressed issues such as: connections with ASD, teaching practices, and interest in an ASD-specific training.

Results: Based on the three universities included, about a third of faculty had some personal connection to ASD; about half had taught a student who self-disclosed as having ASD. Professors indicated a limited understanding of the needs of students with ASD. Notably, significantly fewer UC faculty provided information about disability supports on their syllabus or announced in class that accommodations were available. From the majority of faculty (86-96%) who had been approached by a student with disability documentation, a small percentage (5-6%) reported asking a student specifically what type of disability they had. Faculty across campuses (83-85%) also indicated their willingness to participate in a training program. Results from open-ended items indicated that faculty were interested in learning more about their obligation under the law and inclusive learning practices.

Conclusions: It is not a question of whether a faculty member will have a student with ASD, it is a question of *when*. This study provides evidence for heightening awareness and adequately educating faculty about neurodiversity on college campuses. In this effort, our research team has engaged in two innovative approaches to reach the instructional community: (1) the production of a documentary, featuring five students on the spectrum who voice their experiences in college, including their interactions with faculty; (2) the development of a training program to educate faculty, e.g., on how to recognize ASD, provide instructional accommodations. An overview of these platforms will be provided.

201.004 *(Panel)* Examining the Benefit of Parent-Mediated Social Skills Training: The UCLA PEERS® for Young Adults Program

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Background: Research suggests impaired social skills are often the most significant challenge for those with ASD (Reichow & Volkmar 2010), with adults often experiencing the greatest social barriers. While there is a dearth of evidence-based social skills interventions for this highly underserved population (Rao, Beidel, & Murray 2008), caregiver-mediated interventions have shown promise in teaching social skills to adults with ASD (Gantman et al. 2012; Laugeson et al. 2015). Including parent and non-parent caregivers as social coaches is thought to be an important mechanism of change in social skills training (Laugeson 2017), yet little is known about the differences in treatment outcomes depending on the type of caregiver utilized.

Objectives: The purpose of this study is to: (1) examine changes in social functioning following caregiver-mediated social skills training for young adults with ASD; and (2) examine differences in treatment outcomes when parent or non-parent social coaches are included in treatment.

Methods: Participants included 60 cognitively-able adults with ASD (77% male) ranging in age from 17-35 (*M*=23.22; *SD*=3.87). Participants attended 90-minute weekly social skills instruction for 16-weeks using the PEERS® for Young Adults curriculum (Laugeson 2017). Skills focusing on relationship development were targeted. In vivo social coaching was provided by parents (*n*=44) or non-parent caregivers (*n*=16) for the duration of the study. Non-parent caregivers included life coaches, peer mentors, and other family members, nominated by the participant. Treatment outcome was measured using the Social Responsiveness Scale-Second Edition (SRS-2; Constantino 2012), Social Skills Improvement System (SSIS; Gresham & Elliott 2008), Empathy Quotient (EQ; Baron-Cohen & Wheelwright 2004), Quality of Socialization Questionnaire-Young Adult (QSQ-YA; Laugeson 2017), and Social and Emotional Loneliness Scale for Adults (SELSA; DiTomasso & Spinner 1993).

Results: Paired sample t-tests examining outcomes in the parent-mediated group revealed significant improvement in T-scores on the SRS-2 Total score (pre-test: *M*=66.52, *SD*=9.07; post-test: *M*=58.82, *SD*=8.29; $t(43)=5.97$, $p<0.01$), standard scores on the SSIS Social Skills Subscale (pre-test: *M*=79.64, *SD*=12.05; post-test: *M*=87.93, *SD*=11.16; $t(43)=4.38$, $p<0.01$), empathy on the EQ (pre-test: *M*=24.25, *SD*=10.44; post-test: *M*=31.43, *SD*=11.68; $t(43)=4.57$, $p<0.01$), social engagement on the QSQ-YA (pre-test: *M*=2.07, *SD*=2.10; post-test: *M*=4.73, *SD*=3.87; $t(43)=4.63$, $p<0.01$), and loneliness on the SELSA (pre-test: *M*=58.18, *SD*=18.95; post-test: *M*=46.23, *SD*=19.58; $t(43)=5.39$, $p<0.01$).

Paired sample t-tests examining outcomes in the non-parent-mediated group revealed significant improvement in T-scores on the SRS-2 Total score (pre-test: *M*=69.62, *SD*=8.14; post-test: *M*=61.75, *SD*=7.71; $t(15)=3.96$, $p<0.01$), standard scores on the SSIS Social Skills Subscale (pre-test: *M*=78.19, *SD*=14.13; post-test: *M*=88.12, *SD*=11.88; $t(15)=2.59$, $p<0.05$), and empathy on the EQ (pre-test: *M*=20.44, *SD*=7.02; post-test: *M*=25.94, *SD*=11.26; $t(15)=2.53$, $p<0.05$). Significant improvements were not observed on the QSQ-YA or SELSA.

In order to compare differences in treatment outcome across the two groups (parent-mediated v. non-parent-mediated), independent samples t-tests were conducted. Significant differences in change scores were observed across the groups on social engagement on the QSQ-YA (parent-mediated: *M*=2.66, *SD*=3.81; non-parent-mediated: *M*=-0.07, *SD*=5.75; $t(20)=2.16$, $p<0.05$). There were no other significant differences between the two groups.

Conclusions: Findings reveal that involving parents as social coaches results in greater social engagement following the PEERS® for Young Adults curriculum.

ORAL SESSION — ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL
301 - A Window into the Life of Adults with Autism

301.001 *(Oral)* The Effect of Competitive Integrated Employment on the Independence of Young Adults with Significant Impact from Autism

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Background: Employment provides opportunities for individuals with ASD to learn life skills beyond required job duties. Therefore, sustained participation in employment offers individuals with ASD perpetual opportunities for skill development over time. This is important because findings from several studies indicate that when the provision of stimulating activities is absent in adulthood, skill growth plateaus.

Objectives: The primary research objective driving this study was to identify the impact of competitive integrated employment (CIE) on the overall independence of youth and young adults with significant impact from autism between the ages of 18 – 24.

Methods: This study was part of a larger prospective multi-site, parallel block randomized clinical trial of Project SEARCH plus ASD Supports (PS+ASD, Wehman et al., 2019). Participants were eligible for the study if they; a) had a medical diagnosis or educational eligibility label of ASD; b) attended local public school where research was being conducted; c) were between the ages of 18 – 21 by the first day of school; d) displayed independent self-care including using the bathroom, eating, and moving from place to place; e) were eligible for funding through the state VR office; and f) had continued eligibility for public school services in the coming school year. Randomization occurred at a 1:1 ratio to the treatment (81 participants, Project SEARCH plus ASD Supports, [PS+ASD]) or control (75 participants, high school) arms. Participants in both groups reported requiring significant prompts to learn tasks, remain on task, demonstrated low reading and math literacy, and were inconsistently able to communicate basic wants and needs verbally. They were all also seeking a special education certificate of completion and not a standard diploma. In short, the individuals in both conditions were significantly impacted by their disabilities.

Results: Support needs were measured using the Supports Intensity Scale, Adult Version (SIS-A, Thompson, et al., 2004) at three points during the study; baseline, graduation, and 1-year follow-up. Participants in the PS+ASD group gained CIE and further exhibited improvement on all scales of the SIS. Total scores were 4.5 and 5.1 units lower at graduation compared to baseline and 5.3 and 6.1 units lower at 1-year follow-up. Similarly, graduation to baseline improvement of standardized subscale scores ranged between 0.6 and 1.1 units lower, with the Lifelong Learning (Difference=-1.0), Employment (Difference=-1.1), and Health Safety (Difference=-0.7) having the largest magnitude of change. Meaningful improvements between baseline and either graduation or 1-year follow-up in the control group were observed only in the Community Living subscale.

Conclusions: The present study provides strong evidence that CIE results in increased independence in young adults with ASD. This is an impressive finding that suggests two important points. First, employment is likely a therapeutic pursuit for youth with significant impact from ASD. In other words, the youth who acquired employment continued to develop in most areas while their peers in the control condition displayed plateaued growth. Second, after nine months of intervention followed by approximately one year of employment, youth with ASD showed impressive improvement in their overall independence.

301.002 *(Oral)* Health Status of Medicare-Enrolled Autistic Older Adults in the United States

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Background: While there is emerging evidence on the prevalence of physical and mental health conditions among autistic adults, less is known about this population's needs during older adulthood (aged 65+). Much of what is known about the autistic older adult population is based on: 1) self-report studies, which exclude those for whom survey methods are not accessible; or 2) studies with limited generalizability due to fairly small sample sizes of autistic older adults or restriction to a single geographic region. Moreover, some studies have grouped autistic older adults together with younger age groups, making it challenging to draw conclusions about the unique needs of those over 65 years of age. To our knowledge, no studies to date have used United States data at the national level to characterize the prevalence of health conditions in autistic older adults.

Objectives: To compare the prevalence of physical and mental health conditions in a United States national sample of Medicare-enrolled autistic older adults to an older adult population comparison (PC) group.

Methods: We conducted a cross-sectional retrospective cohort study of Medicare Standard Analytic Files for the years 2016-2017 to compare the prevalence of physical and mental health conditions in a national sample of autistic older adults (n=4,685) to a matched population comparison (n=46,850) cohort. We identified mental and physical health conditions from inpatient and outpatient medical claims using the Healthcare Cost and Utilization Project Beta Multilevel Clinical Classification Software for ICD-10, which identifies conditions based on the diagnosis codes included in the medical billing record and groups them into a smaller number of clinically-relevant categories. Logistic regression models were performed to compare autistic and PC older adults on the odds of each condition while controlling for sex, race/ethnicity, age, rural residence, and estimated household income.

Results: Autistic older adults had significantly greater odds of nearly all physical health conditions including epilepsy (OR=18.9; 95% CI=17.2-20.7), Parkinson's disease (OR=6.1; 95% CI=5.3-7.0), and gastrointestinal conditions (OR=5.2; 95% CI=4.9-5.5). Most mental health conditions were more common among autistic older adults, including schizophrenia and psychotic disorders (OR=25.3; 95% CI=22.4-28.7), attention deficit disorders (OR=24.4; 95% CI=16.2-31.0), personality disorders (OR=24.1; 95% CI=17.8-32.5), and suicidality or self-inflicted injury (OR=11.1; 95% CI=8.9-13.8). Health conditions commonly associated with advanced age in the general population (e.g., osteoporosis, cognitive disorders, heart disease, cancer, cerebrovascular disease, osteoarthritis) were also significantly more common among autistic older adults.

Conclusions: This study provides a comprehensive comparison of the prevalence of physical and mental health conditions in a national sample of Medicare-enrolled autistic older adults and a PC group. Our results, which suggest that autistic older adults have significant physical and mental health care needs when compared to their peers, underscore the importance of developing innovative person-centered healthcare approaches to evaluate and address the specific healthcare needs of this population. Future research is warranted to determine the contributions of both intrinsic (e.g., genetic conditions), and extrinsic (e.g., lack of access to quality health care) factors that may influence the prevalence of mental and physical health conditions.

301.003 *(Oral)* "It's Something I Have" or "It Defines Who I Am": What Language Do (autistic) Australian Adults (on the autism spectrum) Prefer?

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Background: When describing autism, language is more than a system of communication, rather it reflects how individuals understand and experience autism, and how they would like that to be expressed to others. Many autism advocates have rejected person-first (person with autism) in favour of identity-first (autistic) language. However, as highlighted at the 2019 strategic planning meeting of the International Society for Autism Research (INSAR), there is no clear consensus within the autism community on which approach should be adopted (Robison, 2019). As stated by Robison, "Language that is appropriate to one person is offensive to another" (2019, p. 1006).

Objectives: (1) To investigate which labels commonly used to describe autism are most preferred, and which seem most offensive, to adults with an autism diagnosis. (2) To explore reasons behind label preferences.

Methods: Participants were 198 Australian adults aged 18 to 71 who reported a clinical diagnosis of autism. Participants completed an online survey rating their preference for, and the offensiveness of, six common autism labels (person with autism, person on the autism spectrum, autistic, autistic person, person with autism spectrum disorder [person with ASD], person with autism spectrum condition [person with ASC]) on a 7-point Likert scale. Participants were also asked to rank these labels in order of preference and offensiveness, and were provided free text to explain why they chose their most preferred and offensive labels. Data were analysed using mixed methods.

Results: Overall correlations between label preference ratings showed significant positive relationships between person-first labels (*r*s = .38– .54), and between identity-first labels (*r* = .79), and negative correlations between person-first and identity-first labels (*r = -.19– -.25),* suggesting a split within the sample. Mean ratings (Figure 1) of label preference showed *autistic, person on the spectrum* and *autistic person* rated significantly higher than other labels, with labels with diagnostic terms rated lowest. Ratings of offensiveness mirrored the preference ratings. Regarding label rankings (Table 1), *autistic* was most often ranked most preferred, but was also frequently ranked least preferred, with few rankings in between. *Person on the autism spectrum* was ranked most often in the top three, with weighted mean rankings indicating it most preferred, and significantly different from other labels. Labels with *condition* and *disorder* were ranked least preferable. Qualitative results reflected the split between person-first and identity-first language, with themes stressing the individual ('autism is only a part of my identity' and 'unique in a broad spectrum') or identity ('being autistic is core to my identity'). Other themes stressed 'difference not disorder', 'stigma and stereotype', and 'pragmatism'.

Conclusions: Overall there was no clear consensus on what label participants preferred or why. However, ratings clearly showed *autistic, person on the autism spectrum* and *autistic person* were most preferred. Rankings of labels suggest a split in the sample on identity-first labels, with *person on the autism spectrum* ranked most favourably overall. This suggests that while many may prefer identity-first, unless otherwise specified, *person on the autism spectrum* may currently be the most inclusive option.

301.004 *(Oral)* Lifestyle Choices of Autistic Adults: Exercise, Diet, and Sleep

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Background: Autistic individuals experience higher rates of physical health conditions, which can affect both quality and length of life. In addition, autistic children and adolescents are also at increased risk of experiencing dietary restrictions and/ or eating disorders, sleep disturbances, and decreased participation in physical activity. However, no existing studies broadly consider the lifestyle choices of autistic adults, and specifically those without intellectual disability.

Objectives: To better understand lifestyle choices of autistic adults to identify potential targets for improving health outcomes.

Methods: We developed an anonymous, online health survey that asked about demographics, self-reported autism diagnosis, lifestyle choices, personal medical history, and family medical history. We utilized binomial logistic regression and covaried for age, sex, ethnicity, and education-level in all models. Our final sample included n=1,110 autistic individuals (females n=703) and n=1,174 controls (females n=797), comprising a total of n=2,284 individuals. Across both groups, the mean age was 41.50 years (sd = 15.00) and females, UK residents, and white individuals were overrepresented.

Results: *Exercise*: Autistic individuals were less likely to meet recommended weekly exercise goals (at least 75 minutes of exercise per week) and were less likely to exercise at least once per week compared to controls.

Sleep: Compared to controls, autistic individuals were more likely to have difficulty falling asleep, difficulty staying asleep, frequent night terrors, excessive daytime drowsiness, narcolepsy, sleep apnea, sleepwalking, sleep talking, wetting the bed, and were less likely to sleep at least 6 hours per night.

Diet: Autistic individuals were more likely than controls to eat high calorie foods 6 or more times per week and were more likely to have at least one dietary restriction (including vegan or vegetarian, lactose free, nut free, gluten free, no fish, or other dietary restriction). They were less likely to meet daily fruit and vegetable goals at least 4 days per week, but also less likely to drink 7 or more caffeinated beverages per week. There were no significant differences between the likelihood of autistic people drinking at least 7 cups/ glasses of water per day, drinking 7 or more high sugar beverages each week, or being soy free.

Conclusions: This is the first study to investigate lifestyle factors of diet, exercise, and sleep patterns in a large population of autistic adults, and particularly in those without intellectual disability. Overall, autistic individuals are less likely to meet crucial sleep, exercise, and dietary goals, but are more likely to experience sleep disturbances and have dietary restrictions. Differences in quality of sleep, diet, and exercise may contribute to patterns of increased health risk and premature mortality. Future research should focus on confirming these findings, as well as identifying potential means of reducing these disparities among autistic adults.

ORAL SESSION — **ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL**

302 - Anxiety: Measures, Effects, and Interventions

302.001 *(Oral)* Cognitive Behavioral Intervention for Driving (CBID) Intervention for Reducing Driving Anxiety and Improving Driving Outcomes for Autistic Teens and Adults

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Background: Many autistic individuals are approaching adulthood; however, interventions to promote skills towards independence are lacking. Driving is a critical step towards independence and social, vocational, and educational opportunities are substantially enhanced when individuals can transport themselves to and from activities (Curry et al 2018). Due to common autistic behaviors, AS individuals may experience difficulty in acquiring driving skills (Bian et al, 2013). It may be related to the common challenges as: 1) cognitions (attention modulation, shifting, flexibility, contextual awareness), 2) emotions (anxiety, frustration) and 3) motor abilities (coordination, planning) (Cox et al 2017). A survey showed only 24% of able individuals with AS were driving and fear to drive was a common reason for not driving (Cox et al, 2012).

Objectives: This study tested through a pilot open trial a novel, community-based intervention teaching executive functioning and emotion regulation skills required to drive through a manualized group program paired with individualized graded exposures on a driving simulator. Multiple outcomes were assessed (ratings and simulator performance) across informants (self, parent) and satisfaction.

Methods: A total of 19 teen/adults (μ= 20.53 SD=4.40 yrs; 15-29 yrs) participated. The participants were male (95%), somewhat race/ethnically diverse (26%), 32% teens (<18 yrs), 47% in High School, 26% graduated with diploma or certificate and 26% participated in college. The CBID curriculum was delivered over 10 weeks with 90minutes active group sessions. The curriculum combines cognitive-behavioral therapy strategies such as 1) identifying and changing anxious or negative thoughts to positive, rational thoughts, 2) emotional awareness and management skills, and 3) use of practicing behavioral skills through graded step by step exposures with cognitive enhancement strategies that targeted executive functioning (EF) skills of contextual awareness, sustaining attention, shifting attention, cognitive flexibility, problem-solving and goal-oriented thinking and behaviors. EF skills were taught first. The simulator consisted of a steering wheel with turn signals, a wide screen monitor and foot pedals (gas and brake). Pre and post assessments include a full battery of assessments including: Anxiety (STAI), Driving Cognitions (DCQ), Driving Attitude (DAS) and Driving Simulator performance.

Results: Overall there was high completion rates with 53% of the participants attending every session and another 30% missing only 1 session. 100% of the participants reported an attitude change towards driving to be more positive about learning to drive and less anxious or apprehensive about driving. 94% demonstrated improved driving skills as recorded on the driving simulator (refer to results below). 100% of participants demonstrated increased motivation by participating in 1 or more driving related activity (practice driving, studying for driving exam, enrolling in course, reading DMV book, taking driving test, etc.) 100% of families reported usefulness of the CBID intervention. After the program, up to 2 months post group 47% of the participants obtained either their drivers permit or license.

Conclusions: This study demonstrates that CBID intervention is feasible, acceptable and positively impacts teens/ adults with ASD towards obtaining a drivers' license. Participants reduced driving anxiety, increased driving attitudes and behaviors and almost half pursued and obtained their driver's license.

302.002 *(Oral)* Towards a Measure of Anxiety for Autistic Adults: Development and Evaluation of the Anxiety Scale for Autism- Adult (ASA-A)

J. Rodgers[1]*, K. J. Farquhar*[2]*, D. Mason*[3]*, S. Brice*[4]*, S. Wigham*[4]*, B. Ingham*[5]*, M. Freeston*[6] *and J. R. Parr*[7]*, (1)Institute of Neuroscience, Newcastle University, Newcastle Upon Tyne, United Kingdom, (2)Newcastle University, Newcastle, United Kingdom, (3)Social, Genetic and Developmental Psychiatry Centre, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, United Kingdom, (4)Institute of Neuroscience, Newcastle University, Newcastle upon Tyne, United Kingdom, (5)Northumberland Tyne and Wear NHS Foundation Trust, Newcastle upon Tyne, United Kingdom, (6)Newcastle University, Newcastle upon Tyne, United Kingdom, (7)Population Health Sciences Institute, Newcastle University, Newcastle upon Tyne, United Kingdom*

Background: Autistic adults display elevated rates of anxiety, significantly higher than in the general population. Anxiety in autistic adults impacts on quality of life and functioning and is associated with lower life satisfaction. It is essential that anxiety can be identified accurately to inform research and clinical practice. Questionnaires developed to identify anxiety in a neurotypical population may not be suitable for use with autistic people. Emerging evidence suggests that the presentation of anxiety may be different for autistic people compared to the general population and yet most of the tools used to assess anxiety in autism were developed for neurotypical adults. The lack of measures that have been validated in this population hinders attempts to evaluate treatments. An anxiety measure developed and validated specifically for autistic children is the Anxiety Scale for Children – Autism Spectrum Disorder (ASC-ASD). The ASC-ASD consists of four subscales (Performance Anxiety, Uncertainty, Separation Anxiety, and Anxious Arousal.

Objectives: The objectives of this study are

- Through consultation with autistic adults to modify the ASC-ASD for autistic adults
- Investigate the factor structure, further refine the scale, and explore its psychometric properties

Methods: Through consultation with autistic adults and professionals working with autistic people a preliminary self-report anxiety measure was developed. 551 autistic adults were recruited from the Adult Autism Spectrum UK-Cohort study and completed the measure and another measure of anxiety and depression (The Hospital Anxiety and Depression Scale; HADS). The measures were completed again after one month to determine test-retest reliability. The sample was split (stratified by age and gender) to enable exploratory and confirmatory factor analyses to be undertaken on different samples. Internal consistency and convergent and divergent validity analyses were undertaken and receiver operator curve (ROC) analyses were completed to investigate sensitivity and specificity and identify an indicative clinical cut-off.

Results: Factor analyses identified three factors; Anxious Arousal, Uncertainty and Social Anxiety with confirmatory factor analyses indicating that a bi-factor solution with orthogonal general and specific factors was an adequate fit. Bi-factor analyses suggested that minimal measurement bias would occur if the scale was treated as unidimensional so the total score could be used as a valid measure of anxiety. There is good evidence of convergent and divergent validity for the total score against the HADS, an established measure of anxiety and depression. A ROC analysis indicates a score of 28 could be considered as an indicative clinical cut-off. Test-retest reliability of the final scale was excellent.

Conclusions: The Anxiety Scale for Autism – Adults (ASA-A) is the first self-report anxiety questionnaire specifically developed and validated for autistic adults. The ASA-A was found to have promising psychometric properties. Preliminary evaluation of the measurement properties indicate that the scale will be a useful tool in research and clinical contexts.

302.003 *(Oral)* Evaluating How Social Anxiety, Autistic Traits, and Social Network Changes Influence University Transition Outcomes Amongst First-Year Autistic Students

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Background: Students transitioning to first year of university face significant changes in their social network structure (SNS) and access to support. Between 28-50% of autistic students also experience high levels of social anxiety, further affecting their ability to establish a new supportive SNS at university. Using a longitudinal design to help partition the long-term impact of social anxiety, autism symptom severity, and changes in SNS and perceived social support (PSS) on transition outcomes can help stakeholders develop more focused interventions supporting autistic students.

Objectives: Longitudinal study assessing:

1) Changes in SNS/Perceived Social Support (PSS) across first-year of university

2) How changes in SNS/PSS relate to university transition outcomes

3) Whether social anxiety or autism symptom severity influence transition outcomes

Methods: 21 first-year autistic students (age: M(SD) = 18.33(0.48) years; 11 Male) completed self-report measures on 3 occasions with 3-month intervals, during October (T1), December (T2), and March (T3) of first year at university (Table 1). At T1, students completed: 1) Autism Quotient-28; 2) Social Anxiety Scale for Adolescents (SAS-A); 3) Social Network and Perceived Social Support (SNaPSS). SNaPSS measures a) SNS: name up to 20 network members who are important to you; b) PSS: the frequency and quality of support each network member provides across academic, daily-living, and socialisation areas. At T2 and T3, students completed SNaPSS and SAS-A to assess changes in SNS, PSS, and social anxiety over time, and Student Adaptation to College Questionnaire (SACQ) to assess university transition outcomes. Due to small sample size, we used non-parametric data analyses included Friedman's Test with Bonferroni-corrected Wilconxon signed-rank test as a post-hoc, and Kendall's tau-b correlations.

Results: Objective 1: Overall, students reported no significant changes in social network size or density over time, though networks contained a significantly greater proportion of friends than family/university staff (Z = -2.52, p = .012; Z = -.384; p < .001, respectively) (Figure 1 shows one example network highlighting individual differences). For PSS, students found family and friends provided more frequent and better-quality support than university staff (Z = -3.53 to -3.10, p <.002). Students perceived they received more frequent and better-quality support in daily-living tasks relative to academic and socialisation areas (Z = -3.04 to -2.62, p <.01). Objective 2: Changes in SNS/PSS over time were not associated with transition outcomes at T2/T3. Objective 3: Higher levels of social anxiety over time, not autism symptom severity, was associated with poorer academic, personal/emotional adjustments, and attachment to institution (t_b=-.34 to 0.41, p = .009 to .034) across T2/T3.

Conclusions: Although autistic students sought support from new friendships during first-year university transition, family members continued to provide high levels of support. Changes in SNS/PSS did not buffer against the negative impact of having high co-occurring levels of social anxiety on autistic students' university transition outcomes. Directly targeting social anxiety (a frequently co-occurring condition in autistic young people) during university transition might encourage better transition outcomes for autistic students. Future studies with larger sample size can compare social network changes against typically developing students.

302.004 *(Oral)* Are Elevated Autistic Traits Associated with Greater Risk of PTSD in Older Adults?

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Background: Research with young adults has begun to explore possible associations between autism/autistic traits and vulnerability to Post Traumatic Stress Disorder (PTSD). Large scale studies have not been conducted, however, nor have associations been explored in older adults.

Objectives: This study will explore differences in the frequency and types of traumatic experience and symptoms of post-traumatic stress among older adults with/without elevated autistic traits.

Methods: Using baseline cross-sectional data from the ongoing online PROTECT study, a total of 20,220 adults age 50 years+ reported whether they experience behavioural qualities commonly observed in the autistic spectrum. Approximately 1%, 251 individuals, were identified as endorsing elevated autistic traits in childhood and currently, referred to henceforth as the Autism Spectrum Trait (AST) group. Differences between the AST and an age mean/range and sex ratio matched Control Older Adults (COA; n = 9,179) group were explored in self-reported traumatic experience throughout their lives and current symptoms of post-traumatic stress.

Results: The experience of childhood and adulthood trauma and symptoms of post-traumatic stress were found be negatively associated with age in the COA group, but not in AST. Individuals in the AST group demonstrated significantly higher rates of self-reported traumatic events both childhood and adulthood, including emotional, physical and sexual abuse. Furthermore, elevated current symptoms of post-traumatic stress were reported by AST when compared to COA. An interaction was also observed between autistic traits and severity of traumatic experience, with those in the AST group reporting elevated rates of current post-traumatic stress symptoms increasing with severity of traumatic experience when compared to COA. This interaction remains significant when controlling for current depression and anxiety symptoms.

Conclusions: The findings from the current study suggest that elevated autistic traits may increase the likelihood of experiencing trauma throughout childhood and adulthood. Furthermore, older adults with elevated autistic traits may be at a greater risk for experiencing post-traumatic stress symptoms in later life when compared to those with few autistic traits. Further work is needed to see whether these results extend to individuals meeting diagnostic criteria for autism.

POSTER SESSION — ADULT OUTCOME: MEDICAL, COGNITIVE, BEHAVIORAL, SOCIAL, ADAPTIVE, VOCATIONAL

401 - Adult Outcome: Medical, Cognitive, Behavioral, Social, Adaptive, Vocational Posters

401.001 *(Poster)* "You Have to Find It Yourself": Experiences of Support Following Adult Autism Diagnosis

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Background: Changes in autism awareness and diagnostic criteria over time has led to increasing numbers of adults undergoing autism assessment. Although adults generally described receiving an autism spectrum diagnosis as a positive experience, accessing formal support services is often difficult. Research in the UK (e.g. Crane et al., 2018; Jones et al., 2014) identified problems including a lack of clear pathways to support following diagnosis and mismatches between available services and adult needs. Existing studies also identified informal sources of post-diagnosis support such as families and online autism groups, but these have not been explored in detail. There is little known about support experiences of adults receiving an autism spectrum diagnosis in Australia and elsewhere. A qualitative exploration would help elucidate the roles of various sources of support and provide insights into ways which services could provide optimal support to these adults.

Objectives: To understand adults' experiences of seeking and receiving support from formal and informal sources following an autism spectrum diagnosis.

Methods: Australian adults (*n*=6, age 26-83, 3 male, 2 female, 1 non-binary; at time of abstract submission) who received first-time autism diagnoses at age ≥18 took part in individual semi-structured interviews. Participants were recruited via the Australian Longitudinal Study of Adults with Autism (ALSAA), the Study of Australian School-Leavers with Autism (SASLA), autism diagnostic services, and various autism and disability-related organisations in Australia. The interview schedule was developed with advisory support from autistic adults, and contained seven questions on initial diagnosis, support received, and desired areas of support. To support participants' communication needs and preferences, these interviews were conducted via a choice of formats including face-to-face (*n*=1), video link (*n*=1), telephone (*n*=2), and email (*n*=2). Thematic analysis was conducted to identify recurrent patterns of meaning across responses. Participant recruitment, interview and analysis are ongoing.

Results: Preliminary analysis identified several themes relating to formal support, informal support, barriers, and support needs. Participants generally viewed formal support as either unnecessary or inaccessible, with inadequate provisions from both mainstream mental health and autism-specific services. Informal support from family and social relationships served the functions of emotional connection, guidance, and acceptance. Participation in online autistic support groups uniquely provided a sense of community and belonging, though excessive sharing of negative experiences was viewed as a detrimental aspect of these environments. Barriers to obtaining support included confusion navigating support pathways, concern over not qualifying for services, stigma, and financial difficulties. Participants expressed the need for clear signposts to service providers, autism-informed adult psychological services, face-to-face peer support groups, and assistance finding and negotiating suitable employment arrangements.

Conclusions: Inadequate support may potentially lead to detrimental outcomes in terms of mental health, social connectedness, and employment. There is a need for support services to recognise and adapt to the needs of late-diagnosed autistic adults, as well as for improved connection between diagnostic and support services. Considering the prevalence of mental health difficulties and dissatisfaction with mainstream treatment, further research on adapting psychotherapies to the autistic population would be invaluable.

401.002 *(Poster)* #Takethemaskoff: Unmasking Autistic Representation

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Background: In June 2018, a collective of Autistic Autism activists initiated the #TakeTheMaskOff campaign on Twitter. The campaign highlights and problematises the expectation that Autistic people 'mask' their Autistic traits and present as Neurotypical (non-Autistic) to achieve social inclusion. Contemporary understandings of Autism are situated predominantly within the Medical Model of disability, which understands Autism as a biologically disabling condition that poses its own barriers to good outcomes. However, literature on masking indicates that it leads to poor outcomes for Autistic people by increasing stress, anxiety, depression, and poor self-image (Sasson and Morrison 2019). Furthermore, many Autistic adults report feeling pressured to mask to achieve social inclusion and obtain jobs (Cage 2019). Accordingly, the #TakeTheMaskOff campaign raises the following questions: What are the social drivers of masking, and can they be conceptualised as oppressive social constructs which disable Autistic people through enforcing Neurotypical Normativity? This study aims to address these issues through the Social Model of Disability. It explores whether masking may constitute a form of assimilation reflective of Neurotypical privilege, and how this relates to social, educational, and employment outcomes for Autistic adults.

Objectives: As an Autistic researcher, I aim to respond to expert and community concerns that the under-representation of Autistic researchers hinders Autism research (Pellicano 2014). Furthermore, this is an intersectional study with a strong focus on cultural, gender, sexual, and ethnic diversity, and their relationship to masking. This presentation will address the social drivers of masking and their consequences for Adult outcomes —ranging from subjective to socio-economic wellbeing—by adopting a sociological approach, thereby taking existing research on masking in new directions.

Methods: Two key methodological approaches are used. Firstly, Participatory Action Research (PAR), which relies upon participant engagement to understand culture and produce social change. The research findings which will be presented are gathered from an online survey representing a diverse selection of autistic participants, who are questioned on their social identities and experiences of masking, alongside techniques that might help them unmask. These data on the social drivers of masking will inform the development of a set of Best Practice Principals—which will be tested in a follow-up study—to facilitate unmasking and improve socioeconomic and wellbeing outcomes.

Secondly, an autoethnographic approach is used, which relies on critical reflection from the author's lived experience of socioeconomic marginality and inequality as an Autistic person, to shape both the overall structure and method of the study, alongside the analysis of its data, and shaping of its outcomes in response to the needs of the Autistic community.

Results: Data collection is currently underway, and will indicate how, why, and in which situations Autistic adults mask, alongside which factors contribute to facilitating unmasking.

Conclusions: In response to the #TakeTheMaskOff campaign this project seeks to improve Autistic socioeconomic outcomes by shifting the focus from assimilatory masking to external understanding. This project also contributes an Autistic perspective to research which begins to address community concerns over Autistic underrepresentation in the field. An intersectional approach produces findings sensitive to the diversity of the Autistic community.

401.003 *(Poster)* A Comparison of Functioning between Young Adults with and without Employment History

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Background: The majority of young adults with autism are unemployed or underemployed (Chen et al., 2015). Whereas some research has examined predictors of competitive employment in this population (Chiang et. al, 2013), there is a gap in the literature regarding potential differences in functioning between adults with and without employment history.

Objectives: To compare young adults with and without employment history on measures of autism symptoms, intelligence, adaptive functioning (AF) and executive functioning (EF).

Methods: Participants were 21 young adults with a DSM-IV or DSM-5 ASD diagnosis (M age = 24.19, SD = 4.36) and at least one parent of each participant who participated in a larger mixed-methods study. Participants with employment history (n = 11) had been competitively employed for at least one year during adulthood. Participants without employment history had never been employed (n = 8) or had been previously employed, but for < 4 months (n = 2). All but one participant met criteria for autism or autism spectrum on the ADOS-2 (Lord et al., 2012) and all participants had a composite IQ of 70 or above (KBIT-2, Kaufmann & Kaufmann, 2004). Each parent reported on their young adult's AF and EF by completing the Adaptive Behavior Assessment System (ABAS-3; Harrison & Oakland, 2017) and the Behavior Rating Inventory of Executive Function – Adult Version (BRIEF-A; Roth et. al, 2013).

Results: Reported in Table 1, participants with employment history were significantly older than participants without employment history and the effect size was large. There were no significant differences in composite IQ, AF, or EF. There was a difference on the behavior regulation index (BRI) of the BRIEF-A that was approaching statistical significance and the effect size was large. Specifically, participants without employment history had less impaired behavioral regulation than participants with employment history. Post-hoc independent samples t-tests on the clinical scales that make up the BRI indicated that participants with employment history were significantly more impaired on the inhibit ($t(18) = -2.12$, $p = .05$) and self-monitor ($t(18) = -2.11$, $p = .05$) subscales.

Conclusions: Participants with employment history were, on average, five years older than participants without employment history. This may reflect a high level of vulnerability for unemployment in the years immediately after high school (Shattuck et al., 2012). Surprisingly, young adults with autism who had sustained employment history demonstrated less behavioral regulation than participants without employment history. It is possible that reduced inhibition and self-monitoring may be adaptive for individuals with autism such that they may be more likely to seek out employment opportunities than individuals who are more behaviorally inhibited. This interpretation is consistent with evolutionary theories of ADHD that suggest that impulsiveness, high energy, and risk-taking were adaptive as the human species evolved, and may continue to be adaptive in modern society (Shelley-Tremblay & Rosen, 1996). With replication, the current findings suggest that young adults with autism with relatively high levels of behavioral regulation may need additional support in the form of initiating and maintaining meaningful contacts related to employment.

401.004 *(Poster)* A Continuum of Learning and Attention Difficulties in Females, Extending from FMR1 Premutation to Full Mutation

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Background: Although once thought to be asymptomatic, it is now well documented that both female as well as male premutation carriers of Fragile X expanded gene might suffer from associated medical comorbidities, beyond Fragile X Associated Tremor and Ataxia (FXTAS) and Fragile X Associated Premature Ovarian Failure (FXPOI).

Autism Spectrum Disorder and Intellectual Disability are a hallmark of Fragile X Syndrome (FXS). However, when examining other presumably asymptomatic female family members of a patient with FXS, such as mothers, sisters and aunts, insidious deficits and complains occur. Wether fragile-X premutation has a subtle effect on cognition has been under debate for several years.

Objectives:

We assume that there is a continuum of specific learning and attention deficits that correlate with increased number of CGG repeats on FMR1 gene.

Methods: 98 women were referred to our center due to a related Fragile X Syndrome (FXS) patient, mainly offspring or sibling. Variable data was collected from index cases and relatives. This is an ongoing project. The information included genetic results of CGG repeats, demographic information, structured questionnaires for ADHD, learning disabilities of language and mathematics, and independence. The group carrying FMR1 premutation was analyzed separately and compared to the group carrying full mutation. Females with fully symptomatic Fragile X Syndrome, were excluded.

Results: When analyzed as a continuum, there was a significant increase in the following complaints correlated with higher number of repeats:

- labor difficulties and C-Section
- FXPOI
- Not being able to drive a car
- ADHD severity
- Learning disabilities and specifically - language difficulties, dyscalculia, inattentiveness, spelling difficulties
- Executive dysfunction

79 women carried premutation of 56-199 repeats and 19 women carried a full mutation of more than 200 CGG repeats on the FMR1 gene. When observed within the premutation group as compared to full mutation group, we found a linear correlation FXPOI, ADHD, spelling and organization skills. Distractibility correlated inversely with CGG repeats.

Conclusions: Our study supports the findings that the premutation of FMR1 allele may lead to other disorders in addition to FXTAS and FXPOI. ADHD and learning difficulties correlate with increased number of CGG repeats and are prevalent features of premutation and of full mutation in females.

401.005 *(Poster)* A Critical but Understudied Aspect of Adulthood: Autism Traits Differentially Predict Parenting Behavior

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Background: Although it has long been acknowledged that individuals with autism spectrum disorder (ASD) often become parents, very little is known about how distinct ASD traits relate to parenting style. This is a striking gap in the literature, as understanding how ASD traits relate to parenting would allow for the development of appropriate supports for parents with ASD. Although the small existing literature suggests that overall ASD traits may be related to lower parental involvement, more difficulty with parenting, and lower parenting satisfaction, it is imperative to (1) examine a wider range of parenting outcomes, (2) specify which particular aspects of ASD symptoms most strongly predict parenting, and (3) consider whether ASD traits predict parenting over and above other variables critical to parenting behavior, such as comorbid internalizing and ADHD symptoms.

Objectives: The current study aimed to examine the association between self-reported ASD trait domains and a diverse range of parenting practices and beliefs. We also aimed to examine whether ASD traits predicted parenting above and beyond cooccurring ADHD and internalizing symptoms.

Methods: Community parents (n=138; 72% female) with children under the age of 18 years completed the Broad Autism Phenotype Questionnaire (BAPQ) to assess core ASD traits (aloofness, pragmatic language difficulties, rigidity). To examine parenting practices and beliefs, participants completed the Alabama Parenting Questionnaire (APQ) and the Parental Emotional Styles Questionnaire (PESQ). Parents reported on comorbid ADHD symptoms using the Adult ADHD Self-Report Scale (ASRS) and internalizing psychopathology (e.g., depression, social anxiety, panic, and obsessive-compulsive symptoms) using the Inventory of Depression and Anxiety Symptoms (IDAS-II). First, Pearson correlations between BAPQ subscales and the parenting measures were examined. Second, hierarchical regressions were used to examine the effects of ASD traits on parenting attitudes over and above comorbid ADHD and internalizing symptoms.

Results: Correlations among study variables are presented in Table 1. The BAPQ subscales demonstrated unique patterns of correlations with the parenting outcomes. BAPQ Pragmatic Language Difficulties were correlated with nearly all of parenting outcomes, whereas BAPQ Aloofness and Rigidity related more specifically to unique parenting outcomes. Hierarchical regression results are presented in Table 2. For all parenting outcomes except Inconsistent Discipline, the BAPQ subscales explained significantly more variance than ADHD and Internalizing symptoms. In particular, above and beyond all control variables, pragmatic language difficulties predicted less emotion coaching, more inconsistent discipline, and worse monitoring. Aloofness predicted less emotion dismissing, less positive parenting, and less involvement. Rigidity uniquely predicted more emotion dismissing.

Conclusions: Overall, results indicate that ASD traits strongly predict parenting practices over and above the effect of other relevant factors including ADHD and internalizing symptoms. Moreover, these findings suggest that distinct dimensions of ASD traits show unique patterns of relations with parenting practices. In particular, Pragmatic Language difficulties were associated with difficulties across a range of different parenting domains. Replication in a clinical population would further support the importance of developing targeted parenting supports for adults with ASD, perhaps with an emphasis on pragmatic language deficits.

401.006 *(Poster)* A Narrative Approach to Career Identity Construction of Adults with ASD

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Background: Transition into adulthood presents many challenges for individuals with ASD. Supports provided through childhood and adolescence are no longer available, and the structured educational environment is substituted with an uncertain and ambiguous reality. While educational programs support and promote success, the labor-market has a stricter set of rules, expecting job seekers to adjust and conform in order to achieve stable employment (Siegel 2018). Career identity is considered one of the core foundations for employability (Fugate et al. 2004). It derives from sequences of work-related experiences, assimilated into a meaningful structure of ‘‘who I am’’ in relation to employment. Self-perceptions of goals; values, interaction styles, and more can form a clear career identity that provides a compass, pointing to personal goals or aspirations. While some theorists understand career identity as an internal cognitive structure, others argue a constructivist approach, situating career identity within social-cultural concepts and norms (LaPointe, 2010). This theoretical lens, illuminating the intersection between self and society, seems highly relevant for expanding our knowledge on employment of adults with ASD, where difficulties in integration are known to occur.

Objectives: The study aims to explore how adults with ASD perceive their work experiences and construct their career identities.

Methods: Participants were 12 individuals (3 females, aged 28-47y), with a formal ASD diagnosis, and work experience of at least six consecutive months. Educational level ranged from a high-school diploma to a master's degree. Narrative interviews were carried out (Rosenthal, 1993), given that narratives are considered a primary genre for discovering the dynamics of identity (LaPointe, 2010). Participants were invited to share their work experience, with minimal interruption. Following, specific questions were asked, covering subjects or narrative gaps that called for further inquiry. Dialogical data analysis was employed, taking into account different aspects of the narratives such as: content, structure, function and context (smith 2016).

Results: Data analysis revealed that career identity is crafted through a process of *negotiation* between self-concepts and work-related social constructs. Participants portrayed various *dynamics of positioning* within the negotiation process: resistance; contingency; compromise; and integration. Most narratives demonstrated movement between at least two of these dynamics, expressing the complex, evolving nature of career identity. Socially acceptable work constructs were often challenged by the participants, from questioning common career trajectories and goals, through criticizing the employer-employee balance of power, to undermining the very idea of work as the only mean for subsistence. Data analysis further found ASD diagnosis to be a key component in the narratives provided. Specifically, when diagnosis was received in the midst of the career story, it usually influenced a positive shift in career identity.

Conclusions: The processes of *negotiating* and *positioning* suggested by the results in this study, enhance the role of individuals with ASD as active agents, constructing their career identity within labor market constraints (Mclean & Syed 2016). Applications of the narrative approach can offer a therapeutic opportunity for adults with ASD to reflect on work experiences and form a meaningful construct, establishing a clear career identity and increasing employability.

401.007 *(Poster)* A Qualitative Analysis of Employers’ Perspectives on the Hiring and Employment of Autistic Individuals

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Background: Despite recent federal and state initiatives to promote inclusion of people with disabilities into the workforce, employment rates for individuals with a disability remains low (up to 76.8%; Lauer & Houtenville, 2018); and even lower for autistic individuals (<38%; Roux, Rast, Anderson, & Shattuck, 2017). The impact of contextual factors, such as the organizational culture of the employer, are important to consider when attempting to address the issue of unemployment (Erickson, Von Schrader, Bruyere, & VanLooy, 2014); however, studies have yet to thoroughly examine employer perspectives of hiring individuals with ASD in the United States (Black et al., 2019).

Objectives: To understand: 1) employers’ perspectives on factors that influence the decision to hire an autistic individual, 2) employers’ needs in order to hire and integrate an employee with ASD into the workplace, and 3) the skills employers perceive as important to workplace success.

Methods: Hiring personnel from thirteen businesses in the U.S. were interviewed (age range = 29-64 years; 53.85% male, n=7; 46.15% female, n=6). Three participants reported having had previous experience hiring an autistic individual. Businesses were either ‘small’ (i.e., ≤250 employees; *n*=11) or ‘large’ (i.e., 500-1,000 employees; *n*=2).

Audio recordings of the interviews were transcribed. Data were analyzed using a data-driven thematic approach at the semantic level (Braun & Clarke, 2006). Interview transcripts were read, content was discussed, and preliminary codes were identified. Each transcript was independently coded by two trained coders using QSR NVivo 12 Plus software (2018). Any coding discrepancies were resolved through discussion and consensus. Codes were then reviewed, content themes were generated, and themes were refined as needed.

Results: Employers were able to identify several benefits of hiring an autistic individual, including preference for routine and repetitive work tasks and attention to detail. In addition to individual skills, employers identified the added benefits that hiring individuals with ASD can have on their broader workplace and community (i.e., promote diversity in the workplace). In addition to these benefits, employers also described the reservations they would have about hiring an autistic individual, which were largely related to symptomology (i.e., social communication challenges, cognitive inflexibility, sensory sensitivities) and the ways that these symptoms may negatively impact work performance.

Employers also identified what they would need in order hire an autistic individual and integrate them into the workplace successfully. Employers described a desire to understand more about the individual whom they are hiring, including the individual characteristics of the person, as well as information about their diagnosis. Employers also reported a desire to understand the types of workplace accommodations that are needed to support an employee with ASD.

Employers identified five skill areas that are important to workplace to success, with an emphasis on soft skills such as emotion regulation, social skills, problem solving, and planning.

Conclusions: Results suggest there are numerous benefits to employing individuals with ASD that should be emphasized during the hiring process. Several concerns also emerged, which can be addressed through workplace accommodations, employment preparation programs, and workplace disability diversity trainings.

401.008 *(Poster)* A Qualitative Study on Permanent Employment with Talents Rehabilitation and the Life of Individuals with Autism Spectrum Disorders: Based on the Experiences and the Perceptions of Autistar Designers and Their Parents

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Background: Successful employment is perhaps the primary aspiration for most individuals. Postsecondary employment opportunities, however, have traditionally been very limited for individuals with ASD(O'Brien & Daggett, 2006). The reason is based on particularly complicated for an adolescent or adult with ASD due to unique communication and social impairments (Müller, Schuler, Burton & Yates, 2003). Job opportunities are also limited and employment outcomes revealed negatively in Korea. Seven years ago first social enterprise, Autistar was estabilished to support individuals with ASD in Korea. Autistar is a design company, appreciating the artistic ability of young people with ASD. They recruit and train designers with ASD. All products of AUTISTAR are developed with their precious artistic senses and abilities.

Objectives: This study was implemented to inquire into the permanent work experiences with talents rehabilitation and their impact on the life of individuals with autism spectrum disorders and their families.

Methods: For the purpose of the study, we conducted in-depth interviews and focus group interviews of designers working at the company Autistar which recruits individuals with autism spectrum disorders based on their talents and their parents. Six out of 10 designers who were able to communicate sufficiently for the purpose of the study and 10 parents were participated.

Results: As the results of the qualitative analysis, four major themes and 13 sub-themes were emerged. Four major themes are the following: (1) past job-related experiences, (2) Autistar work experiences, (3) future growth and development, (4) difficulties and support needs based on characteristics of autism spectrum disorders.

Conclusions: Based on the results of the study, implications and suggestions were discussed centering around expanding employment based on talents rehabilitation of individuals with autism spectrum disorders, providing continuing support in work site, increasing high-quality outcome of employment, and establishing a systematic supporting system

401.009 *(Poster)* Achieving Employment Success in Adult Autism-Specific Medicaid Programs

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Background: Employment is key marker of success during the transition to adulthood and maintaining employment is critical throughout adulthood. However, poor employment outcomes for individuals on the autism spectrum have been documented across the US and multiple systems that share a goal of supporting autistic individuals throughout the employment process. In one large northeastern state in the US, two programs funded through Medicaid (public health insurance) formulated to serve adults on the spectrum have served as emerging models for structuring service delivery to adults, including employment support services. Examining employment outcomes across service models is an important step to identifying policies and programs that may be replicable to improve employment outcomes among autistic adults.

Objectives:

- Describe the employment rate among autistic adults in two Medicaid-funded programs.
- Identify the characteristics of individuals and employment support services among autistic adults who achieved employment and maintained it over time compared to those who did not gain or maintain employment.

Methods: A series of seven monitoring questions focused on employment status and characteristics of individuals enrolled in two adult autism-specific Medicaid programs was implemented in 2017 to regularly track employment outcomes among individuals enrolled. The seven monitoring questions ask if an individual was employment in competitive integrated employment. Competitive integrated employment is defined as employment that pays at or above federal or state minimum wage (whichever is higher) and is based in a location where employees interact with people without a disability. Additional employment monitoring questions ask about the number of hours worked per week, if the individual receives benefits, the type of job, and if the individual is self-employed. Demographic characteristics of individuals enrolled in the autism-specific Medicaid programs were identified using descriptive analyses. Logistic regression was used to identify characteristics of individuals who were employment compared to individuals who were not employed.

Results: The sample included 738 adults on the spectrum with continuous employment monitoring questions completed over a two year span (2017 – 2019). The average age of the adults included was 29.9 years old, with a range of 21-64. Most participants were male (78.2%) and white (83.3%). Almost forty percent (39.7%) of the individuals had successful employment during the observation period. The most common job types were Food Preparation and Serving Related (25.6%), Sales and Related (22.9%), and Building and Grounds Cleaning and Maintenance (18.43%). Most individuals (71.9%) worked 21-35 hours per week. Regression results showed that adults on the spectrum who identify as African American were more likely to have employment (OR=1.98 CI 1.095-3.594) compared to those were white. Additional data analytics will include analysis of employment maintenance over time, seasonality trends, and self-employment compared to traditional employment models.

Conclusions: The national rate of employment among autistic adults in the US has been estimated at 22%. Identifying policies and programs that can boost employment among adults on the spectrum provides opportunity to grow and replicate models of success. By doubling the national employment rate among autistic adults, two Medicaid programs provide promising practices and opportunity for growth.

401.010 *(Poster)* An Autistic-Led Cross-Sectional Survey of the Barriers to Healthcare Experienced By Autistic Adults: Consequences & Policy Implications.

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Background: Autism is associated with reduced life expectancy, poor physical and mental health, and increased prevalence of gastrointestinal & sleep disorders, epilepsy, obesity, hypertension, diabetes and stroke. In-hospital mortality is also increased. Previous studies have shown that barriers to healthcare are multi-factorial including challenges in communication, physician knowledge of autism, and sensory issues.

Objectives: To compare the self-reported barriers to healthcare amongst autistic adults with parents of autistic children and with non-autistic controls, and the self-reported consequences of such barriers.

Methods: A survey, "What do you wish your GP knew about autism?" was conducted at Autscape 2018, a conference organised by and for autistic people. Thematic analysis of N=75 responses was used to develop a 57-item online survey with recruitment of autistic participants, parents of autistic children and non-autistic controls via social media. Three main themes emerged: communication issues (notably difficulty using the telephone), sensory issues (e.g. crowded waiting areas), and executive functioning (notably difficulty planning appointments in advance). The online survey (N=1,980) was completed by 1,271 (64.2%) autistic adults, 406 (20.5%) parents and 303 (15.3%) control adults. 63.7% of autistic adults, 93.8% of parents and 85.0% of control respondents were female. Non-binary gender was expressed by 17.6% of autistic adults, 1.1% of control respondents and none of the parents.

Results: Difficulty visiting a GP when required was reported by 78.2% of autistic adults, 51.4% of parents and 34.9% of controls. The highest-rated barriers by autistic adults were deciding if symptoms warrant a GP visit (71.9%), difficulty using the telephone to book appointments (60.7%), not feeling understood (55.5%) and difficulty communicating with the doctor during appointment (53.0%). 74.3% of autistic adults reported that anxiety increased communication difficulty, significantly more than parents (25%) or controls (23.2%).

78.1% of autistic respondents avoid using the telephone, 61.1% avoid voicemail and 29.7% avoid face-to-face verbal communication, all significantly more frequently than parents or controls. Autistic adults more frequently experience physical mobility needs (15.8%), having nobody available to support hospital admission (15.1%), collection following surgery (17.7%), home care following discharge (24.9%), and childcare when unwell (5.8%).

Adverse health outcomes were reported by autistic adults substantially and significantly more frequently than parents or control respondents. These included untreated physical and mental health conditions, not attending specialist referral or screening programmes, requiring more extensive treatment or surgery due to late presentations, and untreated potentially life threatening conditions.

To facilitate attendance, autistic adults reported a need for online or text based appointment booking, first or last appointment of the day, a quiet place to wait, facility to email in advance the reason for consultation, and a sensory box in the waiting room, in all cases significantly more often than parents or control respondents. A significant level of non-registration with a general practitioner was noted.

Conclusions: Reduction of healthcare inequalities for autistic people requires that healthcare providers understand autistic culture and communication needs. Reasonable accommodations are legally and morally required, and adjustments for autistic communication needs are analogous to wheelchair ramps for the physically disabled.

401.011 *(Poster)* Are Elevated Autistic Traits Associated with Greater Self-Reported Self-Harm and Suicidal Ideation and Behaviours in Older Adults?

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Background: Suicide has been identified as a leading cause of premature death in autistic populations. Studies have also documented that elevated autistic traits are associated with self-harm, suicidal ideation, and suicide attempts in the general population.

Objectives: This study will explore differences in the frequency and type of self-harm behaviours, and in prevalence rates of suicidal ideation and suicide attempts among older adults with/without elevated autistic traits.

Methods: Using baseline cross-sectional data from the ongoing online PROTECT study, a total of 20,220 adults age 50 years+ reported whether they experience behavioural qualities commonly observed in the autistic spectrum. Approximately 1%, 276 individuals, were identified as endorsing elevated autistic traits in childhood and currently, referred to henceforth as the Autism Spectrum Trait (AST) group. Differences between the AST and an age mean/range and sex ratio matched Control Older Adults (COA; n = 10,495) group were explored in self-reported frequency and type of self-harm behaviours, and in prevalence rates of suicidal ideation and suicide attempts.

Results: Self-harm and suicidal thoughts and behaviours were found be negatively associated with age in the AST and COA groups.Individuals in the AST group demonstrated significantly higher frequencies of self-reported self-harm behaviours than COA, including self-injury (e.g. self-cutting, scratching, hitting), intoxication (e.g., ingesting medication in excess of the normal dose, ingesting excessive alcohol, or ingesting recreational or illicit drug), swallowing dangerous objects or products, and stopping prescribed medication without consulting a medical professional. Furthermore, a higher total number of self-harming behaviours were reported by the AST group than COA. The AST group also report higher frequencies of suicidal ideation and suicide attempts, with a five to six-fold increase in likelihood of experiencing these behaviours when compared to the COA group. This pattern of results remains significant when controlling for current depression and anxiety symptoms.

Conclusions: The findings from the current study suggest that elevated autistic traits may increase the likelihood of self-harming behaviours, as well as the experience of suicidal thoughts and behaviours, including suicide attempts. Further work is needed to see whether these results extend to older adults meeting diagnostic criteria for autism.

401.012 *(Poster)* Associations between Coping and Mental Health Outcomes in Autistic Adults

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Background: Mental health difficulties in autistic adults are common, with high prevalence rates of anxiety and depression. Coping literature suggests that an individual's approach to coping with stress can have a substantial impact on their mental health. Avoidance-oriented coping strategies have been associated with poorer psychological well-being, while approach-oriented coping strategies, with increased positive affect and mental health. Research into coping and its association with mental health in the autistic population is limited, especially in adults. Studies with autistic youth report mixed findings, with some suggesting an association between avoidance coping and fewer depressive symptoms, or a lack of relationship between approach/engagement coping and better emotional outcomes, both opposite to the general trend in the literature. These mixed findings raise the possibility of different trajectories from coping strategies to mental health outcomes in the autistic population. Understanding the coping-mental health relationship in autistic adults is critical to allow us to provide evidence-based support for the mental health difficulties prevalent in this population.

Objectives: To examine the relationship between coping style and mental health outcomes in a sample of autistic adults.

Methods: Our sample consisted of 255 autistic adults, aged 15-80 years, recruited through two longitudinal studies. Autism traits, coping style and psychological well-being were measured using the abridged version of the Autism-Spectrum Quotient (AQ-Short), Brief COPE, Patient Health Questionnaire-9 (PHQ-9), The DSM-5 Generalized Anxiety Disorder Dimensional Scale (DSM-5 GAD-D) and The Warwick-Edinburgh Mental Well-being Scale (WEMWBS). Three multiple regression models examined the six coping dimensions of the Brief COPE (i.e., Engagement, Support-seeking, Disengagement, Substance-use, Religious and Humour coping) as potential predictors of variance in depression, anxiety and positive well-being. Age, gender and autism traits were included as co-variates. Due to some non-normal distributions, analyses were performed using 2,000 resamples bootstrapping.

Results: For levels of depression: gender ($\beta = 0.103$), AQ-short ($\beta = 0.132$) and disengagement coping ($\beta = 0.601$) were significant predictors in the final model, accounting for 45.6% of total variance in the PHQ-9, $R^2 = 0.456$, $F(4, 224) = 46.97$, $p<0.001$.

For levels of anxiety: age ($\beta = -0.255$), gender ($\beta = 0.109$), AQ-Short ($\beta = 0.145$) and disengagement coping ($\beta = 0.589$) were significant predictors in the final model, accounting for a total variance of 47.7% in the GAD-D, $R^2 = 0.477$, $F(6, 225) = 34.17$, $p<0.001$.

For levels of positive well-being: AQ-Short ($\beta = -0.216$) and disengagement coping ($\beta = -0.435$) were significant predictors in the final model, accounting for a total variance of 28.1% in the WEMWBS, $R^2 = 0.281$, $F(3, 228) = 29.77$, $p<0.001$.

Conclusions: Our findings support existing literature reporting strong associations between disengagement coping and poorer levels of mental health. A lack of relationship between engagement coping and mental health outcomes suggests that these strategies, although adaptive in theory, may not have a significant beneficial impact for mental health in autistic adults. Our findings offer novel information regarding coping strategies to consider (i.e., a focus in reducing disengagement coping) when addressing support options for mental health difficulties in this population.

401.013 *(Poster)* Atypical Top-Down Processing in People with Autism Spectrum Disorder Revealed By Repeated Verbal Stimuli Under Noise

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Background: Individuals with autism spectrum disorder (ASD) often experience atypical sensory-perceptual processing. Our previous study compared the characteristics of an auditory illusion, called the verbal transformation effect (VT) between individuals with ASD and typically developed (TD) individuals. In VT, listeners perceive illusory changes for a repeated, physically unchanging verbal form. For example, the forms reported by a TD participant during a five-minute presentation of a word "banana" were "banana... banaN... panaN... panana... panaN... banaN" ("N" is a special mora in the Japanese phonological system). On the other hand, an ASD participant, for instance, reported "aru... danana... haiNnaino... hairando... heNnano ...panama", and another one reported "banana... peNdaNto... banama... tadano... peNdaNtu... pedanu", for the repeated presentation of "banana". We found that individuals with ASD perceive illusory changes more drastically deviated from the original form, and, to explain this, we assumed the existence of strong, unique top-down processing. This finding challenges the conventional view that people with ASD tend to perceive sensory signals as they are (i.e., less susceptible to illusions).

Objectives: In this study, we investigated the reason why individuals with ASD show such strong and unique top-down effects in perception in VT. To explore whether bottom-up information is less reliable in individuals with ASD, we conducted an ambiguous VT experiment by presenting background noise.

Methods: We conducted a listening test to compare perception of a repeated sound pattern, namely a spoken word, between ASD and TD groups. Prolonged listening to a repeated word without a pause may induce perceptual changes, which is known as the verbal transformation effect. To explore whether bottom-up information is less reliable in individuals with ASD, we conducted an ambiguous VT experiment by presenting background noise. For five minutes, participants diotically listened through headphones to the word "banana" spoken repeatedly by a female Japanese native speaker in the clean condition. In the noise condition, pink noise was presented with VT stimuli (signal to noise ratio was 0 dB). In the count task, participants pressed a key on a keyboard when they perceived transitions from one verbal form to another. In the report task, participants reported the forms when they perceived transitions from one verbal form to another. We recorded the participants' reports with a voice recorder and transcribed them, and analyzed the quantitative and qualitative nature of the VTs in the clean and noise conditions.

Results: We found that TD individuals perceived less deviated changes in VT with noise than individuals with ASD did. On the other hand, individuals with ASD perceived more drastic changes with noise. Some individuals with ASD reported drastically deviated forms due to the presence of noise.

Conclusions: These results suggest that the drastic illusory changes in VT are not solely induced by bottom-up sensory processing, but are induced by atypical top-down processing in individuals with ASD as well.

401.014 *(Poster)* Autism Friendly - What Does It Mean?

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Background: Autism friendly society is evidently something to strive for in order to have autistic individuals able to live meaningful lives. There are campaigns around the world promoting the idea, and even giving certificates awards for autism friendly acts. What does it mean and who determines the content?

Objectives: We strove to clarify what autistic individuals and professionals thought the term means for them.

Methods: A convenience sampling method was used. An online web survey and phone interview survey was conducted to ask directly what the term autism friendly means. The person could choose which method to use for answering. We contacted professionals who work with autism via listed organisation working with autistic individuals, for example, social and healthcare organisations, employmency offices, youth services, universities and so forth. We also conducted a workshop asking the same question, using pen and paper, at a seminar organised by autistic individuals about autism.

Results: The survey was answered by 152 autistic individuals and by 586 professionals. The workshop had 25 participants. The most common terms the professionals used to describe the term were: simplified language, more knowledge, equality, let people be different, equality for services, more services, altering services, acceptance. The autistics individual's similarly described the term to mean: general acceptance, tolerance, no expectations that everyone understands the same way, being understood, getting support, recognising sensory sensitivity, not only 'rehabilitate' to society but also the other way around, worklife flexibility, but also that there is no such a thing as autism friendly. At the workshop the descriptions were: simplified language, pictorial instructions, forethought/action, individual needs, sensory sensitivity, equality, patience, accepting people as they are, possibility to alter surroundings, and allowed to socialise differently.

Conclusions: It was found that autistic individuals and professionals had similar thoughts what autism friendly means. It seems that the common theme is acceptance and ability to have adaptable environments, and to have information beforehand with visual help.

401.015 *(Poster)* Autism Traits Moderate the Effects of Cognition and Adaptive Behavior Discrepancy on Psychopathology in Young Students with Autism Spectrum

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Background: , Among individuals with high functioning autism (HFA), the gap between cognitive ability and adaptive function was postulated to enhance anxiety and depression, due to the high self-awareness level (Kraper et al., 2017). Such psychopathology can impede social and academic adaptation. In addition, the level of autistic features was previously associated with cognitive flexibility (Albin-Urious et al., 2018) and metacognition (Carpenter et al., 2019), features which may affect daily coping.

Objectives: , 1. To examine the association of the gap between cognitive ability (specifically, a scholastic understanding of social conventions) and adaptive behavior to psychopathology in young university students with HFA. 2.To examine whether the level of autistic traits moderates the association between the cognitive-adaptive ability discrepancy and psychopathology.

Methods: , The study included 53 HFA university students (4 females) with a mean age of 23.5 years, (*SD*=2.81). Cognitive ability (knowledge and understanding of social convention and norms) was measured using the Comprehension sub test of the Wechsler Adult Intelligence Scale (WAIS). Adaptive skills were measured using the Adaptive Behavior Assessment System (ABAS-II). Autistic traits were assessed using the Autism Spectrum Quotient (AQ), and Social Anxiety was measured with the Liebowitz Social Anxiety Scale (LSAS).

Results: , A significant positive correlation was found between the gap of the WAIS Comprehension subtest and the ABAS Social Composite Score (cognition – social adaptive skills) and total $r(47) = .40$, $p<0.001$) and avoidence $r(47)=.48$ $p<0.001$) LSAS scores. However, this association was moderated by AQ scores. Among HFA students with relatively high autism traits (AQ score above median =>46), a greater gap between cognition and social adaptive skills was associated with more avoidance symptoms of social anxiety $r(23) = .74$, $p<0.001$). However, such an association was not evident among HFA students with relatively low autism traits (AQ<46) $r(24) = .15$, $p=.24$) . In a regression analysis, the interaction term of the Comprehension subtest and the ABAS Social Composite Score (cognition-social adaptive skill) X AQ score (below/above the median) significantly predicted 31.1% of the variance in social anxiety avoidance symptoms (LSAS avoidance).

Conclusions: , The study's findings suggest that in HFA, the effects of cognitive/adaptive ability discrepancy on psychopathology are moderated by the level of autistic features. One possible explanation for this interesting finding relates to cognitive flexibility (i.e the ability to disengage from one task and adapt to a new situation) and metacognition (the ability to attribute mental states to oneself), both of which have been previously negatively associated with autistic features. Thus, it is possible that individuals with HFA and relatively low autistic traits can cope more efficiently with a cognition/adaptive behavior gap due to their ability to display more flexible and adapted social behaviors, and reflect on their mental states. These abilities may lead to a reduction of the negative effects of such a discrepancy on daily situations. The findings may have important clinical implications for understanding adaptive functioning of young students with HFA.

401.016 *(Poster)* Autistic Adults Using Autonomous Vehicles: Analysis from Autonomous Shuttle Rides Followed By Focus Group Discussions

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Background: There is a growing body of literature that focuses on autonomous vehicles for persons with disabilities, however there is no known active research or published literature focused on autistic adults. This research study was conducted with autistic adults that both rode an autonomous shuttle and discussed their experiences and feelings afterwards in focus groups.

Objectives: To conduct research focused on investigating strategies for designing and deploying self-driving vehicles so they can best accommodate the often-diverse needs of persons on the autism spectrum.

Methods: The research was conducted through series of three autonomous shuttle rides followed by structured focus group sessions convened with 14 autistic adults and 2 with related developmental disabilities. Demographic data of the 16 study participants can be found in Table 1. The goal was to document their direct experience as passenger using a shuttle type of Autonomous Vehicle (AV). The research was conducted during Princeton University's 2019 SmartDrivingCar Summit. The core intent of this research was to gather feedback and recommendations on AVs from persons with autism who had acquired a level of familiarity with the technology through a direct vehicle encounter, transcending their knowledge of AV solely as an abstract concept. The IRB of record was with Rutgers University. The sessions were digitally recorded, uploaded in NVivo12 then transcribed, coded and analyzed.

Results: Key findings based on the questions and prompts are presented in Table 2. Significant findings were that only 31% of the participants knew about AVs prior to the study but 87% liked the ride, 93% liked the vehicle, 81% wanted to ride in autonomous vehicle again, with 6% wanting additional practice and only 13% unsure. Many of the participants communicated that availability and usage of AV would also help to decrease feelings of "isolation," "depression," and even "jealousy" that they often feel when they cannot access a ride to a desired or needed destination. In discussing AV in comparison to other modes they currently utilize, participant support and preference for AV was clear. Many felt that an AV would reduce the burden to their parents. Others noted they preferred AV travel to community transit options and ADA complementary paratransit they have utilized, mainly because they envision the former as a more on-demand, user friendly travel option. The two participants who drive discussed that AV would be less stressful overall compared to driving themselves, especially when traveling in unfamiliar locales. The most cited concerns were price, payment options, vehicle interface, and the option to be the sole passenger.

Conclusions: The authors captured invaluable information on participant initial impressions of AV; their in-vehicle trip experience; interest in utilizing AV in the future; and AV-related concerns. Findings demonstrate that the majority of participants had both positive initial and post-trip impressions of AV and were extremely interested in utilizing AV to meet their current trip needs. Participants also offered insightful recommendations that can contribute to continued development of AV technology so that it can more fully accommodate the travel needs of autistic individuals.

401.017 *(Poster)* Autistic Priorities for Future Research on Autism and Employment in the UK

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Background: The employment gap for autistic adults in the UK has led to an increase in research examining barriers to access. Studies have focused on a variety of issues including transition from education, autism-specific employment schemes, and socio-economic background. The present study investigates autistic priorities for future research on autism and employment including attitudes towards the scope of such research to change employment practice. In doing so it contributes to an increasing understanding of how to align future research with stakeholder needs and identifies potential challenges with translating research effectively into practice.

Objectives: Our first objective was to understand attitudes towards the role of research and potential challenges in addressing the research-practice gap. Our second objective was to explore and document the range of autistic priorities for future research on employment.

Methods: Through an online survey, autistic adults (n = 204) were asked about the amount of contact-time they had experienced with researchers and, via a rating scale, participants indicated their perception about the effectiveness of research to change employment outcomes for autistic people. Participants also provided open text responses about priorities for research on employment and their perceived impact of research on practice in the future, which was analyzed using thematic analysis.

Results: Results show participants perceive research will only have moderate success in changing employment outcomes in the future (mean = 2.6; 'not successful at all' = 1, 'very successful' = 5), while 67% of participants reported that they had not experienced any opportunity to discuss their thoughts about research priorities with a researcher (3% reported they had not tried; 2% were researchers themselves). Thematic analysis of the open text responses revealed three priority areas for future research including: (1) research on making organizational culture and practice more accessible to neurodiversity (58% of responses) including research on successful adjustments, career development and sustainable employment; (2) research on socio-economic and legal frameworks for providing support (28% of responses) including research on autistic people belonging to additional minority status groups, research across sectors and the effectiveness of the benefit and welfare system; and (3) critical reflections on the research-practice gap (14% of responses), including topics to avoid, more participatory research strategies and a focus on positive case studies.
Conclusions: Findings demonstrate priorities which are focused on achieving sustainable employment for autistic people over time. Sustainable employment can also be achieved through creating more enabling systems of support at the organizational and socio-economic level that are focused on the wide-scale recognition of autistic strengths and support needs, improved access and alignment of job roles, and the impact of employment on well-being. In addition, there remains an ongoing challenge with improving the current knowledge-base underscoring employment initiatives, with a need for more pathways for autistic involvement in research. The contribution of the present study is to present a list of themes, subthemes and examples, ranked in terms of coding frequency, as a guide to help shape future research agenda.

401.018 *(Poster)* Career Interview Readiness in VR (CIRVR): Feasibility of an AI-Driven Platform for Employers and Neurodiverse Talent

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Background: An estimated 85% of individuals with Autism Spectrum Disorder (ASD) are under- or unemployed, thus resulting in greater reliance on caregivers and support systems and hindering personal growth and self-satisfaction. Recent evidence reveals that this significant employment disparity is attributable not to a lack of employable skills and talents, but rather to the significant and unaddressed barriers to employment faced by individuals with ASD at all stages of the employment process (e.g., candidate identification, the job interview, and on-the-job training). The current work focuses on the unique challenges that the traditional job interview poses to individuals with ASD.
Objectives: Researchers have recently begun exploring the use of simulated job interview systems to prepare individuals with ASD for real-world interviews. However, existing systems have not fully utilized digital platforms to deliver engaging, adaptive, and individualized training to this population, nor have they been designed with the aim of providing insightful feedback to both candidates *and* employers. In response, we have developed Career Interview Readiness in VR (CIRVR) with the aim of improving candidates' performance in simulated job interviews while simultaneously providing meaningful data for potential employers to ultimately gain a better understanding of the accommodations needed for this population of candidates. CIRVR can sense an individual's affective state through physiological sensing, attention through eye gaze, and facial expressions from real-time video capture and utilizes a set of AI modules using Microsoft Azure to create an adaptive and smooth interview protocol.
Methods: We conducted a preliminary, IRB-approved investigation of the feasibility and usability of CIRVR. Fifteen participants were recruited for this study: nine with ASD (mean age = 22.11; SD = 9.10) and 6 neurotypical peers (mean age = 20.17; SD = 3.43). All participants interacted with CIRVR while multi-modal data were collected from several channels including speech, eye gaze, facial image capture, and psychophysiology as measured by a wrist-worn biosensor. Additionally, the System Usability Scale (SUS) as well as an open-ended interview were used to collect qualitative measures of usability and acceptability of the novel system.
Results: All but one participant completed the study. Responses to the SUS by the ASD group were in the "Okay" range (M = 53.61; SD = 17.24) while responses from the neurotypical group were in the "Good" range (M = 73.33; SD = 15.86). The post-interview discussions revealed that participants' experiences with CIRVR were generally positive.
Conclusions: In a preliminary evaluation, CIRVR successfully captured the multi-modal user data and was favorably received by participants. Our preliminary results provide insight into how CIRVR can be extended and enhanced in the next phase of research. In the future, we will implement two important new features: (a) an employer dashboard that will provide key insights to employers, with the ultimate aim of fostering a more inclusive workplace environment; and (b) a real-time adaptive mechanism to provide a more individualized training experience to interviewees.

401.019 *(Poster)* Changes in ADOS Calibrated Severity Scores between Adolescence and Young Adulthood in a UK Population Based Twin Sample

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Background: Across development, autistic individuals may show fluctuations in their presentation of symptoms. This can be examined using Autism Diagnostic Observation Schedule (ADOS) Calibrated Severity Scores (CSS) (Gotham, Pickles & Lord, 2009; Hus & Lord, 2014). Adolescence to young adulthood (YA) is an important transition period with many new challenges and opportunities. Identifying factors that influence change in this period could be helpful to improve outcomes and identify groups needing extra support.
Objectives: This study used data from a population-based twin sample covering the whole autism spectrum. Objectives were to examine factors associated with CSS scores in YA and change in CSS between adolescence and YA.
Methods: In the first phase of testing, adolescents (M_{age} 12 years 11 months, SD= 10 months) completed ADOS assessments, IQ and cognitive testing. Families in this sample were included if one or both twins met diagnostic criteria for autism. Sixty-nine individuals (from 42 families; 61.87% male) were revisited in YA (M_{age} = 22 years 5 months, SD= 12 months). Multi-level models were used to account for family clustering within the data.

Results: Results demonstrated that 39.13% showed reductions in CSS between adolescence and YA, while 30.43% showed increases and 30.34% showed no changes in CSS over this period.

Family level factors (i.e. shared genetic and environmental effects) had a significant impact on young adult CSS. Intraclass correlations suggest that around 22% of variability is attributable to family clustering. After accounting for this, adolescent CSS (p< .001), adolescent IQ (p< .001) and current age (p= .016) were all significantly associated with YA CSS. Individual sex showed no significant association (p= .968), although future samples with greater numbers of females are needed. Greater adolescent IQ and current age were both associated with lower CSS in YA, while higher adolescent CSS was associated with higher CSS in YA.

Changes in CSS between adolescence and YA were also related to family clustering (15.90% variance attributable). Adolescent CSS (p< .001), adolescent IQ (p= .001) and length of follow-up (p= .002) were all significantly associated with change in CSS. Individual sex showed no significant association (p= .832). Higher adolescent IQ, higher adolescent CSS and greater time between assessments were each associated with increased reductions in CSS between adolescence and YA.

Conclusions: These data demonstrate the utility of CSS for mapping changes across the lifespan for autistic individuals. Observed trajectories are diverse and varied, although some general influencing factors have been identified. On average, symptoms seem to improve with increasing age and time. Adolescent IQ is associated with lower young adult CSS and greater reductions between adolescence and YA. Although CSS show some degree of stability, large changes (both positive and negative) can also be seen. Therefore, future work may wish to explore additional factors to better identify those who would most benefit from additional/continued support during the period of between adolescence and YA. It is hoped that this may be used to help some capitalize on their gains during this period while giving greater support to those experiencing increasing challenges.

401.020 *(Poster)* Childhood Predictors of Depression and Anxiety in Autistic Adolescents and Adults and Their Siblings

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Background: Higher rates of depression and anxiety are reported in autistic individuals (Croen et al., 2015) and their siblings (O'Neill & Murray, 2016) than the general population. Little is known about the stability of elevated symptoms from early childhood to adolescence/young adulthood. Gotham and colleagues (2015) found that gender predicted greater increases in symptoms across adolescence and that greater emotion regulation difficulties in later childhood predicted internalizing symptoms in autistic adults. Additional studies are needed to understand predictors of depressive and anxiety trajectories in autistic individuals and their siblings.

Objectives: To examine childhood predictors of depression and anxiety in adolescents and young adults with ASD and their siblings.

Methods: Analyses included 158 individuals with ASD (*M* age=16.09, SD=2.63) and 131 designated siblings (*M* age=16.03, SD=2.70 from the Simons Simplex Collection who completed an online follow-up through the Interactive Autism Network 6 years later (SD=1.06). McNemar's $\chi 2$ test were used to compare the proportion of children who changed clinical classification (i.e., Borderline-to-Clinical range T$\geq$60 vs. Non-Clinical range T<60) on the ASEBA Depressive Problems and Anxiety Problems DSM-Oriented Scales from T1 to T2. Logistic regressions were used to explore predictors of T2 classification; T1 classification, gender, group (proband or sibling) and externalizing symptoms (as a proxy for emotion regulation) were explored in the initial analysis.

Results: Figure 1 shows distributions of clinical classifications on the Depressive and Anxiety scale. Of autistic individuals with elevated T1:Depressive scores, 62% had Non-Clinical T2:T-scores and 29% with T<60 at T1 had elevated T2:T-scores (p=.01). Fifty-seven percent of siblings with elevated T1:Depressive scores were Non-Clinical at T2, and 14% moved from Non-Clinical at T1 to elevated at T2 (p=.70). Within autistic individuals with elevated T1:Anxiety, 46% had Non-Clinical scores at T2 and 21% who were Non-Clinical at T1 had elevated T2:T-scores (p<.001). In contrast, 65% of siblings with elevated T1:Anxiety had T2:T<60, and only 10% moved from Non-Clinical at T1 to elevated at T2 (p=1.00).

Females were less likely (OR=.04, 95%CI[.002, .77]) to have elevated T2:Depressive scores, controlling for group and T1 classification. Males with higher T1 externalizing symptoms were somewhat more likely to have elevated T2:Depressive scores (OR=1.06, [1.00, 1.12]). T1 externalizing symptoms (OR=1.05, [1.01, 1.08]), but not gender (OR=.95 [.45, 1.97]), predicted T2:Anxiety, controlling for group and T1 classification.

Conclusions: More than sixty percent of autistic individuals fell in the Borderline-to-Clinical range on the ASEBA Depressive and Anxiety scales at T1. Somewhat surprisingly, fewer had elevated scores at T2; 46-62% of those with T1 scores in the Borderline-to-Clinical range continued to have elevated scores as adolescents and young adults, six years later. In contrast, fewer than 20% of siblings had elevated scores at either time point. Additional analyses will seek to identify potential protective factors (i.e., characteristics of individuals who do not exhibit depression or anxiety) and predictors of trajectories (e.g., persistence vs. reduction of symptoms). Within family analyses will examine the influence of characteristics of the sibling with ASD on depression and anxiety in non-autistic siblings.

401.021 *(Poster)* College from an Autistic Viewpoint

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Background: Students on the autism spectrum are increasingly attending college; yet there has been limited research related to their experiences. Gelbar et al, 2014 completed a systematic review of autistic student experiences in higher education. Of the 20 articles reviewed, the majority were case studies of only one or a few autistic students. They concluded that there is a paucity of research in this area and advocated the need for increased representation in such studies through interviewing and surveying in order to move towards empirically based recommendations for specific higher education programming.

Participatory approaches that include community members as members of the research team can ensure that research projects, from ideation to dissemination are rooted in community contexts and priorities, and shaped by immediate community feedback. As such, the current study design and key components were developed in consultation with the Academic Autism Spectrum Partnership in Research and Education (AASPIRE), which is an academic-community partnership which includes autistic individuals as equal partners in research. It was created in 2006 by Drs. Raymaker and Nicolaidis.

Objectives: The project uses interviews to address the following research questions: 1) What challenges and successes do college students on the spectrum report related to academic and social life at PSU? 2) What resources and/or supports might improve the experiences of autistic students at PSU?

Methods: Prior to study initiation, the full research team met to discuss research questions, propose methods and measures, and study design. Based on discussion, particularly input from the AASPIRE group, the research questions and methods were finalized. The interview guide was then developed by the first two authors, in consultation with the Drs. Raymaker & Nicolaidis. Following collection of several interviews, the full team provided key suggestions regarding several areas to include in further interviews. The semi-structured interview guide included a number of topics related to academics, social, living situation, autism, services, etc. Demographic information was also collected. Participant inclusion criteria (n=19): 1) registered student for at least 6 months; 2) diagnosis on the autism spectrum; and, 3) communicate in English or American Sign Language (ASL).

Data analysis: An inductive approach was used for data analysis (Thomas, 2006). All interviews were recorded and transcribed. The first three authors completed close reading of the text and in vivo coding to create preliminary categories. The categories were refined through multiple readings and revisions of codebook. Summary categories were created. Consistency checks were completed at each stage.

Results: Key themes included: 1) successes and challenges; 2) people who provide support or create barriers; 3) contexts where successes and challenges occur; 4) communication; 5) identity; and 6) institutional structures. Some co-occurring topics include: positive experiences through challenges; student organization recommendations; and seeking accommodations related to executive function skills.

Conclusions: The study provides increased understanding of autistic student experiences at a PNW urban university; use of a participatory approach increased trustworthiness and supports autistic-lead programming modifications. Next steps include development of survey questionnaire for large-scale examination of neurodivergent student experiences.

401.022 *(Poster)* Community Engagement and Lifelong Learning: The Alyssa Burnett Center Model

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Background: In the next 10-15 years, The Washington State Department of Health estimates 8,000 to 12,000 children with autism will age into adulthood with access to fewer opportunities to continue community participation and lifelong learning. Evidence demonstrates a significant decrease in community participation as individuals with autism transition to adulthood (Myers E, et al, *JADD;* 2015; DOI 10.1007/s10803-015-2403-z).

The Alyssa Burnett Adult Life Center (“the ABC”) was established in 2014 to address the gap in educational, recreational, and social services for adults with autism and other developmental conditions. Operated by Seattle Children’s Hospital, the ABC is a center offering non-accredited classes with a focus on skill building, independence and socialization. The ABC is popular and currently serves 170+ adults with ASD and other developmental conditions per quarter.

Objectives: Our goal is to highlight quantitative and qualitative data to better understand the population being served through the ABC model and the impact of participation on quality of life (QoL).

Methods: The ABC model is based on classes designed by instructors with stakeholder input. Accessibility and accommodation are integral to the design of these specialized classes. Programing is classroom and community-based maintaining an intentional 1:4 staff to student ratio. Classes run weekly over a 12-week session with class size ranging from 5-15 students. Classes vary in baseline skill level and in the amount of support needed to attend (e.g. some classes require participants to provide their own 1;1 caregiver; other classes are attended independently). All students attend an intake evaluation with ABC staff to identify baseline skill level and interests.

QoL Survey data collection is ongoing, beginning in 2019. *Baseline Surveys* are collected during intake evaluations and *Longitudinal Functional Surveys* are sent quarterly to returning students. Surveys include demographic, daily living, community participation, and employment questions.

Results: According to our *Baseline Survey (N=51)*, 29.5% of adults have paid employment and 51% are involved in community-based activities prior to attending ABC. Our *Longitudinal Functional Survey (N=52)* indicates 52% of returning adults have paid employment and 61.5% are involved in community-based activities in addition to attending ABC. When asked to rate how each student's diagnosis has been affecting their daily living, 61% of *Baseline* responses indicated “marked, severe, or extreme” effects, whereas 40% of the *Longitudinal* responses indicated “marked, severe, or extreme” effects.

Regarding demographics, 158 students are enrolled in the current Fall 2019 quarter. 75% are between the age of 20 and 29, with 56% of the total being male. 52% of the students are diagnosed with ASD. 45.5% live within 0-10 miles of ABC, 44% live within 11-20 miles of ABC, and 10% live beyond 20 miles away.

Conclusions: The ABC model is a feasible and popular option for adults with autism and other developmental conditions to continue their community engagement and skill building. Preliminary evidence supports the role of community participation and lifelong learning in improving QoL. Future research is needed to better understand the quality and quantity of participation necessary to impact QoL for specific participant groups.

401.023 *(Poster)* Comparison of Three Coding Schemes for Analyzing the Interaction and Engagement Motivations of Adults on the Autism Spectrum.

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Background: Studies investigating autistic adults' perceptions and attitudes, such as motivation, are sparse and remains a priority for research. Understanding the motivations of autistic adults is critical for developing meaningful programs, services and interventions for this population. However, differing theoretical coding schemes for examining motivations have strengths and limitations that can affect the focus and meaning of their findings. For example, life domains derived from Life Course Theory (LCT) are often used for categorizing emergent adult motivations but may fail to categorize important dimensions, such as self-determination, survival, avoidance, or meaningfulness, that may be better captured with other motivation theories. To date, it is unclear which theories best capture and characterize the motivations of autistic adults.

Objectives: To investigate the utility of three coding schemes, this study compared three coding systems derived from LCT, Self-Determination Theory (SDT), and Motivation Taxonomy (MT) to examine the self-reported life goals, as well as the motivations and barriers to community engagement, reported by 42 adults on the autism spectrum.

Methods: Participants (ages 18 – 34 years) completed an anonymous online survey that included multiple-choice, multiple-response, and open-ended items related to demographic questions, interests, goals, and barriers to activities or social engagement. This study examines the following open-ended items: "Please list one or two of your most important goals", "What motivates you to engage in activities outside the home?", and "What motivates you to engage with others?" Comments were coded independently and through consensus. A competing theories method was used to compare the utility of the coding schemes.

Results: Both LCT and the MT coding systems outperformed SDT in terms of utility for this population. For LCT, many comments could be coded within traditional life domains (desire to increase independence, education, employment, and social relationships), however, many items related to passions and meaning were not codable and required additional "domains". For SDT, many motivations did not fit the theoretical definitions of autonomy, competence or relatedness. However, MT, which provided both a condensed coding scheme (meaning, communion, and agency) and a highly granular scheme (44 codes), revealed important personality differences in motivation while encompassing ideas from both LCT and SDT. While some participants emphasized a desire for a meaningful life (pursuing passions and humanitarian causes, career, intellectual growth, deep relationships), other participants focused on obtaining survival related goals (getting a job, making money, transportation, addressing physical or mental health, battling isolation).

Conclusions: LCT and SDT may not be as useful as MT to capture the ways autistic adults express self-determination including drives related to survival, desires to meet external expectations, and desire for a meaningful life. While MT demonstrated the greatest utility for coding motivation in this population and highlighted the importance of individual differences in this population, it did not adequately account for motivations related to psychological health, transportation, and basic necessities. Future research on autistic adult motivation should carefully consider the utility of theoretical frameworks that guide the examination of motivation in this population.

401.024 *(Poster)* Dental Experiences of Autistic Adults in the United Kingdom

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Background: Previous research has suggested that autistic people have difficulty accessing dental care, due to sensory processing, anxiety and communication issues. To date, however, research on autistic people's dental experiences in the United Kingdom has focused solely on autistic children's experiences as reported by their parents. This study sought to better understand autistic adults' (aged 18 and up) dental experiences in the UK.

Objectives: This study looked at whether autistic adults report different dental experiences compared to those of non-autistic adults: what autism-specific challenges occurred when going to the dentist, what autistic adults reported as positive at the dentist, and what autistic people would like to improve about their dental experiences.

Methods: A questionnaire comprised of quantitative and qualitative questions was completed online by self-selecting autistic (n=37) and non-autistic adults (n=43) in the UK. Quantitative questions asked about dental satisfaction, dental anxiety (adapted from the Modified Dental Anxiety Scale, Humphris, Dyer, & Robinson, 2009) and experiences with patient-practitioner communication (adapted from the NHS Adult Dental Health Survey and the 2007 Health Information National Trends Survey (Cantor, Covell, Davis, Park & Rizzo, 2007; NHS, 2009)). Quantitative responses were analysed using Pearson chi-square tests and unstandardised residuals to identify significant differences between autistic and non-autistic respondents. Independent t-tests compared autistic and non-autistic adults' experiences on the satisfaction scale, and Cohen's *d* was used to calculate effect size on these items. Qualitative questions asked about autism-specific challenges at the dentist, what works well for autistic people and what would improve their experience. These responses were analysed using thematic analysis.

Results: Overall, the results demonstrated that autistic adults in the UK more frequently reported negative overall dental experiences than non-autistic adults. These appeared to be related to sensory atypicalities, communication difficulties and anxiety. Themes that arose from the qualitative data revealed that many autistic people dislike the sensory environment at the dentist, that they may feel misunderstood when they try to express a concern, and that anxiety about the dentist impacts their communication. Other themes were related to the importance of consistency in the dental experience, disclosure of autism at the dentist, and cost of treatment. Autistic participants recommended sensory environment adaptations, having longer appointments and accommodating for individual needs.

Conclusions: This study's findings highlight the importance of dentists working directly with autistic individuals throughout their careers, as one autistic respondent recommended, 'the only way to get familiar with autistic people is by interacting with autistic people'. This study also provides concrete recommendations for dentists to improve their treatment for autistic patients, including allowing pre-visits and being told ahead of time of what procedures involve.

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401.025 *(Poster)* Development and Validation of a New Suicidality Assessment Tool in Partnership with Autistic Adults.

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Background: Autistic adults are a high-risk group for suicide. Our systematic review showed no suicidality assessment tool had yet been validated in autistic adults. However, the Suicide Behaviours Questionnaire – Revised (SBQ-R), is a brief four-item, open source self-report measure, validated and widely used in general population suicidality research. Autistic people interpreted and responded differently to the items of the SBQ-R compared to the general population, suggesting that the SBQ-R needs to be adapted for autistic people.

Objectives: 1) to adapt the SBQ-R in partnership with autistic adults; 2) to explore the appropriateness and measurement properties of this adapted tool in autistic compared to non-autistic adults.

Methods: First, cognitive interviews with fifteen autistic adults co-produced adaptations to the SBQ-R to improve the clarity and relevance of the items. Second, 251 autistic adults (77 male, mean age = 41.9 years) rated the clarity, importance and provided qualitative feedback for each item in the original and adapted version of the SBQ online to inform further adaptations. Third, 289 autistic (80 male, mean age = 39.2 years) and 258 non-autistic adults (82 male, mean age = 41.3 years) completed an online survey including the original and adapted SBQ, autistic traits (AQ-28), Anxiety (ASA-A), Depression (PHQ-9), Social Camouflaging (CAT-Q), and Interpersonal Needs (INQ-15). Participants also provided feedback on the clarity and qualitative feedback on the original SBQ-R, and the final version of the adapted SBQ.

Results: Qualitative feedback from the interviews and two online surveys identified consistent interpretation and response issues with the original SBQ-R, and that the adaptations addressed these issues. These adaptations included simplifying multi-clause sentences, ensuring that scales were clear and captured the full range and intensity of suicidality, and making questions more concrete and less abstract. Exploratory factor analysis of the adapted SBQ supported a one-factor solution with excellent internal consistency in both autistic and non-autistic adults (alpha > .8). Multi-group confirmatory factor analysis showed that unlike the original SBQ-R, the adapted version was measurement invariant at the scalar level when excluding item two (Table 1). In the autistic group, the adapted SBQ significantly correlated with all other variables (autistic traits, anxiety, depression, social camouflaging, interpersonal needs, and original SBQ-R) (Table 2). The adapted SBQ was also more highly correlated with autism constructs (autistic traits and social camouflaging), than the original SBQ-R (Table 2). Adapted SBQ scores at time one significantly correlated highly with scores two weeks later (r = .815). A cut-off score of 12.5 on the adapted SBQ correctly classified 78.9% of autistic people who reported attempted suicide.

Conclusions: Results suggest that co-producing a new suicidality assessment tool in partnership with autistic adults, not only better captures suicidality in this group, but also addresses measurement differences between autistic and non-autistic people. This means that the newly developed SBQ-ASC can be used in future research to better understand suicide in autistic compared to non-autistic people.

401.026 *(Poster)* Diagnosis Disclosure in Employment and Academic Settings: Experiences and Attitudes of Young Adults and Their Parents

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Background: Young adults with autism (ASD) often face difficulties finding and maintaining competitive employment (Roux et al., 2015). Additionally, they may struggle with demands introduced by post-secondary academic settings (Anderson & Butt, 2017). Whether, when, and how to disclose a diagnosis are important decisions that, if answered thoughtfully, may contribute to success in employment and academic settings (Lindsay et al., 2019). Little research exists on this topic, which makes it difficult for stakeholders to make informed decisions.

Objectives: To qualitatively examine disclosure experiences and attitudes among young adults with ASD and their parents.

Methods: Participants were 21 young adults with ASD and at least one parent of each young adult (20 mothers; 4 fathers) who participated in larger study on the transition to adulthood. See Table 1 for participant demographics. All young adults had an IQ ≥ 70, an independent DSM-IV/5 ASD diagnosis, and all but one met criteria for autism/autism spectrum on the ADOS-2. We oversampled for young adults who had been employed consecutively for at least one year at some point during adulthood (n = 11).

Young adults and their parents completed separate semi-structured interviews about the transition to adulthood. The current analysis focuses on responses related to diagnosis disclosure in employment and post-secondary academic settings. Grounded theory methodology (Strauss & Corbin, 1990) was used to analyze interview responses.

Results: The conceptual model derived from grounded theory analysis is reported in Figure 1. The core concept was *Types of Disclosure*, which included full disclosure (immediate, delayed, and forced), limited disclosure (e.g., if needed for accommodations; if the recipient is trustworthy; mixed feelings resulting in mixed behavior), parent(s) disclosing for the young adult, and no disclosure. Five other main categories contributed to, or resulted from, the core concept: (1) *young adult attitudes*, (2) *parent attitudes;* (3) *uncertainty regarding disclosure;* (4) *professional advice,* and (5) *outcomes* (e.g., positive, negative, and surprise).

Conclusions: Participants reported diverse experiences and attitudes. Six young adults and most of their parents endorsed the importance of immediate, full disclosure. They believed that the young adult's autism would disclose itself, and/or that employers, coworkers, teachers, and peers would be more understanding if they knew the young adult had ASD. Multiple participants reported examples of forced disclosure, which resulted from settings tailored to individuals with disabilities. Nine young adults reported limited disclosure for a variety of reasons, including fear of stigma, fear of victimization, and feeling that their diagnosis was not relevant to success in the respective setting. Some parents reported conflict between attitudes (i.e., parent encouraging disclosure and adult choosing not to, or vice versa). A sense of uncertainty was also reported; participants believed the young adult would benefit from accommodations but expressed concerns about negative outcomes of disclosure (e.g., discrimination). Participants reported both positive (e.g., job recovery after being fired; meaningful accommodations; increased understanding) and negative outcomes (i.e., not being offered a job) of disclosure, although negative outcomes were rare. Two of the three participants who reported negative outcomes changed their disclosure strategy.

401.027 *(Poster)* Ecological Momentary Assessment of Physical Activity, Sedentary Time and Anxiety in Adults with Autism Spectrum Disorder

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Background: Participation in regular physical activity (PA) helps reduce anxiety in the neurotypical population, but there have been no attempts to use PA as part of a treatment approach for anxiety in people with ASD. Anxiety is one of the most common and debilitating co-occurring conditions in adults with autism spectrum diagnoses (ASD) and there are few, effective treatment options for this symptom. Research is needed to explore the potential of using PA participation as an adjunct treatment to alleviate anxiety in adults with ASD.

Objectives: The objective of this pilot study was to examine the relationship between PA, sedentary time, and anxiety in adults with ASD using a modified ecological momentary assessment.

Methods: Fourteen adults with ASD and anxiety (10 females; mean age = 28.9, SD = 8.5) were recruited via ASD support groups in social media. A Qulatrics self-report survey addressing PA (modified International Physical Activity Questionnaire), sedentary time, and anxiety occurrence and triggers (Ozsivadjian, Knott, & Magiati 2012) was delivered daily via text message to study participants at 8 pm for seven days. Participants with at least 3 days of valid responses were included in the analyses. Descriptive and correlational analyses were performed using SPSS and significance level was set at $p < 0.05$.

Results: 65 responses were included in the analyses. Median moderate to vigorous PA and sedentary times were 15 min/day (IQR = 52.5) and 540 min/day (IQR = 420), respectively. The most frequently reported anxiety triggers were specific fears and phobias (46.2%), confusion and worries about social and communication situations (41.5%), and too many demands or expectations (26.2%). Also, participants experienced frequent anxiety feelings during 3 – 5 pm (50.8%), 11 am – 1 pm (40%), and 1 – 3 pm (38.5%). Moderate to strong correlations were found between sedentary time and anxiety ($r_s = 0.34$, $p = 0.005$) and between moderate to vigorous PA and physical health satisfaction ($r_s = 0.61$, $p = 0.027$). Moderate to vigorous PA and sedentary time were also moderately negatively correlated ($r = -0.42$, $p = 0.001$).

Conclusions: Adults with ASD show low levels of daily PA and are highly sedentary. High levels of sedentary time are associated with anxiety in adults with ASD. Interventions that target reducing sedentary time, rather than PA, as a way to manage anxiety in adults with ASD warrant further study.

401.028 *(Poster)* Efficacy of Depression Screening Tools in Young Adults with Symptoms of Autism

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental condition that is characterized by challenges with communication and social interaction. Autism severity is associated with increased loneliness and symptoms of depression (Hedley *et al.*, 2018), indicating an increased susceptibility to depression in this population. However, depression in ASD is significantly underdiagnosed (Bitsika, 2015). High rates of undetected depression in people with autism could reflect the unique presentation of depression in this population, potentially associated with reduced insight into symptoms (Hill & Frith, 2004), as well as the lack of autism-specific diagnostic tools.

Objectives: This study tests the efficacy of depression screeners in a non-clinical sample of individuals with low or high rates of autism traits.

Methods: University undergraduates (n=173) ages 18-24 years old [*M(SD)*=19.8(1.3)] completed the Autism Questionnaire (AQ) and Beck-Depression Inventory-II (BDI-II). A total of 153 students completed the survey and endorsed paying close attention to the questions and instructions; of these, we also received 30 parent-report Adult Behavior Checklist (ABCL) scores describing symptoms of depression in their children. Analyses tested whether higher levels of ASD traits co-occurred with more symptoms of depression and also examined convergence of self- and parent-reported depression symptoms in individuals with higher versus lower levels of autism traits.

Results: Symptoms of autism and depression were significantly correlated, $r(153)=.35$, $p=.001$, such that participants reporting more symptoms and traits of ASD also endorsed more symptoms of depression; Figure 1. Child and parent depression scores were significantly correlated in individuals in the low ASD traits group, $r(17)=.53$, $p=.03$; in contrast, child and parent report were uncorrelated in the high ASD traits group, $r(13)=.10$, $p=.74$; see Figure 2.

Conclusions: Findings extend work (Hedley *et al.*, 2018) documenting increased rates of depression in ASD in a non-clinical sample of college students. Furthermore, self- and parent-reported symptoms of depression were less concordant for individuals who self-reported higher rates of ASD traits. That is, participants with more ASD traits perceived their own emotions and mental health differently than did their parents. This result is consistent with two possibilities: individuals with more ASD traits may have less insight into their own symptoms and therefore report symptoms differently; or parents may have less awareness of these symptoms in such individuals, because they are less sensitive to symptoms, because the individuals are less likely to verbalize their feelings, or because the experience of symptoms actually differs. These results do suggest a need for more examination of depression screeners for use in clinical ASD referrals. We are currently collecting additional data in a college group for more robust interpretation, as well as in a cohort of individuals with diagnosed ASD to determine whether the present results extend from ASD traits to frank ASD diagnoses.

401.029 *(Poster)* Emotion Dysregulation, Internalizing Symptoms, and Perceived Driving Difficulties in Emerging Drivers with and without ASD

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Background: Driving is central to independent living and autonomy in adulthood for adults with a disability or ASD (Cox et al., 2012, Schultheis et al., 2002). However, only a third of adolescents with ASD acquire drivers' licenses (Curry et al., 2018) and independent driving is not commonly included in the goals of transition planning (Huang et al., 2012). Many factors influence successful driving outcomes; specifically, emotional dysregulation can impair the ability to manage difficult driving situations (Trogolo et al., 2014). It is important to understand how young autistic drivers experience driving differently than their non-autistic peers since those with ASD experience higher rates of emotion dysregulation (Mazefsky et al., 2013).

Objectives: The current study's objective is to investigate perceived driving difficulty (DD), emotion dysregulation, and internalizing problems in emerging drivers with and without ASD, and how emotion dysregulation and internalizing symptoms relate to DD. We expected 1) greater DD and emotion dysregulation/problems in those with versus without ASD, and 2) a positive correlation between DD and both emotion dysregulation and internalizing symptoms in the whole sample.

Methods: Thirty-seven adolescents and young adults (65% male, age range: 15-24 years, n=15 with ASD) were recruited for a study of driving readiness in autistic individuals. Participants rated themselves on DD in 14 various driving situations and completed two questionnaires: Difficulty in Emotion Regulation Scale (DERS) and Depression, Anxiety, and Stress Scale (DASS). DD items were rated on a 4-point Likert scale from very easy to very difficult, and then averaged. The DERS assesses the recognition and management of negative affect resulting in a total sum and 6 subscales: Nonacceptance, Goals, Impulse, Awareness, Strategies, Clarity. The DASS assesses internalizing symptoms across 3 indices for a total sum and 3 subscale scores: Depression, Anxiety, Stress. For both questionnaires, higher scores indicated greater impairment. T-tests compared mean DD, DERS, and DASS between the ASD and non-ASD groups. Correlational analyses compared scores on the DERS and DASS with mean DD.

Results: Autistic participants scored higher than non-autistic on mean DD, DERS Impulse subscale, DASS total and DASS Stress subscale scores (Table 1). Higher total scores on the DERS and DASS, as well as all DASS subscales and DERS Nonacceptance, Goals, and Impulse subscales, were correlated with higher DD scores across the whole sample.

Conclusions: These findings highlight the important roles that emotion dysregulation and internalizing symptoms play in DD in emerging drivers with ASD. In particular, stress symptoms and dysregulation related to impulsivity may map onto mechanisms of over-reactivity to negative affect and begin to explain why autistic people face particular challenges when driving, since driving requires regulation of behavior in response to difficult driving situations. Future research could include caregiver-report data for a more comprehensive understanding, and a larger sample where mediational analyses can be conducted to understand if these symptoms explain DD in adolescents and young adults with ASD or if other driving metrics, such as interest in driving and licensure obtainment, contribute as well.

401.030 *(Poster)* Employee, Employer, and Job Coach Perceptions of the Importance of Specific Employment Support Services

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Background: The high level of unemployment of individuals with autism and/or intellectual disabilities (ID) in Canada (Statistics Canada, 2018) holds negative consequences for the individual and their families, as well as society at large. Conversely, employment can confer several benefits including greater self-confidence and development of a sense of community (Lindsay, 2018). Job coaching services offer a bridge to employment; employers identify them as the key facilitator for hiring a person with disabilities (Morgan & Alexander, 2005). Yet, little is known about how this support matters to employees with disabilities and employers.

We partnered with a non-profit organization, Action main d'oeuvre, that provides employment support to individuals with autism or ID, and their employers. We co-created a multiple case research study to investigate the impact and perception of their services. Ward, Dowrick & Weyland (1993) previously analyzed both employer and job coach perceptions of specific employment service components to recommend best practices for support. Scott et al. (2015) compared the perspectives of employers and adults with autism. To our knowledge, ours is the first study to incorporate three key perspectives: employee, employer and job coach.

Objectives: Examine how job coach support facilitates job placement and retention, and what the most helpful components are from employee, employer, and job coach perspectives.

Methods: Nine employee-employer-job coach triads (27 participants total) were recruited. Employees were adults with autism (n = 6), autism and ID (n = 1), or ID (n = 2). Triads completed questionnaires at two time points: (1) the month the employee started a new job; (2) three-to-four months after the start. We used a mixed-methods approach to explore the impact of job coach services, and its perception by all three members of the triad. This included (1) an evaluation of the employee rated by employer; (2) job satisfaction rated by employee; and (3) an evaluation of the importance of specific service components received. Specific components prior to job placement (Figure 1, rated by employee and job coach) and post job placement (Figure 2, rated by all three parties) were rated on a Likert scale reflecting perceived importance.

Results: With respect to pre-job placement services, both employees and job coaches rated all components highly. Ratings of employees and job coaches agreed highly, with two exceptions (see Figure 1). For specific service components post-job placement, ratings by all 3 parties (employees, employers and job coaches) were 3.5 or higher on the 5-point scale and often agreed highly. Exceptions are highlighted in Figure 2.

Perception of service components will be complemented by a detailed case analysis including triangulation of measures of the impact of employment support, from the triad's perspectives to highlight both the most beneficial practices, and factors that contributed to dissatisfaction/job loss.

Conclusions: Our data evaluating specific employment service components indicates that employees, employers, and job coaches find all services provided to be important. Analysis of areas of divergence can be applied to improve services. Detailed multiple case analysis will elucidate best practices and barriers to employment success.

401.031 *(Poster)* Evaluation of the Australian Modified Vocational Index for Adults with Autism (M-VIAA)

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Background: Autistic individuals are under-represented in employment and post-secondary education. Research is hampered by a lack of psychometrically valid instruments that asses the vocational activities of autistic people. This study examined the psychometric properties of an Australian modified version of the Vocational Index for Adults with Autism (M-VIAA), an assessment of vocational independence.

Objectives: Examine the psychometric properties of an Australian modified version of the Vocational Index for Adults with Autism (M-VIAA), an assessment of vocational independence.

Methods: Participants were 105 autistic and 106 non-autistic young adults aged 16 to 26 years recruited from the longitudinal Study of Australian School Leavers with Autism. Psychometric properties of the M-VIAA were examined by a) comparing scores between autistic and non-autistic participants, b) examining convergent validity with daily living skills, c) divergent validity with autistic traits, and d) change over time by comparing baseline and 24 month follow-up scores in autistic participants.

Results: Vocational independence was found to be significantly higher in non-autistic compared to autistic participants. No relationship was found between daily living skills and the M-VIAA, thereby convergent validity was not supported. There was a small but significant relationship between the M-VIAA and autistic traits, which was contrary to our prediction regarding discriminant validity. Scores on the M-VIAA remained stable over time for a sub-sample of autistic participants.

Conclusions: The present study provides preliminary support for the M-VIAA with some limitations. Construct validity was questionable as results were not supportive of the hypothesized relationships between the M-VIAA, daily living skills, and autistic traits. Our findings suggest the M-VIAA may not capture the complexity of vocational challenges of autistic people. There is a need for development of a new instrument that builds on the structure of the VIAA, but that is applicable across cultures and contexts, and provides a richer picture of the vocational activities of autistic people.

401.032 *(Poster)* Examining Fear of Negative Evaluation in Young Adults across a Range of Self-Reported ASD Symptomatology

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Background: Prior research has found that adults with autism spectrum disorder (ASD) are at a significantly greater risk of social anxiety than the general population (Seltzer, Shattuck, Abbeduto, & Greenberg, 2004). Fear of Negative Evaluation (FNE) operationalizes the cognitive symptoms of social anxiety, but there are limited empirical studies examining individuals with ASD in this domain (Capriola, Maddox, & White, 2017). However, there is evidence that self-awareness of social difficulties is associated with anxiety in individuals with ASD (Seltzer et al., 2004), and an acute awareness of their impairments may result in heightened anxiety (Capriola et al., 2017).

Objectives: Considering the role of self-awareness and perception in social anxiety and the need for further study of FNE in individuals with ASD, the current study seeks to examine the relationship between FNE and ASD in this vulnerable population. We hypothesized that increased ASD symptoms would be associated with increased FNE.

Methods: Participants included 119 young adults, (73.9% male; mean age=22.52, *SD*=3.987) presenting for social skills treatment through the UCLA Program for the Education and Enrichment of Relational Skills (PEERS®; Laugeson, 2017). PEERS® is an evidence-based, caregiver-assisted social skills program for young adults with ASD and other social challenges (Laugeson et al., 2015). ASD symptoms were measured using self-report scores on the Social Responsiveness Scale-Second Edition (SRS-2; Constantino & Gruber, 2012), and individuals were divided into three groups based on their scores. Those with scores ranging from 0-59 were categorized as the "Within Normal Limits" group; scores ranging from 60-66 were categorized as the "Mild ASD" group; and scores above 66 were categorized as the "Moderate-Severe ASD" group. FNE was measured using self-report scores on the Social Anxiety Scale (SAS) Fear of Negative Evaluation subscale (La Greca, 1999). All assessments were conducted at baseline prior to treatment. An analysis of variance (ANOVA) was conducted to examine whether individuals with higher self-reported ASD symptomatology would show greater FNE.

Results: Results from the ANOVA reveal significant variation in FNE scores across each of the three symptom profiles [$F(2,116)=14.657$, $p<.001$]. The "Within Normal Limits" group scored the lowest ($M=19.32$, $SD=7.84$), followed by the "Mild ASD" group ($M=25.06$, $SD=6.52$), while the "Moderate-Severe ASD" group scored the highest ($M=27.42$, $SD=6.56$).

Conclusions: Results indicate that as self-reported ASD symptoms increase, FNE also increases. However, FNE appears to level off at the highest levels of ASD symptoms, which is surprising considering that the literature suggests that increased awareness of social difficulties results in heightened anxiety (Capriola et al., 2017). One explanation for these results may be that they were obtained through self-report measures, which may reflect subjects' inaccurate appraisal of their actual symptom presentation as it relates to social difficulties and impairments. These findings raise questions about the role of self-awareness and perception in social anxiety in ASD, and suggest that other factors may be increasingly influential in driving social anxiety at higher levels of ASD symptoms. Further research is needed to identify and understand these factors in order to inform the development of more targeted treatment and interventions.

401.033 *(Poster)* Examining Physical Activity and Quality of Life in Adults with Autism Spectrum Disorder

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Background: When individuals with autism spectrum disorder (ASD) participate in exercise programs, research consistently indicates improvements in physical fitness levels, health, and a range of behavioral and social/emotional improvements (Sowa & Muelenbroek, 2012). Self-reported physical activity is also associated with quality of life in young adults with ASD (Hamm & Yun, 2019). While some have examined the relationship between subjective levels of physical activity and quality of life for adults with ASD, few studies have examined the relationship between objective measures of physical activity and quality of life.

Objectives: To (a) describe physical activity levels and quality of life and (b) examine the relationship between step counts and quality of life for adults with ASD.

Methods: Forty-three potential participants with autism spectrum disorder (ages 18–47) were recruited for this study. Of the 43 potential participants, 35 met inclusion criteria. Participants completed demographic and health information. Researchers administered the quality of life questionnaire, measured nonverbal IQ using the Leiter International Performance Scale-Third Edition, observed participants to determine severity of autism symptoms using the Childhood Autism Rating Scale-2 (CARS-2), obtained current height and weight measures to determine body mass index (BMI), and asked participants to wear a Fitbit Flex2 activity tracker for one week.

Results: The average BMI for participants fell in the overweight category (Mean = 29.1, SD = 7.6). Most participants were in the obese category, followed by normal and overweight categories. Overall, participant average daily steps were in the *low active* range (Mean = 6,981, SD = 3,480). Increased average daily step count was significantly associated with overall quality of life, controlling for age and nonverbal IQ ($r = .55$, $p = .001$). The quality of life competence and social belonging domains were associated with baseline step count ($r = .58$, $p < .001$ and $r = .35$, $p = .04$ respectively) and BMI ($r = -.42$, $p = .01$ and $r = -.43$, $p = .01$ respectively).

Conclusions: This study highlights the use of an objective measure of physical activity and provides support for increasing our understanding of the relationship between physical activity and quality of life in this population. Activity trackers are becoming a popular tool for measuring activity to promote positive behavior change. More than 80% of the sample recruited for this study accepted the Fitbit Flex 2. This finding adds to the limited body of literature on the feasibility/acceptability of using Fitbit trackers to measure step counts for adults with ASD (LaLonde, MacNeill, Eversole, Ragotzy, & Poling, 2014).

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401.034 *(Poster)* Exercise Among Adults with Autism: Frequency of Participation, Attitudes and Barriers

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Background: Children and adolescents with autism spectrum disorder (ASD) have low levels of physical fitness and are more likely to be overweight compared to typically developing children. This puts them at risk for health-related problems associated with inactivity, such as increased risk of obesity. Previous research on exercise in persons with ASD has focused more on children than adults but has demonstrated that exercise has a wide variety of benefits for all ages. We used the Theory of Planned behavior, which states that intent for actions is composed of the individual's attitude towards the behavior, subjective norms, and perceived behavioral control, as a model with which to study attitudes towards exercise and potential barriers individuals with ASD experience.

Objectives: The aim of this study was to examine participation in exercise, attitudes towards exercise, and barriers to participation among adults with ASD as compared to typically developing peers.

Methods: The Godlin-Shephard Leisure-Time Physical Activity Questionnaire (2011) was used to assess frequency of weekly physical activity. Kerner and Grossman's (2001) scales assessed fitness attitude, perceived expectations of others, perceived behavioral control, and desire to exercise. Finally, the Barriers to Physical Exercise and Disability survey (add author name, 2000) was modified to assess possible barriers to exercise participants may encounter. These measures were completed by a group of 30 participants with ASD (18-27 years old, mean 22) and 30 participants without ASD in a matched comparison group (18-28 years old, mean 21).

Results: Findings indicated that those in the comparison group participated in strenuous or moderate physical activity significantly more frequently than those with autism (p = 0.01), had significantly more positive attitudes towards fitness (p=0.001), greater perceived behavioral control over ability to perform physical fitness activities (p=0.006), and indicated fewer barriers to participating in exercise (p=0.017). There were no significant differences between the groups for intent to exercise (p=0.11) or their beliefs about others' expectations regarding their exercising (p=0.969).

Conclusions: These findings suggest that more opportunities to exercise are needed for adults with ASD, particularly given that many challenges including anxiety and stress, could potentially be attenuated through exercise. Within the context of the Theory of Planned Behavior, two of the three aspects of intent to exercise, those being attitude towards exercise and perceived behavioral control of exercise, were significantly weaker in the ASD group. Future research will be conducted to investigate ways to strengthen these aspects of intention in adults with ASD.

401.035 *(Poster)* Exploring the Diagnostic Disclosure Experiences of Autistic Individuals in the Workplace

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Background: The employment rate for autistic individuals in the UK is estimated at only 16% for full-time employment and 32% for any kind of paid work, compared to 47% for other disability groups (National Autistic Society, 2016). Autistic individuals struggle to find and maintain suitable employment, and those without intellectual impairment actually have a lower employment rate than those with an intellectual disability in addition to autism. These individuals often experience social communication differences and autism-related stigma in workplace situations, but may also want to ask for reasonable adjustments related to their disability. One of the biggest employment challenges for autistic individuals is deciding whether or not to disclose their diagnosis and, if they choose to do so, how and when they should disclose to their supervisors and colleagues. Studies on autism disclosure in the workplace are scarce, but even scarcer still is research that elicits the views and experiences of autistic individuals who have struggled with the decision to disclose during the recruitment process and at work.

Objectives: This study aims to answer the question, "What are the lived experiences of autistic individuals who have chosen to either disclose or not disclose their diagnosis while seeking or maintaining employment?"

Methods: Semi-structured interviews focusing on diagnostic disclosure were conducted with 24 autistic adults either over the phone, online, or via e-mail. Transcripts from the interviews were analysed by two independent coders using *thematic analysis* (Braun & Clarke, 2006).

Results: The themes that emerged from the analysis were those found to be common across interviews. Global themes include: experiences around diagnosis, struggle as motivation to disclose, challenges after disclosure, successes in the workplace, and disclosure as integral to autistic community and identity.

Conclusions: Several factors may influence an individual's decision to disclose their autism diagnosis while seeking or maintaining employment, and experiences surrounding disclosure may vary. The experiences of individuals who have gone through the struggle of choosing whether or not to disclose provide valuable insights about autism disclosure in the workplace, including both the successes and challenges resulting from disclosure.

401.036 *(Poster)* Exploring the Intersection of Gender Identity and Sexual Orientation in Autism Spectrum Disorder through a Patient-Centered Lens

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Background: Despite research suggesting a need for a better understanding of the key issues encountered by adults with autism spectrum disorder (ASD), there is a dearth of research on gender identity and sexuality in women with ASD. Moreover, little is known regarding the intersection of ASD, gender identity, and sexuality in terms of their needs and the outcomes of these needs being unmet. Research suggests that individuals identifying as Lesbian, Gay, Bisexual, Transgender, or Queer/Questioning (LGBTQ) are at increased risk for depression, suicidal ideations, and self-harm. Similarly, research has found that individuals with ASD are already at an increased risk of depression, suicidal ideations, and self-harm. Thus, females with ASD of intersecting marginalized gender and sexual identities are at an increased risk of mental health conditions and poorer health outcomes-to what extent is unknown.

Objectives: To engage females with ASD to create a better understanding of the issues encountered at the intersection of gender identity and sexuality in ASD, as well identify patient-centered ways to address their needs.

Methods: A Patient-Centered Outcomes Research (PCOR) design was used to build the infrastructure necessary to engage females with ASD ages 18-38 and identify future research responsive to their needs. Sampling procedures did not specify LGTBQ+ identification, but instead was inclusive to all females with ASD. Monthly engagement sessions were conducted over a 2-year time frame. Each session included 6-12 females with ASD for a total of 32 females (n=32). Sessions were audio recorded, transcribed verbatim, and analyzed by two independent qualitative researchers.

Results: Results highlight the unique needs of females with ASD identifying as LGTBQ. More than half (n=20) of the females identified as LGTBQ. All of the participants identifying as LGTBQ noted significant health disparities as a result of their intersecting gender identity, sexuality, and ASD diagnosis. The following themes were identified as significantly impacting the health and health outcomes of these individuals: insufficient training of providers on LGTBQ and ASD, mental health outcomes (e.g., isolation, depression, suicidal ideations) for those feeling unsupported, and the cost of having to see two or more providers (e.g., ASD-specific and LGTBQ-knowledgeable).

Conclusions: Little research has been conducted to understand gender identity and sexual orientation in ASD. Moreover, the limited research that does exist has focused on sexuality in males with ASD. Anecdotal evidence suggests that more females with ASD may identify as LGTBQ than expected in the general US population. However, the impact this intersection has on health and health outcomes is unknown. Thus, this two-year study provides initial insight from the patient perspective and ways to minimize health disparities within this group. Future research is currently being planned to better understand this topic, as well as a series of educational conferences to address the needs of females with ASD.

401.037 *(Poster)* Exploring the Social Cognition Network in Young Adults with Autism Spectrum Disorder Using Graph Analysis

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Background: Autism Spectrum Disorder (ASD) is characterised by an impairment in Social Cognition (SC). SC is a cognitive construct that refers to the capacity to process information about social situations. It is a complex network that includes distinct components. Exploring how SC components work together leads to a better understanding of how their interactions promote adequate social functioning.

Objectives: Our main goal was to use a novel statistical method, graph theory, to analyse SC relationships in ASD and Typically Developing (TD) individuals.

Methods: we applied graph theory to SC measures to verify how the SC components interact, and to establish which of them are important within the interacting SC network for TD and ASD groups.

Results: the results showed that, in the TD group, the SC nodes are connected; their network showed increased betweenness among nodes, especially for the Theory of Mind. By contrast, in the SC network in the ASD group the nodes are highly disconnected, and the efficient connection among the components, mediated by cognitive elaboration, is absent.

Conclusions: ASD adults have not developed SC competencies and functional communication among these skills. We suggest intervening in the development of SC skills in the early years of ASD children, using rehabilitation interventions; in this way, we could supplement their development of complex social skills and avoid their typical social isolation.

401.038 *(Poster)* Factor Structure and Psychometric Properties of the Brief COPE in Autistic Adults

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Background: Autistic adults may experience higher levels of stress and more frequent stressful encounters compared to the general population. However, research into coping with stress in the autistic adult population remains limited, with no standardised coping assessment tools validated specifically for this population. This is concerning as there may be intricacies to the experience of stress and coping that may be unique to autistic individuals. Evidence from non-autistic populations suggests that exposure to stressful experiences and how one copes with stress can have a substantial impact on well-being and mental health. Furthering our understanding of coping in autistic adults has the potential to allow new perspectives to be taken when considering the challenges many autistic adults face (e.g., in employment, personal relationships, and well-being).

Objectives: To explore the factor structure and psychometric properties of the Brief COPE in a sample of autistic adults. Utilising an age-matched sample of non-autistic adults, the factor structures for the two samples were also compared.

Methods: Total sample size was 420, comprising 255 autistic adults and 165 non-autistic adults, aged 15-80 years, recruited through two longitudinal studies. Coping behaviour and psychological well-being were measured using the Brief COPE, Patient Health Questionnaire-9 (PHQ-9) and the Warwick-Edinburgh Mental Well-being Scale (WEMWBS). Principal components analysis (PCA) with Varimax rotation was used to explore the Brief COPE factor structure in each sample. A score for each coping dimension identified was obtained using the sum of its constituent items.

Results: A six-factor model best represented coping responses in both groups, explaining 60.3% and 63.7% of variance in the autistic and non-autistic samples respectively. These factors were 1) Engagement coping, 2) Support-seeking coping, 3) Disengagement coping, 4) Substance-use coping (autistic sample)/Escapism coping (non-autistic sample), 5) Religious coping and 6) Humour coping. High internal consistency for these factors were found (α range: 0.75- 0.95 for autistic group; α range: 0.74- 0.89 for non-autistic group). While both samples had comparable factor structures, minor differences were noted. Self-distraction coping strategies loaded with Disengagement coping in the autistic sample, but with Engagement coping in the non-autistic sample. Substance-use coping, which emerged as a distinct factor in the autistic group, loaded with coping through denial in the non-autistic group, forming a factor more suggestive of Escapism coping. Relevant coping factors (i.e., Disengagement coping and Substance-use/Escapism) showed good convergent validity with the PHQ-9 (i.e., r = 0.673, 0.278 in the autistic group; r = 0.524, 0.286 in the non-autistic group) and divergent validity with the WEMWBS (i.e., r = -0.495, -0.196 in the autistic group; r = -0.445, -0.270 in the non-autistic group).

Conclusions: This is the first study to examine the factor structure of the Brief COPE in autistic adults. A six-factor structure with good psychometric properties was reported. Though there were differences (i.e., self-distraction and substance-use strategies) between samples that may be explored further, these preliminary indications about the compatibility of coping responses in autistic and non-autistic adults, suggest that the Brief COPE may be used to make comparisons between coping in the two populations.

401.039 *(Poster)* Factors That Influence Career Choice: Insights from a Participatory Study with Autistic and Non-Autistic College Students

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Background: Autistic individuals are *less* likely to obtain employment than people with other disabilities (Shattuck et al., 2012). Past research highlights environmental factors that keep some autistic people from succeeding in the workplace, including discrimination (Pfieffer et al., 2017). According to Antonak and Livneh (2000), autistic employees may feel isolated at work due to difficulties with social communication. Despite this challenge, autistic individuals have many strengths that can assist them in the workplace (Sperry & Mesibov, 2005). Little remains known about how possible strengths and challenges influence the career choices of autistic individuals. In addition, factors that shape the career goals of the growing population of autistic college students have been overlooked.

Objectives: To identify factors autistic college students consider before selecting a career and determine how autistic students intend to use their strengths to overcome challenges seeking work.

Hypothesis a: Autistic students will place more emphasis on helping others and passion for their interests as motivating their career goals than non-autistic students.

Hypothesis b: Autistic students will describe detail orientation and writing skills as job-related skills more than non-autistic students.

Hypothesis c: Autistic students will expect social skills, executive functioning, and discrimination to impact their success obtaining career goals more than non-autistic students.

Methods: Autistic college students and academics and non-autistic researchers collaboratively developed hypotheses and an online survey. Autistic students (*n*=85; 50.6% male; 64.0% White) recruited across multiple college campuses and non-autistic students (*n*=56; 35.7% male; 48.2% White) from a single-subject pool answered open-ended questions: Why is this job of interest to you? What skills do you have that could help you succeed in your dream job? What challenges might you face getting or keeping your dream job? Responses were coded after establishing reliability.

Results: Autistic and non-autistic college students expressed similar reasons for selecting a career (Table 1). Autistic students identified writing and pattern matching as skills that could help them get their dream job and discrimination, and social challenges and psychological difficulties as barriers that might prevent them from getting their dream job more frequently than non-autistic students did (Table 2).

Conclusions: Despite the stereotype that autism is defined by "fixated interests," both autistic **and** non-autistic students were guided toward their dream jobs by a passion for their interests and a frequent desire to help others. Although autistic students felt that their strengths in pattern matching and writing would help them obtain their dream jobs, they were also more likely to expect that discrimination, psychological, and social challenges would be barriers to obtaining their dream jobs relative to non-autistic students. These findings indicate that programs to help autistic university students obtain meaningful jobs should build from their strengths, should provide mental health supports and help adapting to workplace social norms, and should focus on combatting discrimination among potential employers and coworkers.

401.040 *(Poster)* Healthcare Utilization Among Transition-Age Youth with Autism Spectrum Disorder (ASD) in the U.S. Inpatient Healthcare Setting

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Background: Little is known about the healthcare utilization of individuals with autism spectrum disorder (ASD), particularly transition-age youth and young adults with ASD. Each year, an estimated 50,000 youth transition to adulthood in the United States. In addition to the expected health conditions associated with aging, young adults with ASD experience a higher number of medical and psychiatric comorbidities (e.g., seizures, anxiety, depression, sleep disturbances, gastrointestinal disorders, bipolar disorder) compared to young adults without ASD. Of great concern is how these medical and psychiatric comorbidities impact their overall health and health outcomes during transitioning and beyond.

Objectives: The objective of this study was to describe the healthcare utilization of young adults with ASD.

Methods: This study incorporated a cross-sectional design to explore the 2016 State Inpatient Databases (SID). Variables within the SID examined included the following: age (15-35), race, gender, diagnosis of ASD (ICD-10 codes F84.0, F84.2, F84.3, F84.5, F84.8, F84.9), admitting diagnosis, number of diagnoses (comorbidities), length of stay, mortality, and readmission.Descriptive statistics were analyzed for the following variables: age, gender, race, ethnicity, length of stay, chronic conditions, marital status, and readmission. Frequency data were analyzed to determine the types and frequency of admitting diagnoses.

Results: A total of 979,099 (n=979,099) patient encounters were explored in the SID. Within this sample size included patients with ASD (n=2822) and patients without ASD (n=976277). Significant differences existed between healthcare utilization in terms of age of healthcare utilization ($p < 0.0001$), length of stay ($p < 0.0001$), gender-based healthcare utilization ($p < 0.0001$), chronic conditions ($p < 0.0001$), marital status ($p < 0.0001$), and readmission ($p < 0.0001$). Of particular note were the significant differences in healthcare utilization during the transition to adulthood (ages 15-35), where a majority of individuals with ASD utilized healthcare during this time (66.86%) compared to those without autism (27.15%). Admitting diagnoses were classified categorically as Medical versus Psychiatric. Top 10 admitting diagnoses for those with ASD were depression, seizures, schizophrenia, bipolar disorder, suicidal ideations, sepsis, psychosis, impulse disorder, unspecified mood disorder, and pneumonia.

Conclusions: Findings of this study support existing research, indicating the reasons why young adults with ASD are being hospitalized. These included a high prevalence of psychiatric (e.g., depression, schizophrenia, suicidal, bipolar) and neurologic (e.g., seizures) conditions among other reasons. When compared to individuals with ASD being hospitalized to those without ASD, the top 10 diagnoses were vastly different between groups. Individuals without ASD were more likely to be hospitalized for common medical conditions (e.g., chest pain, sepsis) compared to those with ASD who were largely hospitalized for psychiatric conditions. These findings of high prevalence of psychiatric disorders is consistent with other studies and offers a better understanding of the various types of psychiatric disorders presenting on admission. Further research is needed to explore racial, ethnic, and socioeconomic status differences in healthcare utilization, as well as the impact these variables have on health outcomes. Future research is being planned with expanded datasets to increase the sample size of individuals with ASD.

401.041 *(Poster)* Heterogeneity in Adults with an Autism Spectrum Condition (ASC): Identification of Subgroups By Means of Community Detection

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Background: Autism spectrum condition (ASC) is often considered to be marked by heterogeneity, which complicates the search for causes and support for individuals with an ASC diagnosis. This led to the idea that different subgroups may exist in the population of autistic individuals with separate outcomes.

Objectives: We aim to identify homogeneous subgroups based on behavioral data in adults with ASC by means of community detection and testing of the subgroups' validity.

Methods: Questionnaire data were collected as part of a larger longitudinal study. The input for the community detection analyses are fourteen variables collected at T1: behavioral measures of ASC traits, demographic, and psychological characteristics. The officially preregistered analysis plan consists of six steps. Step 1: We determine subgroups in a training data set of N=167 adults aged 31 to 89 years with 62% males (113 ASC, 54 controls). Step 2: We repeat the community detection analysis for just the autistic participants to gain more insight into heterogeneity within ASC. Step 3: We compare subgroups based on the ASC sample on three measures not included in subgroup detection (i.e., external validation): cognitive failures, wellbeing and mental health problems. Step 4: We replicate our results from step 1 by determining subgroups in a test data set of at least N=470 additional participants. Step 5: We replicate our results from step 2 by determining subgroups only in participants with ASC in the test data set (i.e., N= 250). Step 6: We replicate our results from step 3 by comparing subgroups in the test data set on the aforementioned external validators. Thus, step 1 to 3 are exploratory, and step 4 to 6 are confirmatory.

Results: Step 1: Two distinct subgroups were obtained. Subgroup 1 includes mainly controls (98%) while subgroup 2 includes mainly autistic adults (79%). Step 2: Within the ASC group, three distinct subgroups were identified ($N_{subgroup1}$ =30 (27%), $N_{subgroup2}$=32 (28%) and $N_{subgroup3}$=51 (45%)). These subgroups did not differ in age, gender and educational level attained. Step 3: The ASC subgroups differed significantly on all three external validation measures. Participants in subgroup 3 experienced the most cognitive failures, mental health problems, and reported the lowest wellbeing compared to subgroup 1 and 2. Participants in subgroup 2 experienced the least cognitive failures, but experienced more mental health complaints than adults in subgroup 1. There were no differences in wellbeing between subgroup 1 and 2. The independent replication of these findings in step 4, 5 and 6 will be presented at the conference as data collection will be finished before February 2020.

Conclusions: Application of community detection on behavioral data, seems to result in identification of three distinct and valid ASC subgroups. If we replicate these findings, this would imply that knowledge regarding behavioral heterogeneity in ASC can be clinically meaningful when shaping support for autistic adults.

401.042 *(Poster)* High Functioning Autistic Adults in India: Their Narratives about Self

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Background: Autism remains a highly stigmatized condition, especially in a low income country like India. Even today many adults with high functioning autism continue to be undiagnosed and/or hidden. Even once the diagnosis is received, parents and therapists rarely disclose or share the diagnosis with the individuals with autism. So, what do our young people know about their autism? How do they perceive and understand themselves and their differences? Not many studies have explored this from the perspective of people with autism. The RAFIN Adult Study is the first to systematically examine adults with ASC in India.

Objectives: This paper reports initial data on explanations by high functioning adults about their similarities and differences and their understanding of the reasons behind them.

Methods: Thirteen high functioning adults with ASC were interviewed in their homes. The interactions with the adults were carried out through semi-structured interviews in the preferred language and lasted for about 2-3.5 hours. Amongst several other topics, individual's understanding of their own self, their perceptions of similarities and differences from others around them, the nature of these differences (if any), as well as the kind of support they may like were discussed. This data is a part of a larger study of 54 adults and their families in Delhi & NCR region where we spoke to adults and their families about their journey since receiving the diagnosis as well as plans for the future. The interviews were audio recorded and the transcriptions were Qualitatively analysed.

Results: Almost all participants had specific thoughts about how they were similar to and different from non-autistic people. The responses were categorised in various themes, such as concrete attributes, personality attributes, interests and preferences, specific skills, diagnoses, disclosure about diagnoses, strengths and limitations of being different.

Conclusions: In one of the first studies of adults with autism in India, the authors present self-reports of verbally fluent adults with ASC about their understanding of their similarities and differences. The study highlights that every person on the autism spectrum is aware of his/her differences – some of them recognised them as early as primary school. However, an understanding and explanation of this difference comes much later, if at all. Most participants in our sample needed further clarity in understanding their difference.

The study emphasizes the need for active involvement of people with ASC in all life aspects, including research and interviews, aimed at understanding their unique life experiences; need for development of self-report measures and interview strategies; and most importantly the process of disclosure of diagnosis to individuals with autism.

401.043 *(Poster)* How Much Do Disability Service Office Staff of US Higher Education Institutions Know about ASD, and How Do They Think about ASD?

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Background: While disability support office (DSO) staff are responsible for providing appropriate support, many academically qualified autistic students continue to experience difficulties on campus and drop out prematurely. If DSO staff members have accurate knowledge and positive attitudes about ASD, they may be more effective in providing a more inclusive environment, and autistic students may be more likely to disclose their disability and any related concerns. Therefore, this study will explore DSO staff members' attitudes and knowledge about ASD and potential variables that may be associated with their attitudes and knowledge about ASD.

Objectives: The purpose of this exploratory study was to assess DSO staff members' attitudes (attitudes toward autistic symptoms, levels of openness, and social distance from autistic individuals) and knowledge about ASD to address the following research questions:

RQ1. Among four blocks of putative predictors, including knowledge about ASD, contact, demographic variables, and institutional variables, which variables are unique predictors of DSO staff members' attitudes about ASD?

RQ2. Among three blocks of putative predictors, including contact, demographic variables, and institutional variables, which variables are unique predictors of DSO staff members' knowledge about ASD?

Methods: One hundred fifty-three DSO staff members completed a Qualtrics online survey (See Table 1 for demographic characteristics). Participants first completed the attitudes and knowledge surveys, which were administered in random order, and the quality and quantity of contact scales were then administered in random order. Items within each scale were also randomized. Four separate multiple regressions were also conducted, with scores on either Attitudes toward Autistic Symptoms, Openness, Social Distance, or Knowledge measures entered as the outcome variable. Predictors were entered by block into each regression model after addressing potential multicollinearity among the predictors.

Results: The means of the summed scores for the Attitudes Toward Autistic Symptoms, Openness, Social Distance, and Knowledge about ASD scales were 8.56 (*SD* = 2.84) 28.56 (*SD* = 3.22), 40.68 (*SD* = 5.13), and 64.26 (*SD* = 7.98), respectively, while the maximum score for each measure was 35, 45, 16 and 70, respectively. From the regression analyses (Table 2), staff members working at 4-year institutions more strongly believed that reducing autistic symptoms would benefit autistic individuals. Staff members with higher-quality contact with autistic people showed more Openness. Staff members with more positive and frequent previous contact, more accurate knowledge about ASD, and who worked at private institutions reported less Social Distance. Finally, staff members with more positive contact and working at institutions with higher average annual costs and a larger number of undergraduate students had more accurate knowledge about ASD.

Conclusions: The quality of previous contact was shown to be relatively consistently associated with Openness, Social Distance, and Knowledge about ASD, reinforcing the importance of high-quality contact. The underlying mechanisms behind the significant associations between institutional variables and attitudes and knowledge about ASD need to be explored. Understanding what kinds of institutional supports and context-appropriate training should be provided to promote collaborative relationships between DSO staff members and autistic students is a promising avenue for future studies.

401.044 *(Poster)* Hypermobility Spectrum Disorders in Mothers of Children with Autism

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Background: Evidence suggests links exist between autism and hereditary connective tissue disorders like Ehlers-Danlos syndromes (EDS)/hypermobility spectrum disorders (HSD), both in terms of comorbidity and familial overlap. In particular, we have found that approximately 20% of EDS/HSD mothers report having autistic children and that these mothers, compared to EDS/HSD mothers without autistic children, experience more immune symptoms. Therefore, in this study we have elected to investigate mothers of children with autism (with or without ADHD) vs. those with children who have ADHD to determine to what extent these two groups display symptoms indicative of hereditary connective tissue disorders like EDS/HSD.

Objectives: To determine whether differences in EDS/HSD-linked traits exist between mothers of children with autism vs. mothers of children with ADHD.

Methods: In this ongoing study, we have currently recruited 47 mother-child pairs from the Department of Developmental-Behavioral Pediatrics at Prisma Health in Greenville, SC, to participate. Mothers received a physical assessment involving the Beighton Scoring system, which is used to diagnose generalized joint hypermobility (GJH) in EDS/HSD and related conditions, as well as a supine-to-standing test, which addresses issues of orthostatic intolerance as measured by a sphygmomanometer (blood pressure, heart rate). Mothers were also interviewed for ongoing medical concerns, including chronic musculoskeletal pain/instability. Finally, mothers received three surveys: one that addressed immune, hormonal, and autonomic issues, and the Autism-Spectrum Quotient (AQ) and Social Responsiveness Scale-2 (SRS-2), the latter two which were used to estimate the Broader Autism Phenotype (BAP) within these populations.

Results: Although data collection is not yet complete, preliminary analyses indicate divergence between the autism and ADHD groups along the lines of body-mass index (BMI) ($p < 0.0001$) and hypermobility-associated musculoskeletal (MSK) pain and instability ($p = 0.0417$), with the autism mothers experiencing more problems overall. (BMI and MSK pain/instability did not share a significant interaction indicating the pain is unrelated to weight.) Within the autism group, hypermobility-associated MSK pain/instability was strongly associated with reported immune symptoms ($p = 0.0121$, $r = 0.5776$), although immune symptoms did not share a similar relationship with hypermobility in this group ($p = 0.2979$, $r = 0.2155$). MSK pain also was a negative predictor of maternally reported autistic regression in the child ($p = 0.0323$, $r = -0.3678$). Finally, autism mothers with lower AQ scores were more likely to report autistic regression in their children ($p = 0.0311$, $r = -0.4827$).

Conclusions: Though these data are extremely preliminary, they suggest a relationship may exist between maternal hypermobility-associated MSK pain/instability, immune disorders, and BMI and a child's risk for developing autism. Meanwhile, autistic regression appears to occur less frequently in families that already have a significant hereditary load (i.e., BAP), which has been reported previously. With further data collection we hope to continue to shed light on the potential relationship between hypermobility-related MSK pain/instability and immune disorders in autism families.

401.045 *(Poster)* Implementation Strategies to Maximize Inclusion of Young Adults across the Autism Spectrum in Social Network Data Collection

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Background: While decades of sociological research confirms that social networks provide critical social capital for seeking and securing employment, to our knowledge, few research studies in the field of autism have investigated how the social networks of young adults with ASD impacts employment (McGhee Hassrick et. al. 2017). Disconnection from institutional resources represents a significant loss of valuable social capital, defined as informal employment assistance for youth, post high school. We need more information about the social networks of youth on the spectrum. One key barrier is our lack of knowledge about how to successfully collect social network data from youth on the spectrum, including minimally verbal youth (approx. 25-35% of the ASD population; Rose et al. 2016) and youth with intellectual disability (ID) (approx. 31% of the ASD population; CDC 2018). While we have some data about how to successfully consent participants with ID (Hamilton et al, 2016) and assess minimally verbal populations with autism (Kasari et al. 2013), no studies have developed effective implementation approaches for collecting social network data from this population. For this project, we identified implementation strategies (Powell et al., 2011) to improve the recruitment, consent and participation of autistic youth in social network research.

Objectives: To maximize inclusion across the spectrum, we used implementation strategies to develop an inclusive process with 3 accommodation components. We then conducted feasibility pilots (n=16 young adults; n=5 minimally verbal and 13 with ID)) of the accommodation components to measure the social capital of youth on the autism spectrum.

Methods: First, we conducted a literature review of evidence-based practices to support the inclusion of young adults on the autism spectrum. Second, we partnered with a trained developmental psychologist who specializes in working with the ASD population to adapt our instruments based on our review findings and finalize our accommodation strategies. Third, we implemented our adapted strategies with pilot participants and iteratively revised and improved our accommodations through each pilot study, based on observation and participant feedback.

Results: We developed 11 accommodation strategies for recruitment, consent, and protocol implementation (see Table 1). The following implementation strategies (Powell et al., 2011) were utilized: Plan strategies (gathering info, selecting strategies, develop relationships); Educate strategies (develop materials); Restructure strategies and Quality Management strategies. All 11 strategies were utilized by pilot study participants at least once (Table 2). All participants utilized recruitment accommodations, revised language, and location choice. All MV participants with ID utilized adapted consents and pictures during the protocol, while no other groups of participants used these accommodations. Participants with ID across both studies utilized comprehension questions during the consent process and breaks/ reinforcements during protocol implementation.

Conclusions: When youth with ASD provide self-report, we can gain access to new knowledge about how to connect youth on the spectrum with opportunities for work or schooling in the first few years after high school. Implementation strategies for accommodations incorporated into the protocol allows young adults from across the spectrum to successfully provide self-report.

401.046 *(Poster)* Improving Outcomes of Preschool High Function Autism Spectrum Disorders in a Chinese Community：Protocol for the Social Cognitive Training Randomized Controlled Trial

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Background: Autism spectrum disorder (ASD) is characterised by impairments in social communication. Core symptoms are inappropriate daily social behaviours, including unable to interact with others in a socially expected manner, and effectively share space with others. There is a new sense of urgency to develop social treatments for ASD who are going to primary school. Social Thinking®, a framework based in social-cognition has broadly used in western culture, but there is no report in the Chinese ASD preschoolers. We designed a group intervention which is based on "WE THINKERS™" and combined with dialogic reading strategies for preschool high functional Autism spectrum disorders in a Chinese Community.

Objectives: It is designed to train individuals with ASD to facilitating social cognitive skills and social interactions among peers. We predict that the intervention will improve the social competence and undermine the underlying neuroscience mechanism.

Methods: The Social competence group intervention for preschool high functional Autism spectrum disorders is a preliminary, randomized controlled trial comparing the group intervention with await list control condition. 60 preschoolers (4–6 years) with ASD with a Full-Scale IQ between 70 and 130, and their parents will be randomly assigned (equally to intervention or the control condition) following baseline assessments. The 16-session intervention program comprises 16 half-hour home-based therapeutic sessions in two 8-week blocks, an outcome assessment.

Results: Primary outcomes are assessed with Autism Diagnostic Observation Schedule（social communication domain），ABAS-II(Communication domain and the Socialization domain)，Developmental Neuropsychological Assessment（emotion and TOM domain）;Secondary outcomes are assessed with questionnaires such as childhood autism rating scale, Behavior rating scale of executive function, strength and difficulty questionnaire social responsiveness scale and clinical global impressions scale and fnirs. The analyses will focus on evaluating the feasibility and preliminary effectiveness of the intervention.

Conclusions: A key strength of this robust study is the implementation of a group therapeutic framework that provides a standardized tailored approach for each child, with a focus on social competence in China mainland community. A framework based in social cognitive strategies, with appropriate linguistic and cultural adaptations, appears to be a promising tool for Chinese preschoolers with social learning issues and improve the social behaviours across school and home settings.

401.047 *(Poster)* Insights from Neurodiverse College Students in a Participatory Mentorship Program

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Background: As autistic students increasingly enter college, they often exhibit academic strengths (Bakker et al., 2019) yet face social, executive functioning and self-advocacy challenges (Elias & White, 2017). While autistic students are *less* likely to enroll in college than students with most other disabilities (Shattuck et al., 2017), they are *more* likely to *persist* in college than students *without* disabilities (Wei et al., 2013). However, little remains known about factors that support their *success*. Supports for autistic college students are often neither evidence-based nor informed by their perspectives (Barnhill, 2016). Although promising programs for autistic students have emerged (Kudder & Accardo, 2018), prior research has *not* provided sufficient opportunities for neurodivergent students to develop self-advocacy skills by guiding program development.

Objectives: Evaluate a *participatory* mentorship program in which neurodivergent students play leadership roles in developing, delivering, and evaluating programming.

Methods: Our no-cost program is designed for autistic students but open to those with other disabilities. Students can complete assessments for gift cards, but are under no obligation to provide data. Students choose to attend an hour per week of one-on-one mentorship, structured group meetings, or both. Group curriculum is selected/developed based on individualized assessments and group discussions. The highest ranked group needs this term were planning (M = 8.92 out of 10), communication (M = 8.68), and relationships (M = 8.52). In response to feedback, we added a half-hour of unstructured time prior to group meetings this fall.

Although our goal since program inception was for it to be participatory, becoming truly participatory took time. Sixteen students/alumni with disabilities (11 autistic) have become mentors thus far. An autistic student and an alumni with ADHD now lead group meetings. To better understand their new roles, they coded mentors' and mentees' open-ended responses (collected from Fall 2016-Spring 2018) to the question "How can we improve Project REACH?"

Our participatory research group also led development of a cross-institutional online survey, assessing QoL (ASD-QoL), camouflaging, self-esteem, belonging, and social support; 66 students from other institutions and 19 from REACH participated.

Results: Students in REACH reported higher QoL and reduced camouflaging relative to students from other institutions (ps < .03) but no differences in self-esteem, belonging or social support.

The most common recommendation for improving REACH was to broaden its structure and impact (e.g., start programs at other schools; 34.6% of responses expressed this theme), followed by providing more/better social support (20.5%) with a sub-code improving the mentor-mentee match (14.1%). Students expressed a desire to learn about more topics (15.4%; e.g., STEM; 3.8%). Some felt the curriculum could be more engaging (10.3%), while others felt the program was "good as it is" (30.8%) or were unsure how to improve it (10.5%).

Conclusions: By collaborating with neurodivergent students, we have developed a program that may promote QoL and self-acceptance. Students have gained valuable skills as mentors, researchers, and public speakers. Student feedback highlights the need for more strategic collaborations to develop participatory programming across institutions and research to develop more effective strategies for matching mentors and mentees.

401.048 *(Poster)* Machine Learning for Differential Diagnosis between Conditions with Social Difficulty

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Background: Differential diagnosis in adult cohorts with social difficulty is confounded by comorbid mental health conditions, common aetiologies and shared phenotypes. Identifying shared and discriminating profiles can facilitate intervention and remediation strategies.

Objectives: The objective of the study was to identify salient features of a composite test battery of cognitive and mood measures using a machine learning paradigm in cohorts with social interaction difficulties and assess whether youth and adults with Autism Spectrum Disorder (ASD), Social Anxiety Disorder (SAD) and Early Psychosis (EP) may be differentiated based on a set of composite features.

Methods: We recruited participants who met standardised diagnostic criteria for ASD: N=62, EP: N=48 or SAD: N=83 and compared them with a neurotypical comparison group (TYP: N=43). Using five machine-learning algorithms and repeated cross-validation, we trained and tested classification models using measures of cognitive and executive function, lower and higher order social cognition and mood severity. Performance metrics were the AUC and Brier scores.

Results: Sixteen features successfully differentiated between the groups. The control versus social difficulty cohorts were differentiated by social cognition, visuospatial memory and mood measures. Importantly, a distinct profile cluster drawn from social cognition, visual learning, executive function and mood, distinguished the neurodevelopmental cohort (EP and ASD) from the SAD group. The mean AUC range was between 0.892 and 0.915 for social difficulty versus control cohorts and, 0.731 to 0.777 for SAD vs neurodevelopmental cohorts.

Conclusions: This is the first study that compares an extensive battery of neuropsychological and self-report measures using a machine learning protocol in cohorts characterised by social difficulty. Findings are relevant for diagnostic, intervention and remediation strategies for these groups. They are particularly important in facilitating differential diagnosis in undiagnosed youth and adults with ASD compared to individuals with likely EP or SAD.

401.049 *(Poster)* Methods Matter: Why a Multivariate Approach Is a Fruitful Addition to Univariate Approaches When Investigating Cognitive Profiles in ASC Adults.

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Background: Researchers often define groups of people as “typical” or “deviant” and use mean-derived statistics to infer something about these groups. By doing so, known heterogeneity within a group is ignored. Autism Spectrum Condition (ASC) is a good example of this, as the cognitive heterogeneity seen in ASC is often observed, but not easily captured. This makes it challenging to define patterns of cognition in heterogeneous groups such as autistic adults.

Objectives: We have two goals (1) showing how univariate and multivariate normative approaches can be implemented in clinical research to detect differences between autistic and non-autistic adults on an individual level instead of on a group level; (2) assessing whether taking a multivariate approach is better at capturing cognitive variation in ASC.

Methods: Our pre-registered analysis plan consists of three major steps. Step 1: Comparing 111 autistic adults with a comparison group of ~220 adults (age range: 30-80 years) on 6 different cognitive tasks (11 dependent measures of visual and verbal memory, working memory, generativity, theory of mind and processing speed) using (a) univariate methods without familywise error correction- as commonly used in clinical practice- and with familywise error correction (i.e., multiple case series analyses) and (b) a multivariate normative comparison method in order to investigate entire cognitive profiles, instead of singular task performances. Step 2: Exploring whether we can predict which autistic adults show a deviant cognitive profile based on age, gender, self-reported autistic traits and psychological distress. Step 3: Repeating Step 1 and 2 in a replication sample of ~100 autistic adults.

Results: As data collection still continues (expected to be finished feb2020) we here used the full autistic sample, but only a subset of the comparison sample, N=118/220. In step 1 we observed no significant group differences in the number of univariate cognitive deviations using the uncorrected multiple case series approach. After correcting for familywise errors nearly all deviations disappeared in both groups. However, multivariately, we detected a distinct group of 31 out of 111 autistic individuals (29%) with a deviant cognitive profile, whilst in the comparison group only 5 out of 118 individuals (3,3%) showed a deviant cognitive profile. The deviating group of autistic individuals scored significantly lower on almost all cognitive measures when comparing them to the non-deviating group of autistic individuals. In step 2 we observed no significant predictors for these deviant cognitive profiles in ASC adults. Analyses based on the full comparison sample and the replication sample (Step 3) will be presented at INSAR 2020.

Conclusions: We have found preliminary evidence for a systematically lower performing group within our ASC sample. This group seemed to perform lower on most cognitive measures, yet this was only detected when using a multivariate approach and not when using univariate approaches which are commonly used in clinical practice. This shows the importance of using advanced statistical techniques to deal with the known heterogeneity within the autistic population.

401.050 *(Poster)* Narrative Orientation and Autistic Identity: Fiction As a Channel for Authentic Expression

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Background: Since the 1970s, autistic people have been assumed to lack imagination and to interpret things concretely, a premise that studies have borne out until recently (Wing & Gould, 1979; Low et al., 2009). However, the population from which these studies have drawn has primarily been children. More contemporary studies have noted that autistic individuals are in fact capable of imagination, and that prior observations of deficit may have overlooked nuances (Ten Eycke & Müller, 2015). Fictional characters may be exceptionally salient for autistic people (Grelotti et al., 2005) who may develop fictional alter-egos to deal with challenging situations (Williams, 1996). Fiction may also help people develop understanding of others (Kidd & Castano, 2013).

Objectives: This study, led by an autistic undergraduate honors student, examines the extent to which autistic individuals absorb and take on fictional personas as paths to self-realisation rather than camouflaging.

Methods: Autistic college students (*n*=18; M 60% White; 20% Female) were recruited primarily from a mentorship program. A non-autistic (*n*=197; 39.1% White; 60.5% Female) comparison group was recruited at the same campus. Through an online survey, students responded to questions: "I think about my life as a story," "I feel like the main character in my life," "I understand my life by reading about other people and/or characters," "I interact with others using fictional characters,” and “How often do you try to ‘camouflage’ or mask your autism in social situations?” (Cage & Troxell-Whitman, 2019).

Results: Autistic students (*M*=3.06, *SD*=1.59) reported more frequently interacting with others as a fictional character than non- autistic individuals (*M* = 1.61, *SD*=1.48; *t*(213) = -3.93, p<0.01). No differences between groups were observed in understanding life through stories or feeling like a main character. Among autistic students, interacting as a fictional character and camouflaging were unrelated constructs.

Conclusions: This study has important implications for understanding how autistic adults use fiction in their lived experiences. Autistic individuals were more likely than non-autistic individuals to use fictional personas to interact with others; having a fictional persona was a separate construct from camouflaging. This implies that imagination in autistic young adults has utility beyond its use in therapy or teaching social skills; if anything, fiction and imagination may be instrumental to the autistic young adult’s identity development, should they choose to nurse their interest in it. Though our questions didn’t focus on the causes of this phenomenon, I — an autistic young adult — can offer a few possible explanations. Intrinsic to fiction is a hypothetical, character-driven framework for social interaction. For some, this framework may be easier to engage with than real-time interactions laden with overwhelming sensory cues. Consumers of fiction may find characters’ thought processes to be more internally consistent than in reality, providing certainty in an arena where they normally find none. Fiction is also more accessible than social interaction: One need not be invited into a character’s story, whereas social relationships are governed by complex rules and social customs that one might consider arbitrary or confusing.

401.051 *(Poster)* Outcome Studies of Autistic Adults- Quantifying Effect Size, Quality, and Meta-Regression

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Background: Longitudinal studies of autism have sought to measure and predict the outcomes of autistic adults. Early accounts of outcome were based on clinician judgement; were often based on normative criteria (e.g. living a "normal" or "near-normal" social life); and generally indicated a poor prognosis for most autistic people. More recent studies with empirical criteria (e.g. does the autistic person have a job?) have likewise revealed poor outcomes from many (but not all) autistic samples. A recent meta-analysis of outcome studies (up to 2015; Steinhausen et al, 2016) identified a small proportion of good outcomes (19.7%), and a large proportion of poor outcomes (47.7%) for autistic people. However, this review did not examine the quality of outcome studies, not did it explore childhood predictors of adult outcome (e.g. IQ).

Objectives: To update the findings of Steinhausen et al. (2016), report on the quality of outcome studies and risk of bias, and examine the effect of childhood predictors in a meta-regression model.

Methods: The following databases were searched up to the 21st October 2019: CINAHL, MEDLINE, Embase, and PsychINFO. Search terms were generated by looking at keywords in previous reviews and existing outcome studies. Examples of search terms used: autis*, adult*, longitudinal*, and predict*. Example inclusion criteria were: studies reporting primary data (e.g. a study reporting empirical data), studies involving autistic adults (mean age 18+ at follow-up), and studies reporting a composite outcome score (employment/education, living status, friendships/relationships). For the meta-analysis a random-effects meta-analysis will be conducted, with inverse variance weighting of each study. The Q-statistic and T^2 will be used to examine the heterogeneity of the observed effect sizes; the I^2 statistic will be used to examine the proportion of variance that is due to true effects.

Results: 7,903 records were returned by the search strategy. After removing duplicates (N=3,815) 4,088 records were screened at the title and abstract level by the first author. From this, 49 records were carried forward for a full-text read through. Initial results have identified 15 papers that meet inclusion criteria. GS will perform a reliability check on a random 10% of the 4,088 records to establish reliability. DM and SC will be performing data extraction for the meta-analysis, and quality and risk of bias assessments. Both authors will compare findings to ensure reliability of effect size calculation for the meta-analysis.

Conclusions: Initial results from full text read throughs indicate that the proportion of good, fair, and poor outcomes is comparable to Steinhausen et al. (2016). Of note is the finding that newer studies (those published in 2017 and 2018) are exploring different variables that may be related to outcome (e.g. cognitive level factors). However, this review will add to the literature in two ways: the quality assessment and risk of bias will highlight to researchers the current strengths and limitations of existing outcome studies, and the meta-regression will examine the pooled effect size of childhood predictors of outcome (e.g. childhood IQ) since data from individual studies are often conflicting.

401.052 *(Poster)* Overweight and Obesity across Time in Young Adults with Autism Spectrum Disorder

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Background: Rates of overweight and obesity are higher in the ASD population than in the general population. Those with ASD face challenges that are risk factors for the development of obesity, including higher incidences of psychotropic medication use (which can cause weight gain), reduced physical activity sometimes related to motor or social difficulties, and food selectivity associated with sensory aversions or ritualistic patterns (see Hill, Zuckerman, & Fombonne, 2015).

Objectives: Using a longitudinal sample, we describe the rates of overweight and obesity across time to asses change throughout adolescence and into adulthood, as well as factors that might be associated with obesity, within our sample of young adults who have been followed since childhood.

Methods: 253 individuals, referred for possible autism at young ages, completed assessments including recurring height and weight measurements starting in early adolescence, again in mid-adolescence, and in adulthood. Height and weight measurements were converted to a Body Mass Index (BMI), which we used to classify the participants into one of four categories based on the CDC classifications: underweight, normal weight, overweight, and obese. Analyses here include BMI at three time points: early adolescence, mid-adolescence, and adulthood.

Results: In adulthood, 53% of our sample was classified as being overweight or obese. Repeated measures ANOVAs were conducted to examine change in adult BMI over time as a function of age and IQ. There was a significant effect of age, indicating increases in BMI from early adolescence to mid-adolescence ($p < .001$) and from mid adolescence to adulthood ($p < .001$; $F(2, 292) = 82.45$, $p < .001$). While there was no main effect of IQ, there was an interaction between age and adult IQ (VIQ >70 or ≤ 70), which indicated a significantly greater increase in BMI from mid-adolescence to adulthood for individuals with higher adult IQs compared to individuals with lower adult IQs ($F(2, 292) = 75.29$, $p = .01$, see Figure 1). Linear regressions revealed significant positive associations between adult BMI and the number of neuropsychiatric medications taken in adulthood ($\beta = .19$, $p = .003$), which remained significant after controlling for adult IQ ($p = .004$).

Conclusions: More than half of our adult sample was classified as overweight or obese, making clear that weight poses a prominent health problem for the individuals in our sample. Additionally, some unexpected changes in weight were observed. For example, BMI continued to increase throughout adolescence and adulthood, especially for those with higher IQs. Not surprisingly, however, is the association between neuropsychiatric medication use (common within this population) and overweight or obesity status. The prevalence of this health issue in our sample across time suggests the need for ongoing health monitoring well into adulthood.

References: Hill, A. P., Zuckerman, K. E., & Fombonne, E. (2015). Obesity and autism. *Pediatrics*, *136*(6), 1051–1061. https://doi.org/10.1542/peds.2015-1437

401.053 *(Poster)* Perceptions of Autistic Job Candidates: The Role of Verbal and Non-Verbal Communication

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Background: Autistic individuals experience significant challenges finding and maintaining employment, as evidenced by internationally low rates of employment and high rates of underemployment comparative to other groups. Although there is evidence that autistic individuals are perceived more negatively than their non-autistic counterparts (e.g., Sasson et al., 2017; Sasson & Morrison, 2019), few studies have explored this within an employment context (e.g., Cage & Burton, 2019). Further, while verbal and non-verbal behaviour is expressed differently among the autistic population (American Psychiatric Association, 2013), to our knowledge the role of these types of behaviours in employment has not been examined experimentally.

Objectives: To a) examine employment ratings of autistic and non-autistic job candidates and b) the relative impact of verbal and non-verbal behaviour on ratings.

Methods: Participants were 476 individuals (73% female, M_{age} 35.34, SD_{age} 11.44) recruited online. We examined participants' first impressions, ratings of employability, hiring decision and key word descriptions of autistic and non-autistic actors presented in 10s extracts of simulated job interviews. To examine relative impact of verbal and non-verbal behaviour, participants were allocated to one of three conditions (verbal, visual, combined).

Results: A main effect of group was found for first impressions, $F(1, 453) = 64.55$, $p < .001$, $\eta p^2 = .13$, whereby autistic individuals were rated more poorly than non-autistic. There was no effect of condition indicating ratings were similar between verbal, visual and combined conditions. There was a significant interaction effect between group and condition, $F(2, 453) = 6.45$ $p = .002$, $\eta p^2 = .03$; however, post-hoc tests failed to reveal significant differences. There was a main effect of group for employability, $F(1, 453) = 61.40$, $p < .001$, $\eta p^2 = .12$, with autistic individuals rated as less employable. There was no effect of condition, and no interaction effect. Overall, and within each condition, autistic individuals were 'hired' less frequently (148 times) than non-autistic candidates (317 times), $^2(2) = 6.75$, $p < .05$. The most common words used to describe the autistic candidates were 'nervous', 'confident', and 'awkward', while those used to describe non-autistic candidates were 'confident', 'scruffy', and 'passionate'.

Conclusions: Regardless of the type of information presented, autistic job candidates were given less favourable first impression and employability ratings and were 'hired' at a rate lower than their non-autistic counterparts. Further, differences were evident in the words used to describe the autistic candidates, with words tending to be more negative compared to non-autistic. These results provide further evidence of bias toward autistic job candidates suggesting disadvantage associated with traditional recruitment process and knock on effects for employment participation amongst autistic job seekers.

401.054 *(Poster)* Perceptions of Rude and Unattractive, Intrusive, Distant, and Autistic Behaviors on a First Date

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Background: Autistic individuals often express interest in being in a romantic relationship. However, most autistic adults are not currently in a romantic relationship (e.g., Strunz et al., 2017), often reporting anxiety and uncertainty about what behaviors are expected in a dating context.

Objectives: The study had two main objectives: (1) To assess how potential dating partners respond to a variety of dating behaviors in a first date context, with the goal of providing practical dating advice to autistic individuals and (2) To examine whether potential dating partners' biological sex and self-endorsed autistic traits affect their perceptions of dating behaviors.

Methods: Participants were recruited via Amazon's Mechanical Turk platform. After screening for inclusion/exclusion criteria, 236 participants remained in the final sample. Participants completed the Dating Behaviors Questionnaire to indicate their willingness to continue dating someone across 50 dating behaviors (e.g., "asks too many questions about you") and the Short Autism Spectrum Quotient (Allison et al., 2012) to index autistic traits. A principal components analysis (promax rotation) was conducted to determine the factor structure of the Dating Behaviors Questionnaire. Regressions were conducted with gender, autistic traits, and the interaction term as the independent variables and the components of the Dating Behaviors Questionnaire as the dependent variables.

Results: Four components were retained for the Dating Behaviors Questionnaire (see Table 1): Rude and Unattractive Behaviors ($\alpha = 0.94$), Intrusive Behaviors ($\alpha = 0.87$), Distant Behaviors ($\alpha = 0.85$), and Autistic Behaviors ($\alpha = 0.85$). The regression models (see Table 2) significantly predicted variability across all behaviors (Rude and Unattractive, $F(3, 232) = 13.90$, $p < 0.01$, Intrusive, $F(3, 232) = 37.00$, $p < 0.01$, Distant, $F(3, 232) = 6.37$, $p < 0.01$, Autistic, $F(3, 232) = 9.97$, $p < 0.01$). Compared to males, females were less willing to date someone displaying any of these behaviors, particularly intrusive behaviors (Rude and Unattractive, $t(232) = -3.90$, $p < 0.01$, Intrusive, $t(232) = -10.03$, $p < 0.01$, Distant, $t(232) = -2.39$, $p = 0.02$, Autistic, $t(232) = -3.54$, $p < 0.01$)). Individuals with greater autistic traits were more willing to date someone displaying Rude and Unattractive Behaviors, $t(232) = 3.96$, $p < 0.01$ and Autistic Behaviors, $t(232) = 2.23$, $p = 0.03$. In addition, females with greater autistic traits were more willing to date someone with Intrusive Behaviors, $t(232) = 2.40$, $p = 0.02$.

Conclusions: Females are more sensitive to unexpected dating behaviors than males, especially behaviors or conversations that seem overly intimate for a first date. Given that autistic individuals often express anxiety and confusion about appropriate dating behaviors (e.g., Strunz et al., 2017), these results suggest that heterosexual, autistic males may benefit from showing less intimate and intrusive, rather than more intimate and intrusive, behaviors in an early dating context. Also, individuals who are autistic or have elevated autistic traits may be more receptive to romantic relationships with other autistic individuals; such individuals, though, may have difficulty recognizing rude or inappropriate behaviors in a dating context, potentially leading to a heightened risk of sexual victimization.

401.055 *(Poster)* Prevalence, Incidence, and Prodromal Presentation of Dementia in Autistic Adult Medicaid Beneficiaries

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Background: Autistic adults now have the opportunity to live long lives in their communities, yet it is unknown whether autism spectrum disorder (ASD) confers increased risk for dementia. Known dementia risk factors—including depression, hypertension, hyperlipidemia, and diabetes—are elevated in autistic adults, and these factors may contribute to the emergence of dementia. Population-based epidemiological work is needed to clarify the extent of clinical dementia in autistic adults and assess prodromal risk factors.

Objectives: Our objective was to describe prevalence and incidence of dementia in autistic adults compared to adults with intellectual disability (ID) and to assess the impact of prodromal dementia risk factors (depression, diabetes, hypertension, hyperlipidemia) on incident dementia.

Methods: We assessed Medicaid claims for adults (≥21 years) who ever had two claims for ASD or ID on two different days during their Medicaid enrollment. Our sample included 3,336 autistic adults without ID, 2,524 autistic adults with ID, and 13,482 adults with ID. We excluded adults with Down syndrome because of the known link between Down syndrome and dementia. We analyzed claims from January 1, 2008 to December 31, 2018. Dementia claims were extracted from codes for any dementia from the Center for Medicaid Services Chronic Conditions Data Warehouse Condition Categories. We required ≥3 years Medicaid enrollment to ensure validity of dementia claims; therefore, beneficiaries entered our cohort at any point between 2008 and 2015. We categorized age at first claims by age group (<40, 40-54, ≥55) to account for confounding by age and compared dementia prevalence and incidence by diagnostic group using an age category-adjusted Poisson regression. Finally, we compared prevalence of prodromal risk factors (depression, diabetes, hypertension, hyperlipidemia) as identified in claims prior to incident dementia by group.

Results: We report descriptive statistics in Table 1. In adults aged 55 and older, 19.09% (N=61) of autistic adults without ID, 21.6% (N=132) of autistic adults with ID, and 24.9% (N=1,623) of adults with ID had claims for dementia. In the ASD groups, dementia was 0.48 times as prevalent (95% Confidence interval: 0.4, 0.6) in the non-ID compared to the ID group in an age-adjusted Poisson regression. Incidence did not differ between ASD without ID, ASD with ID, and ID groups in the 40-54 (log rank test P=0.06) or ≥55 age group (P=0.3). Prevalence of prodromal depression (45.7%) was highest in the ASD only group while prevalence of prodromal diabetes (26.9%), hypertension (49.1%), and hyperlipidemia (41.5%) were highest in the ID group.

Conclusions: While our interpretation is limited by reliance on claims rather than direct assessment and a lack of non-developmental disability control group, our findings from a state-wide health service system indicate that dementia is highly prevalent in autistic adults after the age of 55. High dementia prevalence in Medicaid beneficiaries with ASD underscores the need to develop dementia services and supports for autistic adults as they age and reside in Medicaid-funded assisted living and/or skilled nursing facilities. Findings also stress the need for exploration into how dementia manifests in autistic adults.

401.056 *(Poster)* Psychiatric and Medical Characteristics of Independent Adults with Autism in SPARK

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Background: SPARK is an online study of individuals with a professional diagnosis of autism and their family members. As of December 2018, 8,713 participants aged 18 years or older were registered in SPARK. 5,025 were registered as dependents by a legally authorized representative, while 3,688 registered as legally independent. A previous study described the psychiatric and medical characteristics of dependent adults with autism in the SPARK cohort (Fombonne & Green Snyder, in submission). This companion study examines medical and psychiatric comorbidities in independent adults with autism.

Objectives: To describe medical and psychiatric comorbidities in independent adults with ASD in SPARK.

Methods: Subject characteristics including ASD diagnosis and psychiatric and medical comorbidities were collected by self-report in 2,315 independent adult participants aged 18-85 years (M=34, SD=12). Medical screening data included factors such as birth or pregnancy complications, neurological conditions, growth conditions, vision or hearing conditions, and birth defects. Additionally, developmental diagnoses and psychiatric disorders also were used for analysis. Sex differences were examined using Chi square analyses.

Results: Participants were 56% female and 44% male, and the majority of the sample was of European ancestry (89%). Mean age of ASD diagnosis was 22 years. Estimates of income and education in SPARK (N=1,600) suggest 13% earn over $101,000 and 62% have completed at least some college. Almost half of the sample reported they were diagnosed with Asperger Disorder (49%), while 35% reported Autism Spectrum Disorder. Anxiety and depression were the most common psychological conditions occurring with autism and were reported in nearly half the sample (48% for each), followed by ADHD (39%), Social Anxiety (31%) and OCD (23%). Intellectual disability or delay was self-reported by 6% of adults, and history of speech/language disorder/delay or learning disability in 15% and 20% respectively. The most frequent medical diagnoses were neurological conditions (25%) and sleep disorders (25%). History of birth complications was 10%. Female subjects had higher levels of medical and psychiatric comorbidities overall, and frequently reported mood disorder or OCD (45%). Chi square analyses showed mood disorder, OCD, anxiety, depression, and sleep disorders all showed significant sex differences, with greater preponderance in females ($p<.05$).

Conclusions: The SPARK cohort provides the opportunity to investigate the profile of medical and psychiatric co-morbidities in a large cohort of adults with autism. It also permits us to examine the challenges unique to independent adults, who are often presumed to be higher functioning. Results suggest that independent adults with ASD are three times more likely to have certain mental health issues than the general population. Despite independent legal status, educational attainment, and a high rate of self-reported Asperger Disorder which is considered to have intact verbal and cognitive ability, there are some adults in this group that report cognitive, language and learning impairments. Limitations to the current study included potential sampling bias in terms of greater participation by females and Caucasians, and higher income levels than average. Further understanding of the extent of psychiatric issues in independently functioning adults with ASD will identify service needs for supporting the population.

401.057 *(Poster)* Rating the College Experience: Feedback from College Students with and without Autism Spectrum Disorder

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Background: Studies have shown that the transition into higher education for young adults with ASD can be a precarious life stage (Pinder-Amaker, 2014; Van Hees, Moyson, & Roeyers, 2015). Despite the potential to perform well, college students with ASD are at a heightened risk for academic difficulties during these years. As the number of students with ASD is expected to increase substantially in the upcoming years (Ames et al., 2015), it is imperative that we understand the challenges these students face.

Objectives: The primary objective of this study was to obtain information from college students with and without ASD about their college experiences.

Methods: Seventy students participated, 31 students with ASD and 39 neurotypical (NT) students (see Table 1 for demographic information). Participants with ASD were recruited through the accessibility office at the host university, a psychology participant pool, and through college ASD listservs. NT students were recruited through the participant pool and accessibility office. Following informed consent, participants completed a 5-point (1 = Strongly Disagree; 5 = Strongly Agree) Likert scale questionnaire with 39 items that tapped into students' experiences with others, their participation in extracurricular activities, and mental health. The survey was administered through a secure on-line platform.

Results: Mean ratings and the percent agreeing or strongly agreeing with a statement are shown in Table 2. Independent-samples t-tests conducted on the rating data showed a number of differences between the ASD and NT groups, $t(60 - 68) \geq 1.32$, $p < .05$. Students with ASD reported more difficulty interacting with their peers than NT students, whereas students with and without ASD did not differ in their ratings of their interactions with their professors. Students with ASD felt more isolated and desired more friendships. Although students with ASD felt that extracurricular activities were less accessible to them, they were also less likely to want to be involved in extracurricular activities. Students with ASD reported more anxiety and depression as a result of the social demands of college but showed fewer differences from NT students in terms of how they felt about the academic demands. Overall, students with ASD felt more negative about their college experiences than NT students (see Table 2).

Conclusions: A number of significant differences in the reporting of college experiences were found between students with and without ASD. Most differences centered on experiences with peers, feeling more isolated, and reporting more anxiety and depression due to social demands in students with ASD. These results are in line with past studies (e.g., Cai & Richdale, 2015). However, students did not differ in their ratings of their interactions with faculty and displayed fairly similar feelings associated with academic demands. Thus, the social aspect of college may be perceived to be more challenging to students with ASD than the academic demands, informing the type of support programs and assistance that may be most beneficial to students.

401.058 *(Poster)* Reconceptualizing Behavior Outbursts in ASD: The Role of Anxiety

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Background: Behavior outbursts are the leading cause of psychiatric hospitalizations for those with autism spectrum disorder (ASD) (Mandell, 2008) and relate to poor quality of life (QOL) (Chiang & Wineman, 2014). The majority of research has examined behavior outbursts in ASD as an indication of an externalizing behavioral disorder, with little research examining the potential for internal mechanisms (e.g., anxiety) as a potential driver.

Objectives: Caregiver survey data was used to examine the role of anxiety as a mechanism through which behavior outbursts occur and its impact on QOL in an intellectually diverse adult sample. The study examined whether anxiety is a mediator between an aspect of ASD symptoms (insistence on sameness) and behavior outbursts, and whether anxiety is a mediator between behavior outbursts and QOL.

Methods: A survey was completed by 274 parents or guardians of adults with ASD (20-58 years of age, *M* age=35.4, 80% male) Adults were diagnosed during childhood between 1970-2000. Caregivers completed forms assessing their adult's ASD symptoms (SRS-2), behavior outbursts (Reiss Screen for Maladaptive Behavior), anxiety (Anxiety, Depression, and Mood Scale), and QOL (QOL-Questionnaire). An insistence on sameness construct was created by summing 6 questions from the RRB scale of the SRS-2 (see Figure 1). Structural Equation Modeling (SEM) steps included: 1) Confirmatory Factor Analysis (CFA) to test the measurement model; and 2) Path Analysis to evaluate hypothesis model fit.

Results: CFA of insistence on sameness indicated that all items demonstrated significant factor loading (p's $< .001$) and that the measurement model indicated good latent variable model fit (see Figure 1). Path Analysis of hypothesis model indicated good model fit with significant direct relationships between insistence on sameness, anxiety, and behavior outbursts (p's $\leq .001$) (see Figure 2). Higher levels of insistence on sameness predicted higher levels of behavior outbursts and more anxiety. Higher anxiety predicted significantly higher levels of behavior outbursts. Insistence on sameness accounted for 41% of the variance in anxiety, and anxiety accounted for 43% of the variance in behavior outbursts. There was a significant indirect relationship between insistence on sameness and behavior outbursts through anxiety ($p < .001$), indicating that anxiety is a partial mediator between these two constructs. Additionally, insistence on sameness ($p < .001$) and behavior outbursts ($p < .001$) directly predicted QOL and predicted 24% of the variance in QOL, with higher levels of insistence on sameness and behavior outbursts associated with significantly lower levels of QOL. Lastly, there was a significant indirect relationship of insistence on sameness on QOL through anxiety and behavior outbursts ($p = .003$), indicating that anxiety and behavior outbursts are partial mediators between insistence on sameness and QOL.

Conclusions: The results of this study are the first of its kind to demonstrate the clear importance of anxiety in impacting behavior outbursts and QOL. Anxiety directly predicted more behavior outbursts, and behavior outbursts and anxiety were key mechanisms through which insistence on sameness decreased QOL. Results suggest the importance of treating anxiety as a potential mechanism underlying behavioral outbursts in adults with ASD.

401.059 *(Poster)* Relationship of Mental Health, Well-Being, and Problem Solving to Degree of Autistic Traits in Students Transitioning to University

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Background: A recent survey by the UK's National Union of Students found that high levels of stress and symptoms of anxiety and depression were reported by university students. For autistic students, the transition to university can be particularly challenging, with a disproportionate number dropping out in their first year. Higher autistic-like traits and a diagnosis of autism have been found to predict unsuccessful transition to university, as well as poorer well-being and mental health. However, higher autistic traits and autism have also been related to effective problem-solving within formal assessments which, in turn, is related to successful transition and positive well-being.

Objectives: This study aimed to investigate whether autistic traits in students transitioning to university could be predictive of mental health measures and problem-solving ability. We also sought to investigate to what extent mental health measures and problem solving abilities interacted with each other and autistic traits.

Methods: 114 new first-year students from the University of Bath (39 males, 75 females, mean age = 19, SD = 1) completed an online survey measuring autistic traits (AQ-28) and 4 measures of mental health including social anxiety (Liebowitz Social Anxiety Scale), well-being (The Warwick-Edinburgh Mental Wellbeing Scale), depression (Patient Health Questionnaire), and anxiety (Generalised Anxiety Disorder Assessment), and 4 visual-analogue scales including current stress, university satisfaction, coping, and problem-solving abilities, and finally a measure of problem solving orientation (Social Problem-Solving Inventory).

Results: Data were analysed by 3 multiple regressions, with total AQ as the dependent variable, and sex and IQ in step 1. In the first analysis with social anxiety, depression, anxiety, and well-being as predictors, higher autistic-like traits were related to greater depression (p = .017), anxiety (p = .033), and social anxiety symptoms (p < .001), with a trend toward lower well-being (p = .077), F(6,112) 10.74, p < .001. In the second analysis with the 4 visual-analogue scales as predictors, higher AQ was related to lower university satisfaction, p = .048, F(6,112) 4.33, p = .001 (other ps > .273). In the third analysis with social problem solving inventory total score as the predictor, higher AQ was related to lower scores, i.e., a more negative problem-solving orientation, F(3,112) 7.63, p < .001. A final analysis was conducted to further investigate this relationship, with scores on the social-problem solving inventory for positive, rational, negative, impulsive/careless, and avoidant orientations entered as predictors. Higher AQ was related to both negative (p < .001) and rational (p = .022) problem-solving orientations, F(7,113) 5.92, p < .001 (other ps > .137).

Conclusions: Our findings demonstrate poorer mental health and reduced university satisfaction in students with higher autistic traits transitioning to university, as well as poorer social problem-solving. Moreover, those with higher autistic traits were characterised by a negative, but rational, problem-solving orientation. Our ongoing research investigates the efficacy of a problem-solving intervention to improve mood and well-being in a randomised sample of the above cohort, and will examine whether negative problem-solving orientations may be reduced.

401.060 *(Poster)* Role of Polygenic Risk on the Association of Maternal Smoking in Pregnancy with Autism Spectrum Disorder and Attention Deficit Hyperactivity Disorder

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Background: Prenatal exposure to maternal smoking is considered neurodevelopmentally harmful. Evidence does not support a link with autism spectrum disorder (ASD), but for attention deficit hyperactivity disorder (ADHD), maternal smoking may be a risk factor, although many recent findings suggest genetic confounding of this association.

Objectives: To further elucidate the role of maternal smoking on neurodevelopment, we evaluated these associations in the context of inherited genetic liability using SNP-based polygenic risk scores (PRS) for ASD and ADHD. We addressed confounding by PRS given that smoking behavior is in part genetic, and also whether smoking-neurodevelopment links differed depending on PRS liability (interaction).

Methods: From iPSYCH, a population-based Danish case-cohort study of singleton births with known mothers residing in Denmark at age 1 year, we included births 1991-2005 when maternal smoking (any vs. none, obtained from the birth registry) was available. A 2% random subcohort sample comprised controls, and cases comprised persons with an ICD-10 diagnosis of ASD and/or ADHD in the Danish Psychiatric Central Research Registry prior to emigration, death, or December 31, 2012: 42,837 eligible persons. We excluded 22% due to missing smoking, genetic, or covariate data, yielding 33,769 analyzed.

PRSs were trained using the full iPSYCH sample, and built using LDpred with the infinitesimal model. We analyzed the dataset as a cohort study, estimating hazard ratios (adjHRs) up-weighting the subcohort, using inverse probability weighted Cox proportional hazard models, with bootstrap standard errors from 100 replicates to construct 95% confidence intervals and p-values. We adjusted for birth year, parity, inter-pregnancy interval, marital status, degree of urbanicity, the diagnosis-specific PRS, ten principal components for genetic ancestry and maternal and paternal: income, employment, education, immigration status, age, and any previous psychiatric diagnosis. We tested interactions between continuous PRS and maternal smoking.

Results: Maternal smoking in pregnancy was more common in ADHD (42% of 11,233), than in ASD (30% of 10,431) and the subcohort (26% of 14,703). When adjusted for covariates including PRS, maternal smoking in pregnancy was not associated with ASD (adjHR=0.97 [0.81-1.17], p=0.74), but was associated with increased risk of ADHD (adjHR=1.25 [1.10-1.43], p=0.001), We found almost identical results when not adjusted for PRSs. For ASD, our test of smoking*PRS interaction was suggestive albeit not statistically significant (p_{int}=0.087). Results within ASD-PRS strata were: adjHR=1.13 [0.88-1.46] for high ASD-PRS, adjHR=0.82 [0.65-1.05] for low ASD-PRS. There was no significant interaction for the ADHD-PRS and maternal smoking on ADHD (p_{int}=0.39).

Conclusions: Our results are consistent with a marginal effect of maternal smoking in pregnancy for ADHD, but not ASD. Alternate explanations include selection bias due to exclusion of 22%, or failure to fully account for genetic confounding by using diagnosis-related genetic scores. Although a smoking-ADHD association has been reported previously, some studies show the association can be explained by a failure to control for familial factors. Our finding suggests that a psychiatric PRS is not a proxy for these familial factors. Our observation that impacts of maternal smoking on ASD differed by inherited liability for ASD was suggestive but without clear, statistically resolved results.

401.061 *(Poster)* Social Participation and the Role of Family Relation According to Autistic Adults

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Background: Social participation results from multiple influences between a person's characteristics and their physical and social environment. It presupposes the full exercise of everyday activities and social roles (Fougeyrollas et al. 1998). Parents play an important role in young children and adolescents' social participation (Liptak et al. 2011) but little is known about their role in adulthood.

Objectives: This paper focuses on social participation as reported by autistic adults and aims to answer 3 questions:

- What are the expectations of autistic adults regarding their social participation?
- What are the facilitators and barriers to their social participation?
- What is the family's role regarding the person's desired social participation?

Methods: A qualitative research and interview method was conducted among 25 adults with autism (16 women, 9 men) aged 19 to 67 living in the Montreal area (Canada). The majority is employed or studying, 4 are parents and 11 are in a relationship. A thematic analysis with an analysis grid was conducted with N'Vivo software.

Results: Participants described their social participation in different ways like volunteering, employment, recreation, sports, participation in autism research, art, mutual aid, militancy, involvement in clubs, political parties or community organizations. Expectations: Being able to relate to others and meet new people without having to hide their autistic behavior is a shared wish. All want to see the potential and abilities of autistic people in employment better known and valued. Facilitators: The possibility of practicing activities or getting a job connected to their passions and interests emerged as a contributing factor to social participation and personal fulfillment. Also contributing were employment insertion, support services and peer social support on the web. Obstacles: Microaggressions, particularly in public transport and in classrooms, hinder everyday activities. Perceived lack of awareness of autism in the general population and stereotyped autism understandings from general service workers are major barriers in accessing employment, social services and medical care. Many said they experienced bullying at school or a situation of abuse that led them to "shut themselves out". Family's Role: The spouse is described as a central pillar of the successful realization of daily activities and the exercise of social roles by providing significant emotional support. More than half report strong ties to their families that promote recreational social participation and provide financial and domestic support. Participants with an immigrant background receive little support for social participation from their family back home. Others reported relational tensions with a parent or sibling, which had escalated during adolescence. The youngest said they felt constrained in their lifestyle choices and older ones said they had progressively moved away from "painful" family relationships.

Conclusions: This research contributes to a better understanding of Canadian autistic adults' expectations of their social participation. The results highlight the importance of raising awareness about autism and the heterogeneity of people's life conditions and situations, especially among health and social services stakeholder. Development of social policies must take into account that not all autistic adults receive support for social participation from their families.

401.062 *(Poster)* Some 'deeper' Issues to Consider for the Autism-Psychosis Diametric Model: Trade-Off Versus Co-Occurrence

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Background: The diametric model characterizes autism and psychosis spectrum disorders as two conditions that are etiologically and phenotypically diametrical, predicting opposing effects on functional outcomes. However, independent lines of evidence suggest that both conditions can lead to similar adverse effects in several domains affected by both conditions. Thus, the effect of their co-occurrence is commonly hypothesized to worsen functional outcomes.

Objectives: To test these two competing hypotheses, we investigated the combined effect of autism and psychosis on psychosocial and executive functioning difficulties, central features of both conditions.

Methods: In Study I, we investigated executive functioning using the Sustained Attention to Response Task (SART) in a total of 88 adults with autism spectrum disorder (ASD), schizotypal personality disorder (SPD), comorbid ASD and SPD, and neurotypical adults. In Study II, we examined the concurrent impact of autism and positive symptom expressions on psychosocial functioning in 174 patients with schizophrenia, as well as the impact of genetic risk factors conferring risks for both autism and schizophrenia in 139 healthy risk carriers. Psychosocial functioning was assessed using the Global Assessment of Functioning.

Results: In Study I, group analyses revealed better performance on the SART in the co-morbid group compared to the ASD- or SPD-only groups. Independent of diagnosis, individual difference analyses revealed better performance on the SART in individuals high on both autism and positive symptoms. In Study II, better functioning was observed in schizophrenia patients with balanced autism and positive symptoms. A similar effect was observed among healthy carriers of genetic risks that confer equal risks for autism and schizophrenia.

Conclusions: We show that co-occurring autism and psychosis, at both the dimensional and categorical level, can be associated with benefits in three different populations along the autism-psychosis spectra. The findings from the genetic data suggest that these influences are possibly mediated by the relative dominance of genetic risk factors associated with these conditions. Inter-individual differences in autism and schizophrenia may be better explained in terms of the relative dominance of risks/traits/symptoms associated with one disorder vis-à-vis the other, and that some individuals may present better functioning abilities due to a balanced expression of autistic and psychosis liability.

401.063 *(Poster)* The Change in Classification of Asperger Syndrome: An Exploration of Its Effects on Self-Identity

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Background: Changes in diagnostic frameworks have occurred with each revision of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*). Among the changes in the fifth edition (American Psychiatric Association [APA], 2013) is the elimination of Asperger's disorder (syndrome; AS) and its integration into autism spectrum disorder (ASD). Although scientific evidence supported this modification, the reclassification may have unintended effects. Specifically, there are people who strongly self-identified with and understood that they *are* AS because of their diagnosis (Giles, 2014; Singh, 2011). A clinical identity arises when someone self-categorizes and accepts the characteristics associated with the diagnosis as being part of the self (Charland, 2004). In some sense, the *DSM-5* may have implications for individuals whose identity is comprised in part by their diagnosis. Such self-identification and personal identity are often evident for those with AS partially because there is a community that also self-identifies that way.

Objectives: We explored the elimination of AS in the *DSM-5* with respect to personal identity implications that AS-diagnosed individuals associate with this change. Specifically, this qualitative study examined the identity-related opinions of adults with AS on what the elimination of AS means with respect to clinical identity.

Methods: Twelve participants previously diagnosed with AS completed a demographic questionnaire, the Wechsler Abbreviated Scale of Intelligence – 2nd Edition (Wechsler, 2011), and a 25-item semi-structured interview to ascertain their understanding, appreciation, opinions, and identity related to the changed diagnostic framework. Interviews were transcribed verbatim and analyzed via Thematic Analysis. Malterud's (2001) guidelines, considerations, and standards for conducting and reviewing qualitative research were implemented, as was a second coder, to enhance credibility and minimize researcher bias.

Results: Six primary themes (with several subthemes within each) were identified: (a) Derived meaning from their experiences with the disorder; (b) Knowledge and understanding about AS, Autism, ASD, and *DSM-5*; (c) Perceptions associated with labels; (d) Social identity; (e) Opinions regarding the reclassification of PDD and the *DSM-5*; and (f) Barriers to funding and service provision.

Conclusions: Many participants socially identified and self-categorized as part of the AS community; they derived personal meaning and identity from their diagnosis and the removal of the AS term threaten[ed] their identity. Many expressed concern regarding if they would meet criteria for ASD and described feeling stigma by being grouped with individuals with more severe symptomatology. They were also concerned about eligibility for education or employment supports if they did not meet criteria for ASD. Clinical self-identity was most apparent for those who received their diagnosis at least several years prior to the *DSM-5*; those more recently diagnosed described not having such an identity. Overall, although the APA states that those with AS should receive an ASD diagnosis (APA, 2013), it is the reported invalidation of an AS culture, loss of a clinical identity, and AS-related way of being that are central to this study's outcomes. As one participant explained, "it's not a matter of *what was done* but rather *what the diagnosis meant"* and the impact of this change that is of importance.

401.064 *(Poster)* The Impact of Vocational and Educational Disengagement on Autistic Young Adults' Quality of Life and Vulnerabilities

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Background: Successful transition to adulthood poses a challenge for many autistic young people leaving secondary education. In contrast with the general population, autistic people are over twice more likely to be classified as 'not in employment, education or training' (NEET) (Bancroft et al., 2012). Being NEET has wide-ranging implications, from poor mental health and suicidal ideation to low economic viability and limited independence in the general population (O'Dea et al., 2014). However, there is still more research needed on how disengagement impacts autistic young people specifically.

Objectives: The current study aims to explore how educational or occupational disengagement impacts autistic young people's quality of life and their vulnerabilities.

Methods: We recruited 16-25-year-old young people via the Cambridge Autism Research Database (CARD), social media and support groups. All data were collected using an anonymous online survey. Quality of life (QoL) was measured using the WHO-BREF questionnaire which distinguishes between physical, psychological, social and environmental QoL. The questionnaire has previously demonstrated acceptable psychometric properties in autistic populations (Mason et al., 2018). To evaluate young people's recent vulnerabilities, we developed a questionnaire jointly with the autistic community and professionals. This questionnaire examines social support, mental health, physical health, social isolation, illegal activities and abuse. Data analysis utilised multivariate and univariate analyses of variance as well as hierarchical linear regression modelling to determine how disengagement is linked to QoL and vulnerabilities.

Results: The online survey was launched at the end of September and has recruited 54 autistic young people to date. (NEET=17, Not NEET=37) Recruitment is ongoing until March 2020. Initial analysis of data showed that NEET status had a significant impact on physical QoL ($F=7.017$, $p=0.011$), psychological QoL ($F=4.231$, $p=0.046$) and environmental QoL ($F=6.984$, $p=0.012$), even after controlling for demographic variables and pre-existing vulnerabilities. In addition, the overall vulnerability score was also significantly impacted by NEET status ($F=8.533$, $p=0.005$) where those who were NEET, on average, exhibited higher vulnerability scores. Univariate tests on each sub-domain established that disengagement was significantly linked to domains of 'Social isolation' and ($F=6.567$, $p=0.014$) and 'Physical health' ($F=4.995$, $p=0.031$). Hierarchical linear regression was performed to gauge variables predictive of QoL and vulnerabilities, where NEET status and presence of multiple special needs were significant predictors of the overall vulnerability score ($R^2 = .196$, $p = .004$).

Conclusions: After adjusting for demographic variables and pre-existing vulnerabilities, we found that NEET status was significantly associated with worse physical, psychological and environmental QoL, indicating that NEET status affects the lives of autistic young people independently of other factors. We also found that being NEET negatively impacted young people's vulnerabilities overall. A limitation of this study is the low number of participant due to the survey's recent launch, which means that more data needs to be collected to confirm these preliminary results. Future work will examine how autistic young people compare to those with other special educational needs and those who are neurotypical in terms of their QoL and vulnerabilities after leaving secondary education.

401.065 *(Poster)* The Multi-Media Social Skills Program for Autistic Adults: Efficacy of Video Modeling and Peer Generalization Despite Differing Needs

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Background: Previous work has established that many autistic adults struggle to establish and maintain desired social relationships. Lipak and colleagues (2011) reported than half of their sample of 725 young autistic adults had not spent time or spoken on the phone with a friend in the past year. Increased social isolation is thought to be a significant contributor to mental health challenges. Shatayermman and colleagues (2009) found that in large cross-sectional study over 50% of autistic adults with mental health issues had recently considered suicide.

Objectives: This study adapted a successful social skills program for adolescents, The Multi-Media Social Skills Program (MMSSP), to adults. The MMSSP adolescent version utilizes video modeling paired with peer generalization; the curriculum and generalization experiences focus on conversation and interaction skills and demonstrated good efficacy for improvements in targeted skills, integration of verbal and non-verbal communication, and greater social impact. Objectives for the adult adaptation include similar increased use of targeted skills following intervention with generalization of these skills into community settings

Methods: Twenty-nine autistic adults and 26 NT adults were recruited for this study (see Table 1). Autistic participants were separated in to either Social Acquisition (SA; 48.3 percent) or Social Refinement (SR; 51.7 percent) tracts. The focus of the SA group was to gain new skills while the focus of the SR group was to fine-tune existing skills. Individuals were sorted into the tracts based on their cognitive abilities and life experiences. Individuals in the SA group generally had lower estimated intelligence, slower processing speed, more executive functioning challenges, and were less independent compared to individuals in the SR group. The two tracts received the same 16-week curriculum and video models with different teaching points highlighted depending on the skills level of the group. The two tracts also participated in the same peer generalization activities with differing skills practice opportunities identified and supported. All participants were videotaped in 5-minute dyadic unstructured conversations with a novel peer at pre-, post-intervention, and 3-month follow-up. These taped conversations were coded for a variety of verbal and non-verbal social behaviors using NOLDUS Observer.

Results: Over 85% of autistic adults who enrolled in the study successfully completed the 16-week intervention. Positive changes in simple and complex behaviors were noted at post-intervention and 3-month follow-up (see Table 2). During post-intervention feedback, participants listed the self-video models at the end of each 4-week module and the weekly peer generalizations during post-study feedback sessions as being most helpful.

Conclusions: Improvements occurred in social skills acquisition, maintenance, and generalization for participants in both tracts. The chief focus of this study was to determine whether adaptation of a social skills intervention for adolescents which utilizes video modeling and peer generalization would have efficacy for autistic adults. Assigning participants to differing tracts depended on their skills need(s) appears to have heightened the impact of this intervention. Additional work needs to be done to further explore potential modifications to the two tracts for even greater efficacy and potential unique impact of each intervention component.

401.066 *(Poster)* The Prevalence of Suicidal Behavior in Autism and Its Relationship to Psychotic Disorders

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Background: Lack of social integration, unemployment and psychiatric disorders have been found in adults with ASDs, the same factors that are also associated with suicidal behaviour, which could suggest a particular risk for suicide in those with ASDs. These factors may also be exacerbated by mental health problems, particularly psychotic disorders which co-occur more frequently than would be expected by chance.

Objectives: We aimed to investigate; whether people with ASDs had higher rates of suicidal behaviour and suicide when compared to people with no ASD; whether this was also the case in people with psychosis with autism traits; and further, whether the same pattern was shown in the general population.

Methods: We conducted several studies; a cohort design applied to nationwide register data in Denmark, a naturalistic study of individuals with first episode psychosis, and a study of autism and positive psychotic traits in young undergraduates.

Results: Our cohort study revealed that persons with ASDs had more than a three-fold higher rate of suicidal behaviour and suicide compared to those without ASDs. Persons only diagnosed with ASDs had an incident rate ratio (IRR) of 2.50 (95%CI:2.14-2.94), and those diagnosed with additional psychiatric disorders had an IRR of 9.55 (95%CI:8.89-10.26), when compared to those without ASDs. We also showed a significant relationship between the presence of autism traits and suicidal ideation in people with first episode psychosis, that was mediated through hopelessness. This pattern was also found in a sample of young undergraduates.

Conclusions: Our study is the first to show an elevated rate of suicidal behaviour and suicide in persons with ASDs in a nationwide cohort study. This elevated risk appears to be associated with psychiatric disorder, and perhaps with psychosis in particular. Several risk factors identified are different from risk factors in general population, which indicates the need for tailored suicide prevention activities.

401.067 *(Poster)* The Relation between Structural Learning, Short-Term Memory Span and Integration and Emotion Recognition in Children with Autism Spectrum Disorder

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Background: Following Perner (2000), Theory of Mind (ToM) and memory are closely related. Episodic memory is an important factor influencing ToM but ToM is also a pre-requisite for episodic memory in that remembering the past necessitates that somebody recognises something as experienced previously, which is provided by causal self-referentiality, which develops in typical children between 4-6 years. Individuals with Autism Spectrum Disorder (ASD) have consistently been reported to show difficulties with episodic memory (Boucher & Bowler, 2008), ToM and emotion recognition (Uljarevic & Hamilton, 2013). We have recently suggested that the fundamental mechanism underlying these difficulties in ASD is atypical structural learning based in the hippocampus (Ring et al., 2017). So far, there is only one study published showing difficulties in structural learning in ASD (Ring et al., 2017) and one on children is in preparation (Derwent et al., in preparation). In addition to the difficulties in long-term episodic memory, we recently showed difficulties in short-term relational memory in ASD adults (Ring et al., under revised review). Studies on children with ASD are lacking. Only few studies have so far tested the relation between episodic memory and ToM in ASD and show inconsistent results (e.g. Lind & Bowler, 2009).

Objectives: We aimed to test structural learning, short-term memory span, short-term memory integration and emotion recognition within the same sample of children with ASD to investigate potential difficulties in these processes and whether these are related to one another.

Methods: We used four tests for this study. In the structural learning test (Ring et al., 2017), children are presented with black and white mirror images of simple geometric shapes and are asked to learn three pairs over four blocks until a criterion. In Block 5, participants are presented with re-pairings of these images and their memory for the correct shapes is tested. In the short-term span test (Quinette et al., 2006), participants are presented with sequences of crosses in the cells of a grid and after having seen each sequence, they have to indicate the locations and the order of cross-presentation. In a short-term memory integration test (Quinette et al., 2006), participants are presented with coloured letters in the centre of a grid and crosses in the cells of the grid. They are asked to memorise the letters in the grid cells where the crosses of the same colours are presented and to recognize the letters in the correct cells at test. In the emotion recognition paradigm (Vetter et al., 2018), participants are presented with images of faces and have to indicate which of four emotions they see.

Results: So far we tested 16 children with ASD with an average age of 9,9 years (range: 8 – 12 years) and an average Intelligence-quotient of M = 77,5 (SD = 19,8, range: 51-108). Data collection is ongoing. There are significant positive correlations among all measures (r = .53 - .72).

Conclusions: We interpret results in terms of a general cognitive mechanism developing atypically in ASD underlying ToM and episodic memory difficulties.

401.068 *(Poster)* The Support Services College Students with Autism Spectrum Disorder May Need

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Background: More and more young adults with autism spectrum disorder (ASD) are pursuing a college degree. However, limited research has focused on this population as the number of the studies addressing the needs of these students is fewer than that of the studies addressing the needs of young autistic children. To assist college students with ASD successfully obtain a college degree, it is important to understand what support services they may need.

Objectives: This study was conducted to explore the support services that college students with ASD may need through examining their cognitive ability and adaptive skills.

Methods: All the universities that have students with ASD in Taiwan were contacted. A total of 30 Taiwanese college students with ASD (27 males and 3 females), including 12 individuals with Autistic Disorder and 18 individuals with Asperger's Disorder aged 18-23 years (mean = 20.13, SD = 1.28), participated in this study. The measures used in this study included: (a) Wechsler Adult Intelligence Scale, Third Edition-Chinese Version (WAIS-III-Chinese; Chen & Chen, 2002), and (b) Adaptive Behavior Assessment System, Second Edition-Chinese Version (ABAS-II-Chinese; Lu & Chen, 2008). The university counselors who had known the autistic students were trained by the researchers of this study to conduct the two assessments.

Results: On average, the college students with ASD in this study had average Full Scale IQ (FSIQ). None of these students had very superior, superior, or extremely low FSIQ. Verbal IQ was not significantly different from Performance IQ ($t_{(29)} = 2.31$, $p = .03$). Compared to the normed population, the autistic college students showed below average communication skills, low socialization skills, and below average functional academics skills. Functional academics was significantly higher than communication ($t_{(29)} = 3.96$, $p < .001$) and communication was significantly higher than socialization ($t_{(29)} = 4.07$, $p < .01$). The top three weakest sub-skills in communication were: "Takes turn talking during conversations with people is not too talkative or too quiet", "Talks about realistic future educational or career goals", and "Answers complex questions that require careful thoughts and opinions, for example, questions about politics or current events.". The top three weakest sub-skills in socialization were "Says when he/she feels happy, sad, scared or angry.", "Personally makes or buys gifts for family members on major holidays.", and "Refrains from saying something that might embarrass or hurt others." The top three weakest sub-skills in functional academics were: "Balance checkbook", "Reads classified ads for purchases and services.", and "Budgets money to cover expenses for at least a week."

Conclusions: The findings from this study suggested that there was a gap between intellectual ability and adaptive skills in college students with ASD. These students may need support services to help them improve their skills in communication, socialization, and functional academics.

401.069 *(Poster)* The Teaching Model: Academic and Functional Skill Outcomes of an Intervention through Continuing Education Among Adults with Low-Functioning Autism Spectrum Disorder

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Background: Very few studies have examined intervention programs aimed to advance knowledge acquisition and social-communication skills among adults with low-functioning autism spectrum disorder (LF-ASD). Applied Behavioral Analysis (ABA) has proved to be very effective in children with ASD, but the few studies to examine its effectiveness in adults with LF-ASD have primarily focused on adaptive skills and on decreasing challenging behaviors.

Objectives: -To establish an innovative teaching model (TM) for adults with LF-ASD in a classroom setting.

-To examine outcomes of this TM in knowledge acquisition of the taught subjects and in self-help, adjusted behavior, and social-communication skills.

Methods: The TM was based on ABA strategies and offered courses on music, photography, recognizing emotions, and geography. Topics were taught in small groups of 2-4 participants, for one hour twice a week for four months. In each class, social-communication, organization and self-help skills were practiced.

The study included 86 participants (males=61; females=25) with an age range of 22:0 - 57:6 years (M=34:6, SD=9:1 years).

All the participants were previously diagnosed with ASD based on their medical records and on current scores of the Social Responsiveness Score, and had Vineland Adaptive Behavior Scales scores <70 (LF-ASD). All currently live in sheltered residences for adults with LF-ASD. The TM group (n=66) was compared to a control group (n=20) that later also participated in the TM.

Outcomes of the TM and control groups were assessed by two measures designed for this research, including knowledge examination of the teaching topics and assessment of self-help, adjusted behaviors and social communication skills. Data were collected before (T1) and after the TM intervention (T2) for the TM group. For the control group data were collected at T1 (baseline), after four months without the TM intervention (T2) and after four months with the TM intervention (T3).

Results: First, we compared the T2 knowledge and skills scores between the TM and the control groups. Since T1 scores differed between the groups, we used them as covariates. The TM group, as compared to the control group, significantly increased their skills scores [$F(1,55) = 11.4$, $p = .001$, $\mu^{2=}.17$] and knowledge scores [$F(1,83) = 21.9$, $p < .001$, $\mu^{2=}.21$] from T1 to T2. In all the TM courses, the increase in the knowledge and skills scores from T1 to T2 was significant (repeated measures analyses). The control group did not show significant changes in these measures.

For the control group, a comparison of the two pre-intervention (T1, T2) and the post-intervention (T3) times revealed a time effect for the knowledge test [$F(2,14) = 15.9$, $p < .001$, $\mu^{2=}.69$] and for the skills test [$F(2,14) = 8.7$, $p = .001$, $\mu^{2=}.55$]. For both tests, scores were significantly higher at T3 than at T1 and T2.

Conclusions: The teaching model is an effective continuing education intervention for both acquiring new knowledge and for improving self-help, adjusted behavior, and social-communication skills. The improvements are noticeable in all the courses, regardless of topic. It appears that a specialized program, given in a structured learning environment while simultaneously practicing various skills, is very effective among adults with low-functioning autism.

401.070 *(Poster)* Trait Emotional Awareness in Autistic Adolescents and Young Adults

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Background: The transition from adolescence to adulthood is a significant period of change, marked by an increased expectation of independence, new experiences, and a decline in support. This period has been identified as challenging for autistic youth. Emotional awareness, which is the extent of an individual's ability to identify the emotional state of yourself and others, is a fundamental social skill used in everyday life. The Levels of Emotional Awareness Scale (LEAS) measures trait emotional awareness performance by assessing the complexity of open-ended responses to evocative scenarios and has been validated in non-autistic populations. While there are a growing number of autism-specific publications relating to emotional regulation; performance based emotional awareness has not been explored.

Objectives: The aim of this study was to determine the reliability of a modified, abbreviated LEAS (LEAS-M) and compare the level of emotional awareness of autistic and non-autistic individuals.

Methods: Individuals aged 15-25 years were invited to take part in the Study of Australian School Leavers with Autism (SASLA), which involved completing an online survey measuring a range of demographic and outcome variables. This study focuses on 85 autistic and 85 non-autistic control participants who completed the LEAS-M. The LEAS-M comprised of eight emotion driven scenarios that were modified to be more appropriate for young adults transitioning from high school. The LEAS-M was scored by two trained scorers who were blinded to the diagnosis of the participant. A random sample of responses (n = 57, 34.13%) were double scored to assess inter-rater reliability. The LEAS-M generates a Self and Other subscale score, and a Total score. To assess the reliability of the LEAS-M both intraclass correlations and cronbach's alpha were examined. Differences between autistic and non-autistic participants were assessed using Mann-Whitney U.

Results: Intra-class correlation coefficients [ICC (2, 1)] on double scored cases ranged between .98 - .99. For the autistic group, all cronbach's α coefficients were acceptable, Other (autistic α = .83), Self (autistic α = .70,) and Total (autistic α = .70). For the non-autistic group, cronbach's alpha was acceptable for both Other (α = .78) and Total (α = .70) but was low for Self (α =.55). Autistic participants scored significantly lower on Total score than non- autistic participants (U = 2457.5, p = .038). Autistic participants also scored lower on Other (U = 2247.5, p = .005), but there was no significant group difference on Self (U = 2775.0, p = .346).

Conclusions: The LEAS-M had excellent inter-rater reliability. The scale had acceptable internal consistency for the autistic group. However, the internal consistency for the Self score was poor in the non-autistic group, suggesting that the LEAS-M used be used with caution among non-autistic individuals. Exploring group differences, autistic individuals were comparable to non-autistic individuals when identifying their own emotions, but had more difficulty identifying the emotions of others. The difficulty identifying emotions in other people may be contributing to the challenges experienced by young autistic adults in navigating their transition into adulthood.

401.071 *(Poster)* Transportation Barriers and Community Participation for Individuals with Autism Spectrum Disorders

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Background: Individuals with Autism Spectrum Disorders (ASD) often face serious transportation challenges that impede healthcare access, community participation, and employment opportunities (Risser et al., 2015). One study identified that 72% of individuals with ASD missed at least some their desired activities due to lack of available transportation (Feeley, Deka, Lubin, & McGackin, 2015). Driving is not always a viable option due to the impact of the disability or financial resources. When it is available, public transportation provides a low-cost option that allows for independence to access services and community activities, although its use is often limited by barriers such lack of training and environmental factors. In order to identify and implement appropriate supports and services, it is essential to understand the barriers to public transportation use and the impact on participation.

Objectives: The objective of this study was to understand the types of supports and services needed to improve access to public transportation and reduce barriers for individuals with Autism Spectrum Disorders. Specifically, the study examined types of transportation used, barriers to transportation, and impact of transportation on community participation and employment from the perspective of individuals with ASD and their caregivers.

Methods: Researchers used a cross-sectional descriptive design. Self-identified adults with ASD (n = 158) completed on-line surveys using Qualtrics survey software to acquire information about basic demographics, transportation use, community participation, barriers to transportation, and other pertinent questions regarding their transportation use. Survey data was analyzed using SPSS**.**

Results: There were ninety (57%) men, fifty-seven (36%) women and seven (7%) people identifying as "other" who participated in the study. Participants had a mean age of 26 and represented all regions of the United States. Over 65% of participants reported that the use of independent transportation options would improve their quality of life and 73% reported that they would be more likely to use these transportation options if they had special training. The majority of participants identified that lack of transportation impacted their participation in the community (56%) and employment (52%). Barriers to the use of public transportation included: lack of transportation services or connections (41%); lack of knowledge on how to navigate transit system (21%); hours of operation (19%); expense (13%); safety concerns (12%); and lack of knowledge on how to use the system (12%). Additionally, results suggested a preference for self-reliance and self-efficacy, as the majority of participants indicated a need to reduce dependence on others for transportation.

Conclusions: This study identified important considerations in understanding participation and use of public transportation for individuals with ASD. Future studies investigating transportation barriers, community participation, and specialized transportation training are necessary to better serve this population and contribute to the lack of research in this area.

401.073 *(Poster)* Understanding How Social Anxiety and Empathy Impact Young Adults with ASD

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Background: Prior research suggests that individuals with autism spectrum disorder (ASD) often have higher rates of social anxiety (Bellini 2004) and lower levels of empathy (Baron-Cohen and Wheelwright, 2004) than the general population. Social anxiety may lead to social avoidance and decreased opportunities for social interactions (White & Roberson-Nay 2009), while deficits in empathy may make it difficult to understand and connect with others (Baron-Cohen & Wheelwright 2004). Though research on the independent effects of social anxiety and empathy with regard to people with ASD is prevalent in the literature, there is a dearth of research examining the relationship between social anxiety and empathy in individuals with ASD, especially among young adults.

Objectives: In this study we explored the relationship between social anxiety and empathy in young adults with ASD. We hypothesized that young adults with social anxiety would have lower levels of empathy.

Methods: Participants included 119 young adults (89 males) between the ages of 17 to 35 (M=22.42, SD=3.679) presenting for treatment through the UCLA Program for the Educational and Enrichment of Relational Skills (PEERS®), an evidence-based, caregiver-assisted social skills intervention for young adults with ASD (Laugeson 2017). All participants had clinically elevated ASD symptoms as determined by a caregiver-reported total score ≥ 60 on the Social Responsiveness Scale-Second Edition (SRS-2; Constantino & Gruber 2012). In order to assess the relationship between social anxiety and empathy, young adult participants completed the Social Anxiety Scale (SAS; La Greca 1999) and the Empathy Quotient (EQ; Baron-Cohen & Wheelwright 2004) at baseline.

Results: Pearson correlation coefficients were calculated to examine the relationship between self-reported SAS and self-reported EQ prior to treatment. Results indicate that there is a significant negative correlation between self-reported social anxiety and self-reported empathy (r(119) = -.329, p<.001), revealing that young adults who report higher social anxiety also report lower empathy.

Conclusions: Results support the hypothesis that young adults with ASD endorsing higher levels of social anxiety also tend to exhibit lower levels of empathy. One possible explanation for this finding may be that heightened anxiety, which may cause a hyperawareness of one's own internal state, may hinder an individual's ability to attend to cues related to another person's emotional state. Understanding the relationship between social anxiety and empathy may be important towards developing targeted treatments for this population. Future studies might examine the relationship between social anxiety and empathy across other developmental groups with ASD.

401.074 *(Poster)* Understanding Perceptions and Experiences of Autistic Undergraduate Students Toward Disability Support Offices of Their Post-Secondary Institutions

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Background: Despite the increased interest in the college experiences of autistic undergraduate students and research gathering their perceptions on a range of support services, few studies have examined how autistic students in the US utilize and perceive support services provided by disability support offices (DSOs) in higher education institutions (HEIs). A better understanding of their experiences with DSOs may aid in developing effective DSO services that cater to the specific needs of autistic undergraduate students.

Objectives: This study solicited college experiences of autistic undergraduate students to address the following research questions:

RQ1. How do students perceive their experiences with DSOs to have influenced their college experience?

RQ2. What patterns emerge among responses of autistic students who did not or do not receive DSO accommodations?

RQ3. How do autistic students perceive that DSOs could support them better?

Methods: This study qualitatively examined 27 autistic undergraduate students' responses to semi-structured interviews soliciting their perceptions of a range of support services provided by DSOs in US HEIs. Table 1 presents demographic characteristics. Two doctoral-level students were involved in the analysis of the interview transcripts. As an initial pass, structural coding was applied to create descriptive codes. Then, thematic analysis was conducted to examine overarching, emerging high-level themes from the descriptive codes.

Results: Participants appreciated receiving academic support coordinated by DSOs, such as extended time on exams or taking exams in separate locations; being housed in a single rather than a shared room; and having opportunities to meet other autistic students. At the same time, some students reported negative experiences with DSOs, including lack of helpfulness when professors refused to grant requested accommodations, lack of non-academic social support, DSO staff member's lack of autism knowledge, and their impersonal or delayed responses to autistic students' requests. Students who chose not to receive services reported they did so because they wanted to have a typical college experience, felt that they were academically competent without accommodations, overwhelmed by the complexity of the submission process, or did not believe that DSO services could properly support them, especially when their difficulties were not academic. Students indicated that DSOs need to organize events to increase autism awareness on campus, educate faculty and facilitate student-faculty communications, and address their susceptibility to sensory overstimulation by creating quiet spaces for them to calm down. Finally, students wanted DSO staff to provide more individualized services, opportunities to meet other autistic students or students with various disabilities.. See Table 2 for exemplary quotes illustrating each theme.

Conclusions: Most of the students' requests such as increasing institutional awareness, providing required faculty professional development, and creating sensory time-out rooms, cannot be fulfilled by DSOs alone. Institution-wide support and revised policies are necessary. The findings bear implications for ways in which all campus community members can collaborate to promote autism awareness on campus and improve college experiences for autistic students. Finally, ways to provide the needed supports during the registration process (e.g., peer mentors who already underwent the same process) need to be considered.

401.075 *(Poster)* Uniting Patients, Caregivers, and Stakeholders to Address Transitioning to Adulthood in Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is a lifelong pervasive developmental disorder with symptoms of communication deficits, social interaction impairments, and repetitive behaviors. Estimates reveal that ASD is the fastest growing neurodevelopmental disorder, currently affecting 1 in 59 children and more than 5 million Americans. In addition to the core symptoms of ASD, transition-age youth with ASD experience multiple medical and psychiatric comorbidities (e.g., seizures, gastrointestinal disorders, sleep disorders, depression, anxiety). Of great concern is how these medical and psychiatric comorbidities impact their overall health, health-care decision making, health outcomes, and quality of life during transitioning and beyond. Given that ASD emerges in early childhood, traditional research and interventions have largely focused on children with ASD. Thus, there is a knowledge gap on the complex transition needs of young adults with ASD and how or when to intervene.

Objectives: To form partnerships between patients and stakeholders to gain insight into challenges encountered during the transition phase of ASD and develop comparative effectiveness research (CER) questions alongside them to address these challenges.

Methods: A PCOR approach was used to develop research capacity, build infrastructure, and conduct future research responsive to the needs of transition-age youth with ASD. Young adults with ASD ages 15-40 and caregivers were identified using purposive sampling to participate in monthly engagement groups over 2 years. A diverse advisory board of patients and stakeholders met monthly to provide project guidance. Members of the advisory board included young adults with ASD, educators, caregivers, legislative experts, advocates, ASD researchers, clinicians, patient care coordinators, special needs trust lawyers, and housing experts. Meetings were audio recorded, transcribed, and analyzed for recurrent themes.

Results: This study identified seven key areas of transition in ASD (e.g., healthcare, self-advocacy, independent living skills, safety, career/job, social/relationships, and education) that have not been addressed in research from the patient and stakeholder viewpoint. Patients and stakeholders identified five CER questions to address these seven key areas of transition. Additionally, this study identified the presence of racial and gender differences present in the transition phase that equated to unique challenges and needs. As a result, an overwhelming number of gender, racial, and sexual minority adults with ASD participated in this study to ensure their unique challenges were known. A series of co-learning conferences brought together patients and stakeholders of various key areas to learn from each other (e.g., police officers, adults with ASD, caregivers, emergency medical responders). Lastly, patients and caregivers worked alongside ASD researchers to develop patient-centered database inquires to explore large datasets.

Conclusions: The transition from childhood to adulthood represents a tumultuous time for most, but especially for young adults with ASD and their families. This project demonstrates the importance of using a PCOR approach to unite underrepresented patients and stakeholders towards the common goal of identifying ASD transition needs and shaping future research responsive to their needs. Results of this study have the ability to generate future patient-centered research and potentially close the gap on transitioning to adulthood in ASD, as well as improve health outcomes.

401.076 *(Poster)* Utilizing the Information, Motivation, and Behavioral Skills Model to Examine the Associations between Autism Symptoms, Sex, and Dating Behaviors

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Background: Research has begun to examine whether people with ASD experience unique challenges in their pursuit of romantic and sexual relationships. Solomon et al., (2019) suggests that the Information-Motivation-Behavioral Skills (IMB) Model (Fisher et al., 1994) provides a useful framework for understanding the dating and sexual experiences of young adults with ASD (2019). While some published studies have looked at these three factors individually in this context, examination of the associations between and among all three factors of the IMB Model in the context of ASD has not been done.

Objectives: To investigate the associations among autism symptoms, information, motivation, and behavior as it relates to dating and sex in adults on the spectrum.

Methods: 15 adults with ASD (4 women; *M*=21.47±1.92 years) completed quantitative and qualitative measures assessing their knowledge, motivation, and behaviors related to sex and dating. All participants met criteria for ASD on the SRS-2 and the ADOS-2 and had IQ >70 (*M*=108.13 ± 20.7). The Knowledge of Sexual Health Questionnaire, Anatomy Vocabulary Test, and Perceived Knowledge Questionnaire measured information. The Sexual Activities questionnaire measured behavior. The Sexual Desire Inventory measured motivation in total, as well as desire for solitary and partnered activities. Additionally, adults (*n*=13) and their parents (*n*=11) participated in separate qualitative interviews about the adult's dating and sexual experiences. Interviews were audio recorded, transcribed verbatim, and coded using conventional content analysis.

Results: Pearson correlations between ADOS-2 scores (*M*=42.53, ±14.53) and total sexual vocabulary scores (*M*=11.27, ± 4.0), suggest that the relation between greater autism severity and lower knowledge approached significance, *r*(13)= -.507, *p*=.055. Correlations between SRS-2 scores (*M*=71.13, ±6.24) and total sexual desire (*M*=55.93, ± 27.24), suggest a trend between higher autism severity and motivation, *r*(13)= .45, *p*=.09. Total vocabulary scores (*M*=11.27, ± 4.0) and total solitary sexual desire (*M*=11.87, ± 5.475), were significantly related, *r*(13) = .543, *p*=.045. Autism severity was not related to sexual behavior (*p*=.92). However, most participants reported no exposure to situations in which partnered sexual activities would be possible. Only 27% of participants reported having ever been on a date and only 20% reported engaging in any type of partnered sexual activity. Participants reporting more experiences (sexual activity count, *M*=2.86, ±4.13) tended to have higher perceived knowledge of sexual activities (total perceived knowledge, *M*=3.67, ±1.35), *r*(12)= .477, *p*=.085. In qualitative interviews, participants cited social challenges as the largest obstacle that adults with ASD face when trying to pursue intimate relationships.

Conclusions: Data collection is ongoing, yet, even in this limited sample, autism severity was related to self-reported information, motivation, and initiation of intimate relationships—although unrelated to sexual or romantic behaviors. Reduced social engagement, a core feature of autism, appears to be a significant barrier to engagement in sexual and romantic relationships. This study will continue to collect data to more fully understand the social factors, social perceptions, cognitive abilities in the context of the IMB model. Understanding how the challenges encountered by adults on the spectrum impact dating and sexual health may improve future intervention efforts.

401.077 *(Poster)* Wellbeing in Autism Is Tied to Relationship Experience

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Background: Wellbeing in all individuals is desirable. It has been understood for some time that within the general population those with various protective factors, have improved subjective wellbeing. Among others, these protective factors include the presence of a meaningful romantic relationship. Autistic individuals have long been at a disadvantage in this regard, many having much greater difficulty in obtaining a relationship. However, it has not been clear that the presence or absence of a relationship has the same meaning or similar outcomes as it does for the general population.

Objectives: This study aimed to establish what were the proportions of autistic individuals who had experienced a relationship, and what impact this had upon their subjective wellbeing.

Methods: A total of 459 autistic (N=232) and typically developing (N=227) adults completed the SBS-III online, a validated and reliable measure of sexual behavior. Self-reported levels of romantic experience, sexual behaviors, and subjective wellbeing of non-autistic and autistic individuals were analyzed for female (Autistic N=111, M=26.16, SD= 8.71; non-autistic N=152, M=21.99, SD=4.59), male (Autistic N=95, M=24.35, SD= 7.50; non-autistic N=62, M=22.50, SD=6.57), and nonbinary groups (Autistic N=25, M=23.64, SD=5.70; non-autistic N=13, M=23.33, SD=5.37).

Results: Multiple regression analyses revealed that skills around socializing, formulation of a relationship, concerns about their future, having had a close romantic bond with another person, and the involvement of family in developing this relationship were predictive of between 16% to 68% of the variance of subjective wellbeing, depending upon group. Autistic individuals identifying as nonbinary gender had the least amount of variance accounted for (16%), while autistic males and females had more than 35% of personal wellbeing accounted for by these factors. Non-autistic individuals had between 49% and 68 % of variance accounted for.

Conclusions: These results indicated first that those with autism have their subjective wellbeing improved by having had a relationship. Further, these results also suggest worries about potential future relationships gives rise to concern and a reduction in wellbeing. Last, these results indicate the potential directions for support and assistance that will increase wellbeing among those with autism.

401.078 *(Poster)* "I Thought I Was Going Mad": We Need to Talk about Menopause in Autism

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Background: Within the general dearth of ageing research in autism, issues important to women are especially neglected. In non-autistic women, the menopausal transition is a time when women can experience debilitating or disruptive physical symptoms, and when incidence of physical and mental ill-health increase. Depression, anxiety and suicidality are heightened and cognitive abilities falter, with memory and executive function deteriorating. In this context, it is surprising and worrying that research exploring how autistic women cope with the menopausal transition is severely lacking. This raises serious concerns for a group who are already at heightened risk for suicide, mental and physical ill-health; who struggle with emotion regulation and coping with change; who may already struggle with executive function and other cognitive abilities; who may lack social support and the ability to communicate their difficulties; and who may be confront difficulties in access to healthcare.

Objectives: We aimed to explore existing knowledge of and support for the menopause in autistic women, to hear what challenges this time might pose for the female autistic community as a whole, and to explore themes that arose in personal experiences of autistic individuals (not all identifying as female) who were navigating or had completed the menopausal transition.

Methods: In a two-pronged qualitative approach, we conducted a synchronous online focus group with seven autistic individuals, who met in an online chatroom to answer questions posted by two moderators. These questionscovered the state of extant knowledge about menopause in autism; whether autistic people might experience menopause differently; what support exists and is needed; and what questions might guide future research. Thematic analysis of responses allowed us to derive individual interviews to explore physical and psychological experiences around menopause and the perceptions of autistic women regarding this life event. Seventeen participants (6 from the focus group, and 11 additionally recruited) took part in individual interviews, explored using interpretive phenomenological analysis (IPA).

Results: Themes interpreted from the focus group and interviews reflected a lack of professional knowledge, interest and support around autistic menopause, and a lack of menopausal knowledge among autistic participants. The menopause emerged as a time in which "the cracks in the mask started to appear"; sensory sensitivities were heightened while cognitive abilities declined; previously adaptive coping skills failed and self-care deteriorated; participants experienced heightened emotion dysregulation and, for some, suicide ideation and attempts. For some, the increased difficulties led to their late diagnosis as autistic.

Conclusions: The lack of menopausal awareness in the autistic community, the difficulties that participants experienced in communicating their difficulties and getting help, and the lack of knowledge from professionals suggest that the menopausal transition may be a time where the health needs of autistic women are especially unmet. These findings are stark in the face of the increased challenges and mental ill-health experienced by many participants. Participants emphasized the need for further investigation to raise awareness of the particular difficulties, and potential threat to wellbeing, faced by autistic people at this time of life.

401.079 *(Poster)* "Straight Sex Is Complicated Enough!": The Lived Experiences of Autistics Who Are Sexual Minority Orientation

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Background: Evidence suggests autistics may be more likely to identify as sexual minority orientation (SMO) compared to neurotypicals. Individuals living as a "double minority" at the intersection of autism and SMO may be more likely to experience discrimination, depression, and suicidal ideation. There has been a call to qualitatively explore the experiences of these individuals.

Objectives: To describe the lived experiences of autistics who are gay, lesbian, bisexual, asexual, or other SMOs.

Methods: In this descriptive phenomenology, a purposive sample of 67 adults who identified as SMO were recruited via online message boards and forums to participate in asynchronous online interviews. Responses were analyzed using Colaizzi's (1978) method. Interview transcripts were read and significant statements were extracted. Meanings for each statement were formulated and clustered to identify themes from the data. Themes informed an exhaustive description and fundamental structure of the phenomenon, which were shared with nine participants for feedback and verification of findings.

Results: Six themes emerged from the data. (1) ***"My self-identity is a fluid and flexible thing":*** **Self-acceptance is a multi-layered journey**: Participants described multiple stages in understanding their own identities and faced shame and discrimination about both autism and SMO.
(2) ***"It's hard to imagine things you've never experienced":*** **Autism complicates understanding of sexual identity:** Participants questioned the relationship between their autistic and sexual identities. Autism often increased initial confusion in recognizing sexual orientation. Some who identified as asexual described feeling invalidated by individuals who claimed that asexuality was caused by autism.
(3) ***"It's like getting an intrusive physical from a doctor":*** **Anxiety, sensory overload, and social stressors affect sexual expression:** Many described struggling with sex-repulsion, hygiene concerns, hypersensitivity, and/or discomfort with physical touch that complicated sexual relationships. Others viewed sex as less complicated than verbal communication and were more likely to engage in high-risk sexual behaviors.
(4) ***"It's hard for people to understand exactly how I feel":*** **Feeling misunderstood and misunderstanding others:** Many described feeling isolated from others due to a lack of shared cultural experiences surrounding dating. Many faced exclusion from both the LGBTQ+ and the autism communities.
(5) "***It's difficult to form relationships of any kind, let alone sexual ones":*** **Concerns about the ability to find mutually satisfying relationships:** Participants described challenges pursuing and maintaining relationships, reading romantic cues from others, expressing interest, and anxiety about meeting the needs of romantic partners. Some struggled to read intentions of others, increasing risk of sexual abuse.
(6) ***"I just don't know how to explain what I need":*** **Inability to effectively communicate intimate desires:** Some described difficulty identifying and articulating their preferences for sex and intimacy with partners, which decreased sexual satisfaction.

Conclusions: Findings provide insight into the essence of the experience of being SMO as an autistic. Individuals who use observation and mirroring behaviors as social strategies may struggle to understand dating norms due to lack of LGBTQ+ role models. Clinicians should be aware of the potential for high risk behavior and sexual abuse within this population.

Affective Neuroscience

POSTER SESSION — **AFFECTIVE NEUROSCIENCE**
402 - Affective Neuroscience Posters

402.001 *(Poster)* Atypical Fronto-Temporal Engagement in Processing Dynamic Faces in ASD

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Background: Facial expressions of emotion are an important source of social information. Autism spectrum disorder (ASD) is classically associated with poor emotional face processing skills and atypical neural processing has been implicated. However, most studies have used static faces and few have used more ecological dynamic stimuli to investigate neural process of emotional faces in ASD. We contrasted fMRI measures of dynamic emotional face processing in ASD compared with typically developing (TD) controls across a wide age-range.

Objectives: To determine a) if the processing of emotional faces differs between those with ASD compared to TD controls, and b) if the age-related trajectories of face processing differ between ASD and TD.

Methods: 168 ASD and 98 TD individuals from 5–42 years of age were recruited to participate, most from the Province of Ontario Neurodevelopmental Disorders (POND) network. Data were collected on a Siemens 3T MRI scanner. The fMRI stimuli were dynamic (480ms-long) emotional faces (neutral-to-happy, neutral-to-angry) and dynamic flowers (closed-to-open), presented in 18 pseudo-randomized blocks (6 each of happy, angry, flowers) of 13.5s. The data were slice-time and motion-corrected calculating framewise displacement (FD), and volumes with an FD>0.9mm were censored and the participants with >1/3 of volumes censored were excluded. Data were smoothed, intensity normalized, temporally filtered, and cleaned of signals from the white matter, CSF, whole-brain and six rigid body motion parameters, and further denoised with FSL's FIX. FSL's FEAT was used to obtain the brain response for each subject to the happy, angry and flower conditions. FSL's FLAME was used to investigate group-by-age interactions and group differences in the task condition contrasts, with sex and mean FD as covariates. Statistical images were thresholded using clusters determined by Z>2.3 and a cluster significance threshold of p_{corr}<0.05.

Results: When contrasted dynamic faces to dynamic flowers, significant group differences were shown in occipital and fusiform gyri regions. The activation to faces compared to flowers in these visual regions was reduced in the ASD group, suggesting that they processed faces and flowers similarly. In contrasting between two emotions (happy and angry), the ASD group demonstrated atypical processing in happy faces with an engagement of sensorimotor regions, including pre- and postcentral gyri and superior temporal gyri, while they showed increased activation to angry faces occipitally. Interestingly, regions which are known to be engaged in emotional processing, such as insula, temporal pole and frontal regions, showed increased connectivity strength with age in the TD group while, in contrast, the ASD group showed decreased connectivity with age.

Conclusions: Using dynamic stimuli, the present study demonstrated that the ASD group processes faces similarly to non-face stimuli at a neural level. The age-related atypicalties were more pronounced to happy faces, with decreasing recruitment with age of fronto-temporal regions in those with ASD, yet increased occipital recruitment to angry faces that did not change with age. Decreased functional connections in typical emotional processing regions in ASD suggested persistent difficulties over the lifespan.

402.002 *(Poster)* Differences in Neural Processing of Social and Nonsocial Fear in ASD Compared to Social Anxiety Disorder

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Background:

Adolescents with autism spectrum disorder (ASD) have higher rates of comorbid Social Anxiety Disorder (SAD) than other psychiatric disorders, with 42-85% of individuals with ASD also meeting criteria for SAD (de Bruin et al., 2007; Simonoff et al., 2008). Overlapping behaviors (e.g., deficits in social reciprocity, limited eye contact, and social avoidance) between ASD and SAD makes differential diagnosis difficult (White, et al., 2014). Currently, treatments are implemented based on diagnosis, despite potentially different fear learning pathways. However, it is unknown whether fear is learned the same in ASD as in SAD alone. Neural mechanisms of fear learning may provide tools to tailor treatments. The classic fear conditioning paradigm is well-suited to investigate mechanisms of fear learning.

Objectives: The purpose of the current project is to characterize the neural correlates of fear acquisition in adolescents with ASD+SAD, SAD alone, and neither condition (CON). The central hypothesis is that groups will show differences in neural pathways of fear conditioning.

Methods: Adolescents (N=57) completed this study, which included a diagnostic appointment (Table 1) and an event-based fMRI with two fear conditioning tasks, Social (face + scream sound) and Nonsocial (shape + startle probe). Conditions were counterbalanced within groups. Scanning was conducted on a Siemens 3T Tim Trio system outfitted with a 45 mT/m gradient system, 8 receive channels, and a 12 channel head coil. Slice time correction, motion correction, and spatial smoothing (Gaussian kernel with full-width-at-half-maximum of 2.0 × the voxel size) were performed on the data. Statistical models set the onset of event into a 2 (Event; paired conditioned stimulus (CS+), unpaired stimulus (CS-)) X 2 (Condition; Social, Nonsocial) X 3 (Group; ASD, SAD, CON) ANOVA.

Results:

Whole brain analyses revealed that groups differed in activation in Event type (CS+, CS-) by Condition (Social, Nonsocial) in the Inferior Temporal Gyrus (ITG; Figure 1). A follow-up Region of Interest analysis, with mean values of activation extracted from the ITG for Event and Condition, indicated the Main effect of Event (p = .009) and Condition (p = 0.005) were driving the significant activation observed (Figure 1). The ASD group exhibited greater activation in the Social condition for the CS+ compared to the CS-, and the SAD group demonstrated greater activation in the ITG in Nonsocial CS+ compared to the CS-. Accordingly, the ITG appears to differentiate anxiety to social compared to nonsocial stimuli in individuals with ASD.

Conclusions:

The current study found significant differences in neural responses in fear conditioned responses to social compared to nonsocial conditions across clinical groups in the ITG. In ASD, the temporal gyrus has consistently been hypothesized to relate to dysfunction in social information processing, including eye gaze, social attention, and language learning (Redcay, 2008). Given the increased ITG activation observed in the ASD group to the social fear conditioning stimuli, the ASD group in particular is likely at greater risk for dysfunction in this brain region. Results suggest that different neural pathways may exist for the development of comorbid ASD+SAD compared to SAD alone.

402.003 *(Poster)* Emotional Face Processing Differences in Autism Spectrum Disorder and Comorbid Attention Deficit Hyperactivity Disorder

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Background: Abnormal activity in the extended face processing system has been implicated in face processing challenges in autism spectrum disorder (ASD). However, the impact of comorbid attention deficit hyperactivity disorder (cADHD) on social impairment and the neural substrates underlying face processing has not been investigated.

Objectives: To address this question, we probed the extended face processing system by exposing children with ASD, cADHD, or typical development (TD) to a rapid fearful face and house paradigm using fMRI.

Methods: All study participants were administered the Kiddie Schedule for Affective Disorders (K-SADS). Autism participants who also met criteria for ADHD were assigned to the cADHD group. All other participants with autism were assigned to the ASD group. The Autism Diagnostic Observation Schedule (ADOS-2) was administered to confirm no TD children met ASD diagnosis. After excluding for excessive motion, 21 children with ASD (Age M (SD) = 10.3 (1.62)), 12 children with cADHD (Age M (SD) = 10.5 (1.75)), and 44 typically developing (TD) controls (M (SD) = 10.4 (1.36)) were included.

MR data were collected on a 3T Philips Achieva system. For the fMRI task, 54 volumes of high resolution data (2.3mm3) were collected. Participants were shown blocks of rapidly-presented (150 ms) fearful faces, houses and scrambled images. To ensure that participants were attending to the stimuli, they were asked to press a button every time the target stimuli appeared on the screen. Target stimuli appeared at pseudo-random intervals (average ISI = 6.13 s; range of ISIs = 2.50 s – 13.00 s). fMRI data were processed in FSL using standard processing methods including motion correction, spike artifact removal, high-pass filter of sigma=50s, and spatial smoothing (FWHM=5mm). Rigid body motion parameters and single point regressors were entered as nuisance regressors. We tested group differences in the contrast faces > houses. Higher-level group analyses were carried out using OLS and corrected for multiple comparisons using a corrected cluster significance threshold of $p < 0.05$.

Results: There was a significant difference between the ASD and cADHD groups on the ADOS-2 social affect domain (ASD M=7.71, SD=1.35, cADHD M=5.91, SD=2.23, $p<0.01$). Children with cADHD exhibited greater right superior temporal sulcus ($p < .001$) and prefrontal cortex ($p = .019$) activity than children with ASD for the faces > houses contrast. The children with ASD showed significantly greater activation in the cerebellum ($p = .001$). Qualitative comparisons indicated that the cADHD children exhibit hyperactivation to faces (cortical regions) and houses (cerebellum) compared with ASD and TD participants (see Figure 1).

Conclusions: These preliminary results indicate significantly altered brain activation during face and object processing in children with comorbid ASD and ADHD when compared to children with ASD alone or TD, suggesting a neurobiological difference underpinning transdiagnostic social difficulties. Further research with a larger group of children with cADHD is required to confirm these findings.

402.004 *(Poster)* Intrinsic Network Connectivity with Interoceptive Sensory Regions Correlates with Autism Severity

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Background: Each of us consistently receives a wealth of sensory information from outside and inside the body; our brain then decides which signals are most significant in any given moment. In particular, signals from within the body (i.e., interoceptive signals, such as heart rate, breathing, and hunger) often do not reach conscious perception, yet there is evidence that awareness of these sensations closely affects emotions and sense of self (e.g., Craig, 2003; Quadt et al., 2018; Palmer and Tsakiris, 2018). The salience network is thought to be centrally involved in allocating attention to relevant sensory stimuli; there is cross-sectional evidence for a developmental trajectory of hyper- to hypo-connectivity between the salience network and primary interoceptive cortex (posterior insula) in individuals with autism (Uddin, 2015).

Objectives: We aimed to investigate how autism severity relates to salience-posterior insular connectivity in individuals with autism spectrum disorder (ASD), compared to a neurotypical group.

Methods: N=28 individuals with ASD (ages 8-54) and N=45 neurotypical individuals (NT, ages 8-41) completed a resting-state functional magnetic resonance imaging (fMRI) scan. Subject-level networks were identified using independent component analysis and for each subject, the component with the highest overlap with Yeo et al.'s (2011) salience network map was selected. Functional connectivity between the salience network component and left and right posterior insula regions of interest (ROIs) was calculated by averaging the salience network component association score for voxels within each ROI. Nonparametric measures were used to assess correlation with autism severity as measured by the Social Responsiveness Scale, Second Edition (SRS-2) total scores. This association was also tested when covarying for intelligence quotient (IQ), age, and gender.

Results: Correlations between salience network-posterior insular connectivity and autism severity differed by diagnostic group. In the ASD group, salience network-posterior insular connectivity correlated with decreasing SRS-2 scores for both left and right insular ROIs (left: tau=-0.316, p=0.046; right: tau=-0.345, p=0.030). In the NT group, salience network-posterior insular connectivity did not significantly correlate with SRS-2 scores (left: tau=0.225, p=0.093, right: tau=0.094, p=0.485). While IQ, age, and gender were not significant predictors of salience network-posterior insular connectivity in either group, the correlation between salience network-posterior insular connectivity and SRS-2 scores in the ASD group was attenuated when these variables were included in the model (left: coefficient=-0.06, p=0.118; right: coefficient=-0.089, p=0.057).

Conclusions: Only the ASD group showed a significant correlation between salience network-posterior insular connectivity and autism severity ratings. This suggests that there might be diagnostic group-specific relationships between interoceptive processing and social functioning. Particularly, greater interoceptive neural processing may benefit social functioning in ASD, potentially relating to increased emotional or self-awareness. However, the lack of correlation in the NT group suggests that there may not be additional gains from greater interoceptive processing when social skills are typical. While age effects were not significant in our model, future studies may use longitudinal designs to disentangle how autism severity interacts with interoceptive processing across development. Overall, these findings support that the neural circuitry for interoceptive processing is linked to social functioning in ASD.

402.005 *(Poster)* Neural Processing of Emotional Faces in Youth with Autism: Effects of Sensory Distracters and Priming with Own Emotional Expressions

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Background: Autism spectrum disorder (ASD) is characterized by deficits in social interaction, which relies on the ability to process emotional expressions. Individuals with ASD often show atypical neural activation during emotional face processing even in the absence of behavioral deficits (Harms et al. 2010). Individuals with ASD also show high rates of sensory over-responsivity (SOR), which has been associated with social deficits both behaviorally (Glod et al. 2015) and neurobiologically (Green et al. 2017). However, our prior work showed that directing attention to key social cues led to children with autism engaging medial prefrontal cortex (mPFC) and maintaining activation in social processing regions despite sensory distraction (Green et al., 2017). Additionally, while higher autism traits in neurotypical adults have been associated with slower identification of emotional expressions, this difference disappears when participants are primed with videos of their own faces (Li and Tottenham 2013).

Objectives: To investigate how auditory distracters affect neural processing of emotional faces in youth with ASD, and to test whether priming participants with videos of their own emotional expressions changes the effect of sensory distracters during face processing.

Methods: 30 youth with ASD and 24 age-matched typically-developing (TD) controls (age 8-17) completed an emotion identification task while undergoing fMRI. Groups were matched on performance IQ but differed on full-scale IQ which was covaried in analyses. During fMRI, participants watched neutral faces morph into either happy or angry faces. Participants were asked to identify the emotion as quickly and accurately as possible. For half of the trials, participants completed the task during aversive environmental noises (e.g. sirens, lawnmowers). Halfway through, participants watched videos of themselves making happy and angry faces. SOR was measured using the Sensory Processing 3-Dimensions Questionnaire (Miller and Schoen 2004). Whole-brain analyses were thresholded at $Z>2.3$ and corrected for multiple comparisons at $p<0.05$.

Results: There were no group differences in reaction time or accuracy in any condition. When identifying faces without auditory distracters, both groups activated primary and secondary visual areas, as well as thalamus, insula, inferior frontal gyrus (IFG), and anterior cingulate. When completing the task with sensory distracters, both groups increased activation in bilateral Heschl's gryus, IFG, and subcortical regions. The ASD group additionally increased activation in the insula, hippocampus, and visual cortex significantly more than the TD group (Figure1) whereas the TD group decreased visual cortex activation. After being primed with videos of their own emotional faces, both groups increased lateral occipital cortex, hippocampus, lingual gyrus, and frontal regions, but the ASD group displayed even greater increases in mPFC compared to the TD group (Figure2). Within-group ASD correlations with SOR scores will also be examined.

Conclusions: These findings suggest that despite similar behavioral performance, sensory distractions differentially affect neural processing of emotional expressions for youth with ASD. Furthermore, results indicate that seeing videos of their own emotion expressions helped youth with ASD engage prefrontal regions while identifying others' emotion expressions. The role of within-group differences in SOR on neural processing of face processing and implications for intervention will also be discussed.

402.006 *(Poster)* Neural Response to Emotional Faces As a Predictor of Anxiety in Adults with Autistic Traits

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Background: Adults with autism spectrum disorder (ASD) have high rates of co-occurring anxiety. Both ASD and anxiety have been linked to atypical neural response to visual stimuli, indexed by the P1 event-related potential (ERP) and the face-sensitive N170 ERP. However, the nature of these differences in neural processing and their relationship to behavioral symptoms of anxiety and ASD remain relatively unexplored.

Objectives: To explore how atypical N170 and P1 response to emotional faces, specifically fearful and happy faces, and autistic traits predict anxiety.

Methods: Participants were adults with typical development (TD; *n*=39), ASD (*n*=26), and those that did not meet traditional research standards of ASD diagnosis or those with comorbid conditions (*n*=17). Participants completed the *Social Responsiveness Scale* (SRS-2), a measure of autism-specific social impairment and the *Beck Anxiety Inventory* (BAI), a self-report measure of anxiety. During electroencephalogram (EEG) recording, participants viewed 80 distinct neutral faces that shifted to fearful or happy faces after ~500 ms of fixation on the neutral face, simulating face-to-face interaction.

Results: Autistic traits (SRS-2 raw score) were positively correlated with anxiety (BAI score; R=.589, p<.001). A linear regression model revealed that autistic traits (β=.59, p<.001) and N170 latency for fearful faces (β=-.20, p=.026) explained 38.7% of the variance in reported anxiety (R^2=0.387, F(2,79)=24.94, p<.001). Adding the interaction between autistic traits and N170 latency for fearful faces to the model accounted for an additional 3.6% of variance in anxiety (R^2=.423, F(3,78)=19.03, p<0.001, Table 1, Model 1). Autistic traits (β=.55, p<.001) and N170 amplitude (β=-.194, p=.034) for fearful faces also predicted anxiety (R^2=.383, F(2,79)=24.562, p<.001, Model 2). Notably, these models were emotion-specific, such that latency and amplitude of the N170 elicited by fearful faces, but not happy faces, predicted anxiety. In addition, P1 mean amplitude for fearful or happy faces (fear: β=-.23, p=.012; happy: β=-.24, p=.009) and autistic traits (fear: β=.57, p<.001; happy: β=.53, p<.001) predicted anxiety (fear: R^2=.398, F(2,79)=26.10, p<.001, Model 3; happy: R^2=.402, F(2,79)=26.56, p<.001, Model 4).

Conclusions: Consistent with previous literature, higher levels of autism-specific social impairment were associated with increased anxiety. However, the results also demonstrated that individuals may be even more likely to experience anxiety when social impairment is coupled with atypical emotional face processing (i.e., faster latency or larger amplitude of N170 for fearful faces, and larger P1 mean amplitude for fearful or happy faces.). These results suggest that P1 and N170 responses to emotional faces contribute useful information for identifying subsets of the autism phenotype with higher levels of anxiety.

402.007 *(Poster)* Personal Relevance and Emotional Face Perception in Adults with Autism Spectrum Conditions – a Simultaneous EEG-fMRI Study

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Background: The ability to recognize emotional facial expressions is an essential component of social communication, and deficits in this area are among the defining symptoms of autism spectrum conditions (ASC). Previous neuroimaging research provides evidence that these deficits are accompanied by both reduced and altered brain activations in response to emotional faces. Our project investigates the role of personal relevance (faces of relevant others) in ASC, since it has been shown to increase neural processing of faces in a neurotypical sample. Therefore, we hypothesize that personal relevance might boosts engagement of the face processing network and enhance emotion processing in ASC.

Objectives: Our aim was to investigate the impact of personal relevance on emotional face processing in ASC and neurotypical controls.

Methods: Participants with ASC (N=18) and matched controls (N=13, data collection ongoing) were presented with photographs of a personally relevant person and a matched stranger, displaying fearful, happy, and neutral facial expressions. Participants performed an emotion categorisation task. During face presentation, we recorded simultaneous EEG-fMRI.

Results: Both participants with ASC and neurotypical controls showed significantly increased hemodynamic activity for relevant versus stranger faces in the face processing network, including fusiform gyrus, precuneus, and ACC, with no significant group differences. In the ASC group, emotion effects were shown in regions previously associated with ‘neurotypical’ emotion processing, including amygdala, insular cortex and ACC. Importantly, these effects were limited to the faces of relevant others and absent for strangers' faces.

Conclusions: Our results speak to the importance of accounting for personal relevance in research on face processing in ASC, as it seems to be able to boost neural responses to faces and to ‘normalize’ the processing of emotional facial expressions. Therefore, face processing in ASC seems to be characterized by reduced attention allocation to stranger’s faces, rather than a general processing dysfunction or alteration. Importantly, co-registration of EEG data allows for investigating the mechanisms behind the specificities of face processing in ASC; these results will be presented at the conference.

402.008 *(Poster)* Reduced Emotion-Specific Neural Response to Faces Relates to Impaired Emotion Recognition in Adults with ASD and Typical Development

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Background: Atypicality in emotional face recognition is characteristic of autism spectrum disorder (ASD). Past studies have identified discrepancy in latency of N170, a face-sensitive event-related-potential (ERP), between individuals with ASD and typical development (TD). However, sensitivity of N170 latency to emotional faces is not well defined. The present study was designed to identify emotion-specific variance in N170 latency and consider how this variance may contribute to common ASD symptomatology, specifically impaired emotion recognition.

Objectives: To investigate how neural discrimination of emotional faces relates to emotion recognition, which is commonly impaired in individuals with ASD.

Methods: Participants were adults with typical development (TD; *n*=49) and individuals presenting for ASD evaluation, meeting *Autism Diagnostic Observation Schedule* (ADOS-2) and *Diagnostic Statistical Manual* (DSM-5) diagnostic criteria (ASD; *n*=30) or not meeting research criteria (DNM; *n*=12). Participants were administered the *Reading the Mind in the Eyes Test* (RMET) as a measure of emotion recognition and completed the *Social Responsiveness Scale* (SRS-2) as a measure of autism-specific symptomatology. During the study, electroencephalography (EEG) was collected as participants were presented with neutral faces, which changed to fearful or happy expressions after approximately 500ms of fixation on the neutral face. N170 latency was later extracted from segments based on emotional face presentation in electrode groups over the right hemisphere.

Results: SRS scores ranged from 4 to 158 (*M*=50.40, *SD*=33.11) with significant overlap between diagnostic groups (Figure 1). RMET raw scores ranged from 11 to 34 (*M*=26.54, *SD*=4.83) and also significantly overlapped between diagnostic groups (Figure 2). RMET raw scores were Z-transformed for inclusion as a continuous variable in analysis. Because of heterogeneity of the sample, data were collapsed across all three diagnostic groups. N170 latency was submitted to a 2(condition: fearful, happy) x RMET score(continuous) general linear model, revealing a main effect of condition on N170 latency ($F(1,89)=9.828$, $p=.002$), where happy faces (*M*=174.99, *SE*=2.43) elicited shorter N170 latencies than fearful faces (*M*=179.99, *SE*=2.44). The main effect was modulated by RMET performance, such that high performers (+1 SD) differentiated between happy (*M*=170.89, *SE*=3.44) and fearful faces (*M*=178.50, *SE*=3.46) in N170 latency (p=.001), but low performers (-1 SD) did not ($p=.294$).

Conclusions: Based on these results, high RMET performance is related to discrimination between fearful and happy faces in N170 latency, whereas low RMET performance is related to similar N170 latency for fearful and happy faces. These data suggest that measures of N170 latency to happy and fearful faces may help to identify individuals with impaired emotion recognition. Characterizing these neural patterns may help to inform symptom-specific therapy and treatments of ASD, particularly in cases where impaired emotion recognition affects social functioning.

402.009 *(Poster)* Resting Anterior EEG Asymmetry and Power As a Predictors of Affective and Executive Functioning in Children with ASD, ADHD, and Typical Development

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Background: Resting left and right anterior EEG power, as well as relative difference between hemispheres (i.e., asymmetry) may be related to global approach and avoidance tendencies and subsequently, problems with executive and affective regulation. There is mixed evidence as to whether the relation between asymmetry and affective regulation differs for children with ASD compared typically developing children or other clinical populations with executive functioning challenges (e.g., ADHD). In children with ASD, greater left frontal asymmetry may or may not be related to increased social anxiety in children with ASD (Sutton et al., 2005; Burnette et al., 2011). The degree to which differences in asymmetry may be related to executive functioning tasks that involve affective processing is unknown.

Objectives: (1) To characterize frontal power and asymmetry in children with ASD, ADHD, and typical development (TD); and (2) to relate power/asymmetry to a behavioral task that indexes executive functioning in an affective context and a measure of affective functioning.

Methods: Children with ASD (n=44), ADHD (n=25), and TD (n=23) participated in 2 minutes of alternating eyes open/closed resting EEG data collection at 7-11 years of age. Participants also completed the Hungry Donkey gambling task, which assesses children's strategic long-term decision making in the heightened emotional context of reward. Participants' parents completed the Child Behavior Checklist (CBCL); the Affective and Anxiety Problems subscales were used (Gotham et al., 2015). Frontal right (F4) and left (F3) hemispheric power as well as asymmetry (F4-F3) were derived from the BEAPP/HAPPE processing pipeline, operationalizing power as the natural log of mean power per hertz within the alpha (8-13 Hz) frequency band (Levin et al., 2018; Gabard-Durnam et al., 2018). IQ differed by group and was controlled for in subsequent analyses.

Results: While there were no diagnostic group differences in degree of asymmetry, $F(2,89)=1.24$, $p>.05$, and direction of asymmetry was not different by group, $X^2(2)=1.97$, $p>.05$, qualitative observations suggested wide variability. There were group differences in both right power, $F(2,89)=3.75$, and left power $F(2,89)=4.90$, such that TD children displayed increased right power compared to children with both ADHD and ASD, $t(47)=2.06$; $t(66)=2.15$, and increased left power compared to children with ASD ($t(47)=3.21$), $ps<.05$. There were diagnostic group differences in Affective Problems, $F(2,128)=24.62$, $p<.001$, and Anxiety Problems, $F(2,128)=11.89$, $p<.001$, such that children with ASD and ADHD were reported to have more challenges with anxiety and mood than TD children. For all children, increased right alpha power related to decreased Anxiety Problem scores, $r=-.21$, $p<.05$, while both increased left and right power related to decreased Affective Problems, $r=-.23$, $r=-.23$, $ps<.05$. Finally, children with right asymmetry made more advantageous selections on the final two blocks of the Hungry Donkey task than those with left asymmetry, $t(86)=2.62$, $p<.05$.

Conclusions: Regardless of clinical diagnosis, frontal power and asymmetry relates to anxiety, affective functioning, and reward contingency learning. More work is needed to understand the relation between frontal power, asymmetry, reward processing, and affective functioning, as well as whether structure or strength of these processes fundamentally differ for children with different clinical diagnoses.

Animal Models

ORAL SESSION — **ANIMAL MODELS**
303 - Functional Assessment in Model Organisms

303.001 *(Oral)* Regulation of Autism-Relevant Behaviors By Distinct Cerebellar-Prefrontal Cortical Circuits

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Background: The cerebellum has been increasingly implicated in the pathogenesis of Autism spectrum disorders (ASD); however, the mechanisms by which cerebellar dysfunction results in these behaviors remains unknown. Numerous studies have detailed volumetric changes in the posterior cerebellar vermis and in Rcrus1 in children with ASD, while the degree of volumetric differences in these areas correlates with ASD symptom severity. We recently demonstrated that cerebellar area Rcrus1 plays key roles in social and repetitive behaviors. However, the circuitry which connects Rcrus1 to downstream brain areas to orchestrate these behaviors remains unknown. Polysynaptic connections between the cerebellum and the cortex have been demonstrated both in anatomic tracing studies and from functional connectivity studies. One cortical area shown to be involved in social behaviors and highly implicated in ASDs is the medial prefrontal cortex (mPFC). Changes in cerebellar-mPFC functional connectivity have also been identified in ASD and in cerebellar and ASD mouse models. We and others have further demonstrated functional connectivity between Rcrus1 and the contralateral mPFC in humans, consistent with studies showing disruptions in left mPFC in ASD. Thus, we hypothesize that these cerebellar-mPFC connections play critical roles in the regulation of ASD-relevant behaviors.

Objectives: This study objective is to identify circuits emanating from cerebellar cortical areas such as Rcrus1, which are critical to ASD-relevant behaviors, to the mPFC, and to identify the role these circuits play in social behavior and repetitive behaviors. We also aim to examine these circuits across mouse models of ASD, and in human ASD cohorts. We will also manipulate these circuits in mouse models of ASD to rescue social and repetitive behaviors.

Methods: Here we utilize a combination of mouse and human functional and structural MRI imaging to look at functional and structural connectivity between the cerebellar cortex and the mPFC. We have also utilized retrograde and anterograde tracing techniques in mice to determine the anatomy of these muti-synaptic cerebellar-mPFC circuits.

Results: Here, we highlight connections of Rcrus1 to another domain highly implicated in the regulation of ASD behaviors, the prelimbic/medial prefrontal cortex (mPFC), and show that modulation of mPFC function is sufficient to rescue cerebellar dysfunction induced ASD behaviors. In addition, we delineate the neural circuit bridging these vastly separated regions and show that function of the proximal circuit (Rcrus1, lateral cerebellar nucleus) is sufficient to rescue social impairments in a cerebellar-regulated ASD model, while distal neural circuit underpinnings (vm-thalamus, mPFC) are both necessary and sufficient for both social and repetitive ASD behaviors pointing to an alternative pathway for repetitive behaviors. Lastly, we provide evidence that modulation of another clinically implicated cerebellar domain, the posterior vermis, is both necessary and sufficient for the regulation of repetitive/inflexible behaviors.

Conclusions: These findings highlight critical neural networks between the cerebellum and mPFC that mediate both core diagnostic criteria in ASD and offer the potential for therapeutic benefit of neuromodulation for individuals with ASD.

303.002 *(Oral)* Responses of Oxytocin-Receptor-Mutant Zebrafish to Social Stimulation in Groups and Individually: Support for Zebrafish Autism MODEL

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Background: Recently, intranasal administration of oxytocin has been reported to improve social function in autistic patients and has shown promise as a potential treatment of social impairments seen in autism. Oxytocin is a neuropeptide that regulates a wide range of mammalian social and non-social behaviors relevant to autism, such as bonding, social recognition, anxiety, and aggression. Since the mechanisms underlying autism and oxytocin's role in allaying social symptoms in autistic patients are not well-understood, animal models with capacity for sophisticated genetic manipulation are necessary. Zebrafish (*Danio rerio*) is a highly social vertebrate with phylogenetic conservation in oxytocin and key neurotransmitter systems and we exploit these features to develop an animal model of autism in zebrafish.

Objectives: Importance of the oxytocinergic system in mammalian social behavior is well-established, but less is known about its homologous system in zebrafish. Our aim is to investigate social interaction and neurochemistry in zebrafish mutants with genetically manipulated oxytocin system to further establish a zebrafish model of autism.

Methods: Using adult male and female CRISPR-Cas9-mutants lacking either of the two zebrafish oxytocin receptor genes, *oxtr* and *oxtrl*, we performed two different social behavior tasks. We measured socialization between four fish (same-genotype, $n \geq 20$ for each group) in a large open-field (40x body length). We measured shoaling, schooling, leadership, excursion from the groups, general activity, and specific motor patterns of mutant and wild-type fish in the large pool. We also measured responses of these mutant fish to automated visual-only stimulus when individually placed in a separate tank and compared them with wild-type control fish.

Results: Our data show that zebrafish lacking oxytocin receptors display impairments in shoaling behavior in the large ethologically-relevant open-field. Social behavior was affected by both *oxtr* and *oxtrl* mutation in a similar fashion. In contrast, we found that individual responses to automated visual-only stimulus was affected in *oxtr* mutant fish but not in *oxtrl* mutant fish.

Conclusions: These results suggest that the two oxytocin receptor play important but distinct roles in zebrafish social behavior. Further, these findings advance our understanding of neural mechanisms underlying oxytocin-regulated social interaction in zebrafish and highlight the potential of future investigation of zebrafish oxytocin system towards generating better therapeutic treatments for autism.

303.003 *(Oral)* Constitutional Pten Mutation Alters Alternative Splicing Patterns in the Murine Brain, Contributing to an Autism-like Phenotype

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Background: Alternative splicing (AS) is a post-transcriptional mechanism regulating gene expression that is utilized by organisms to expand the functional complexity of their respective proteomes from comparatively simpler exomes. Recent work has increasingly associated changes in alternative splicing event (ASE) diversity with the functional complexity of the central nervous systems, especially in higher order mammals, and neurodevelopmental conditions like autism spectrum disorder (ASD). Due to the strong genetic association between germline mutations in *PTEN* and ASD, we hypothesized that germline mutation in *PTEN*, especially those known to disrupt nuclear localization, will change patterns of AS, resulting in ASEs that likely contribute to the pathophysiology of ASD.

Objectives: In this study, we analyzed ASEs in the neural transcriptome of the $Pten^{m3m4}$ model, a murine model with cytoplasmic predominant expression of Pten, cellular and molecular correlates of ASD, and autism-like behavior. Our objective was to establish that the $Pten^{m3m4}$ mutation alters AS in the brain and that mutant-specific ASEs correlate with known aspects of ASD pathophysiology.

Methods: RNA sequencing was performed on wildtype, heterozygous mutant, and homozygous mutant hemibrain samples at two-weeks of age and cortex samples at six-weeks of age collected from $Pten^{m3m4}$ male mice on a CD1 outbred background (N = 3). Gene expression was analyzed using an in-house pipeline (Kallisto followed by NOISeq), and ASEs were analyzed with rMATS. The significant ASEs were subject to gene enrichment and pathway analysis. We also performed validation of the ASEs identified by rMATS by RT-PCR.

Results: We identified significant differences in the percent-spliced-in (PSI) distributions among different genotype, where the $Pten^{m3m4/m3m4}$ cortices showed an increase in PSI. Interestingly, we identified a mutant-enriched ASE in *Gfap* with a known molecular association with astrogliosis, a phenotype consistently observed in the $Pten^{m3m4/m3m4}$ brain. Moreover, the genes in which the mutant-associated ASEs occurred were generally found to be enriched in biological processes relevant to ASD pathophysiology: mTOR signaling, synaptic transmission, and DNA damage repair. In addition to AS findings, we found that several neural-enriched splicing factors were significantly decreased in expression: *Celf1-6*, *Rbfox1*, and *Srrm4*. Given the existing *Srrm4* model of autism, we decided to assess AS at Srrm4-regulated microexons. We observed a significant decrease in average PSI across these Srrm4-regulated ASEs (average decrease of 10% PSI). Beyond these descriptive findings, we also observed that the interaction between Pten and spliceosome component U2af2 was disrupted by the m3m4 mutation, suggesting a possible mechanism for how disruption of Pten nuclear localization affects AS.

Conclusions: We have described important changes in AS in the brain of $Pten^{m3m4}$ mutant mice. These ASEs have a clear association with ASD pathophysiology. Although the exact mechanisms by which the m3m4 mutation disrupt AS remains partially ambiguous, it is evident that the changes in the expression of neural-enriched splicing factors and the disrupted interaction between Pten and U2af2 likely contributes to the ASEs observed in mutants. This work offers a deeper understanding of the $Pten^{m3m4}$ transcriptome, which ultimately helps illuminate ASD pathophysiology.

303.004 *(Oral)* Understanding the Neurodevelopmental Bases of DDX3X Syndrome

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Background:

DDX3X syndrome is a recently identified form of intellectual disability (ID). In addition to ID, affected individuals present with behavioral problems (including Autism Spectrum Disorder, ASD), lower weight, movement disorders, hypotonia and brain malformations. Most affected individuals are females with haploinsufficiency of DEAD-box helicase 3 X-linked (*DDX3X*) gene.DDX3X is an RNA helicase, regulating mRNA translation. To date, how DDX3X functions in neurons and at synapses is poorly understood.

Objectives:

The objective of this study is to understand the molecular and cellular functions of DDX3X during neurodevelopment, particularly during corticogenesis and synaptogenesis, and to explore its impact on cognitive and social behavior.

Methods: We have generated a novel conditional knockout mouse modeling *DDX3X*haploinsufficiency. To understand the impact of *Ddx3x*haploinsufficiency on development and behavior we follow a standardized behavioral battery assessing developmental milestones during postnatal life, and cognition, social behavior and motor function in adults. To study the impact of DDX3X haploinsufficiency on cortical development, we assess cortical lamination using layer-specific markers and retrograde tracing to reconstruct intra- and sub-cortical connectivity. To study synaptogenesis, we model DDX3X syndrome using Cre-lox recombination in single-embryo primary cortical neurons. To explore the molecular functions of DDX3X during cortical development and synaptogenesis, we perform translating ribosome affinity purification (TRAP) method and its viral-based development (vTRAP).

Results:

*Ddx3x*null male mice (Ddx3x$^{-/y}$) die *in utero*, compatible with the dearth of boys affected by DDX3X syndrome. *Ddx3x*haploinsufficient females (*Ddx3x*$^{+/-}$)are viable but show physical, sensory and motor developmental delays, as well as anxiety and hyperactivity. DDX3X is expressed in a sex-specific manner in the cortex and at synapses, and *Ddx3x*haploinsufficiency impacts the development of glutamatergic projection neurons in the cortex.

Conclusions:

We have generated a mouse model with construct and face validity for DDX3X syndrome. We are using this mouse model to understand the molecular and cellular neurobiology underlying DDX3X syndrome.

POSTER SESSION — **ANIMAL MODELS**
403 - Animal Models Posters

403.001 *(Poster)* Altered Cortical Development in Mice Harboring Autism-Associated TBR1 Mutations

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Background: Diverse genetic risk factors underlie susceptibility to autism spectrum disorder (ASD). Effective therapeutics will require the development of targeted interventions based on the specific genetics of an individual with ASD. While animal models have greatly informed our understanding of ASD risk gene function, most models were created through multi-exon deletion or insertion of foreign materials. Thus, these models lack the nuance of specific point mutations found in individuals with ASD, which may have diverse functional effects. Here, we report the generation and characterization of mice carrying an ASD-associated *de novo* mutation in the brain-specific transcription factor (TF) *TBR1*. Previous studies in mouse have demonstrated that *Tbr1* is critical for the establishment of normal neuronal identity and cellular architecture within the cerebral cortex, a brain region highly implicated in ASD etiology. However, currently little is known about how altering a single copy of Tbr1 alters cortical development and the Tbr1-regulated transcriptional network.

Objectives: We aim to identify convergent and divergent developmental effects of different types of ASD-associated *TBR1* mutations (i.e., frameshift, missense, and nonsense) on the mammalian cortex, beginning with a frameshift mutation leading to early truncation.

Methods: Using a CRISPR-Cas9 knock-in strategy, a mouse line was generated on a C57BL/6 background that carries an ASD-associated putative frameshift mutation N-terminal to the T-box domain (p.A136PfsX80). Multiple independent F1 lineages were backcrossed for several generations to remove potential off-target mutations. Wild-type, heterozygous mutant, and homozygous mutant littermates were compared at embryonic, postnatal days (P) 0-2, juvenile, and/or adult stages. These data were compared to a putative null allele which removes exons 2 and 3 (Bulfone et al. 1998). Protein expression levels and subcellular localization were measured via Western blotting and immunohistochemistry (IHC). Cortical lamination and development was assessed using IHC, axon labeling, and cell birth dating. To identify changes in gene regulation at single-cell resolution, single-cell RNA-seq (10x Genomics) and chromatin accessibility (sci-ATAC-seq) data were generated.

Results: Tbr1 expression was reduced in *Tbr1*$^{A136Pfs/+}$ mutants and completely absent in *Tbr1*$^{A136Pfs/A136Pfs}$ mutants. There was no evidence of a truncated protein product, and analysis of *Tbr1*$^{A136Pfs/+}$ RNA showed nearly complete absence of the mutation allele, suggestive of nonsense-mediated decay. At P0, *Tbr1*$^{A136Pfs/+}$ mutants exhibited a reduction in anterior commissure thickness as well as alterations in cortical interneuron density. At P21-28, preliminary data on *Tbr1*$^{A136Pfs/+}$ mutants showed ectopic expression of deep and upper layer cortical markers in. At P0, *Tbr1*$^{A136Pfs/A136Pfs}$ mice showed abnormal cortical layering and ectopic axon projections. Genomic analysis are ongoing, however, we expect to uncover dosage-sensitive, cell- and non-cell-autonomous gene expression alterations associated with specific mutations and cortical phenotypes.

Conclusions: Our current results support the conclusion that the ASD-associated TBR1 mutation p.A136PfsX80 is a completely null allele, with findings consistent with previous *Tbr1* knockout studies. These data identified potential molecular and cellular mechanisms underlying ASD etiology in individuals carrying early *TBR1* truncation mutations. Further characterization of p.A136PfsX80 and additional diverse ASD-associated *TBR1* mutations will reveal convergent and divergent mechanisms leading to ASD and provide a foundation for designing targeted interventions.

403.002 *(Poster)* Neuroprotective Effect of Granulocyte Colony Stimulating Factor (GCSF) in VPA Induced Cognitive Deficits in Autistic Rats Via IL-6 /BDNF Pathway

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Background: Autism is a group of complex neurodevelopmental and neurobehavioral disorder of unknown etiology which manifests with problems like social interaction, language, communication and behaviour deficits like stereotypic and repetitive behaviour. This inflammatory condition is often linked to immune system dysfunction enhanced inflammatory activity in ASD children has been demonstrated through pro-inflammatory biomarkers analysis. Interleukins are signalling proteins, belonging to the cytokine family, responsible for immune modulation and inflammatory responses and GCSF is a well-known neuro-protectant, anti-inflammatory, anti-apoptotic, and neurogenesis and excitoprotective properties in both human and rodent models of CNS disorders.

Objectives: The aim of present study is designed to investigate the neuroprotective effect of GCSF in experimental model of autism.

Methods: Animals were divided into six groups. Group 1 (Control, received only Normal saline 0.9%), Group 2 (VPA 600mg/kg on PND 12.5), Group 3 (Pups, Risperidone 2.5 mg/kg, PND 23 to 43) and group 4-6 (GCSF 10, 35,70 µg/kg PND 23 to 43). All the groups were subjected to different behaviour (Three chamber sociability test, Morris water maze) ELISA for various inflammatory markers and histopathological examination using 0.1% Cresyl violet (for Nissl staining)

Results: Treatment group showed significant improvement in the behavioural parameters. GCSF decreases inflammation by decreasing levels of inflammatory markers. The histopathological evaluation implied extensive neuronal loss in the CA1 region of the hippocampus in the VPA treated groups. Decrease in the neuronal score was seen with GCSF treatment. Maximum effect was seen with GCSF dose of 70 µg/kg.

Conclusions: It has been concluded that GCSF has attenuated valproic acid induced developmental histopathological and inflammatory processes. However further research is required to explore the full therapeutic potential of the drug

403.003 *(Poster)* Screening for ASD Therapies Using a Drosophila Model of Neurofibromatosis Type 1

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterised by social communication deficits, restricted interests, and repetitive behaviours. While there are currently no FDA-approved therapies that target this core symptomatology, animal models of monogenic syndromes associated with a high prevalence of ASD, such as neurofibromatosis type 1 (NF1), have the potential to address this issue. For example, deletion of a functionally conserved ortholog of the human *NF1* gene in the fruit fly, *Drosophila melanogaster*, results in behavioural and cellular impairments reflecting those seen in human ASD.

Objectives: We have carried out a targeted screen for compounds that attenuate ASD-relevant behaviour in a *Drosophila* model of NF1, in order to identify potential therapies for the treatment, or even prevention, of ASD in humans. Compounds were initially screened for their ability to rescue increased grooming in male $NF1^{-/-}$ flies, which has been suggested to correspond to the repetitive behaviours typical of ASD children. Additional ASD-relevant behaviours have been subsequently characterised in the $NF1^{-/-}$ flies, against which hit compounds from the grooming assay can be screened and further validated.

Methods: Grooming behaviour was quantified using the *Drosophila* Activity Monitor 5 (DAM5) from TriKinetics Inc. (Waltham, MA), based on the observation that bouts of high frequency activity in the $NF1^{-/-}$ flies correspond to grooming rather than locomotion. Social interaction was examined by calculating the median inter-fly distance (i.e. the distance between a fly and its nearest neighbour) between male flies in a circular arena. Altered larval mechanoreception was assessed by briefly applying firm pressure to a larva, blind to genotype and/or treatment, and observing whether a nociceptive response was induced.

Results: We confirm previous findings (King et al. 2016) that $NF1^{-/-}$ flies exhibit increased grooming behaviour, and show that this can be robustly quantified using the DAM5 platform, in which bursts of high frequency activity act as a proxy for grooming. In this manner, we identified the mTOR inhibitor rapamycin as able to reduce grooming behaviour when administered throughout development, a finding that was later confirmed via manual observation. Moreover, we report the novel observation that male $NF1^{-/-}$ flies demonstrate an increased inter-fly distance, reflecting the social impairments present in ASD and NF1 individuals. Lastly, we show that the likelihood of a mechanical stimulus evoking a nociceptive response was significantly greater for $NF1^{-/-}$ larvae than for isogenic controls, which typically do not respond to such stimulation. This may reflect the hyper-reactivity of individuals with ASD to certain stimuli, such as touch.

Conclusions: The simplicity of the DAM5 system for activity monitoring, together with the strength of the increased grooming phenotype in $NF1^{-/-}$ flies, render this assay appropriate for a targeted drug screen to identify ASD therapies. Supporting the translatability of this work, rapamycin reduced grooming behaviour, and mTOR disruption has previously been implicated in the pathophysiology of ASD. The assays demonstrating aberrant social interaction and mechanoreception, respectively, can now provide follow-up screens to further validate hit compounds for their potential to ameliorate the core ASD symptomatology.

403.004 *(Poster)* Sensory and Cognitive Behavioural Characteristics of the Cntnap2 Rat Model for ASD

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Background: Perturbations of brain development can result in developmental disorders such as autism spectrum disorder (ASD) and Specific Language Impairment (SLI). Respective individuals show alterations in how they process basic sensory features, which are important for reacting to stimuli, for social interaction and communication, and for perceiving and learning about the environment. The CNTNAP2 gene, implicated in ASD and SLI, is highly expressed in sensory pathways and the hippocampus, and plays an important role in brain development. We here characterized how the loss of *Cntnap2* affects sensory processing using behavioural testing of rodents in order to understand the gene's overall role in development.

Objectives: To characterize the behavioural phenotype of wildtype, $Cntnap2^{+/-}$, $Cntnap2^{-/-}$ male and female adult rats by assessing (1) perceptual and preattentive responses to basic and complex sensory stimuli, (2) social behaviour, (3) learning and memory, and (4) cognitive flexibility.

Methods: Sensory filtering and sensorimotor gating of auditory and audiovisual stimuli were determined using the acoustic startle response. Using operant conditioning, the ability to discriminate sound intensity as well as perceive the temporal order of auditory and visual stimuli was measured via two-alternative forced judgement tasks. Social behaviour differences between genotypes was examined by assessing an animal's preference for a conspecific over an inanimate object (sociability), and their preference for a stranger rat over a familiar rat (social novelty). Spatial learning and memory abilities were assessed using a two-day Morris Water Maze protocol. Lastly, the ability to respond flexibly to changes in food reward contingencies was determined via an operant-based reversal learning paradigm.

Results: $Cntnap2^{-/-}$ rats can accurately discriminate sound intensities of auditory stimuli, and accurately perceive the temporal order of auditory and visual stimuli. However, they have a general sensory filtering deficit exemplified by an increased acoustic startle response amplitude and poor sensorimotor gating. They do not exhibit typical social behaviours, showing no sociability nor preference for social novelty. They exhibit slower spatial learning; however, their 24-hour spatial memory remains intact. Lastly, $Cntnap2^{-/-}$ rats show normal behavioural flexibility when using operant conditioning.

Conclusions: The general sensory filtering deficit observed in this study is in accordance with research suggesting pathological sensory processing underpins the emergence of some ASD-related phenotypes. While our audiovisual results in rats are consistent with previous studies in the autistic population performing the temporal order judgement task with simple flash-beep stimuli, the lack of differences in sound intensity discrimination appears contrary to reports of moderate sound intensities being distressing. These findings may therefore instead relate more to the emotional valence of loud stimuli, rather than discrimination ability. Differences in social behaviour and spatial learning align with the altered social interaction and spatial learning/navigation seen in children with ASD. Finally, the lack of differences in behavioural flexibility may be due to the operant task design. In general, the behavioural tests that employed operant conditioning, and therefore extensive training, failed to differentiate the genotypes, while those tasks that relied on innate abilities did indeed show the expected differences for an animal model for autism.

403.005 *(Poster)* Social Deficit in shank3 Knockout Zebrafish Models of Autism Are Rescued: Via Low-Dose-Histone Deacetylase Inhibitor (Valproic Acid) Treatmen

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Background: Social deficit is core clinical feature of autism spectrum disorder（ASD）and SHANK3 is a high-confidence candidate gene. Previous study found that HDAC inhibitor romidepsin and MS-275 could relieves autism-like social deficits in shank-deficient mice model.

Objectives: To investigate whether the autism-like social behavioral deficits could be rescued by Valproic Acid.

Methods: The shank3a and shank3b knockout zebrafish were generated using CRISPR/Cas9 editing, as previously reported, which exhibited the significant reduction of shank3a or shank3b mRNA expression. Shank3a ,shank3b and shank3a&b knockout zebrafish (3.5mpf,male) and age-matched wild type zebrafish(TU strain) were used in this study. Zebrafish of different genotypes were randomly assigned to drug/ 1 × E3, groups. The solution containing low-dose-VPA (5UM Valproic Acid) was removed at 4 dpf, replaced by 1 × E3 until 8dpf. All of larvae were grown until 3.5mpf for behavior testing and other analysis in 3L transparent tanks with system water.

Results: We describes a knockout zebrafish model of the autism-associated *shank3* gene. shank3 MU adult zebrafish exhibited impaired locomotor behaviors in a novel tank assay(open filed, $p<0.05$, bonferrnoni's correction). Sociability (social preference) test was revealed that the WT zebrafish showed a strong group tendency to contact the conspecific group, however, the three types of shank3_MU zebrafish swam around aimlessly and showed reduced social contacts with the conspecific group, which we characterized as a pattern of reduced social interaction($p<0.05$, bonferrnoni's correction).

After the brief (5-day) treatment with low-dose-histone deacetylase inhibitor of shank3 knockout larvae, we then examined social preference and open filed velocity at two different timepoints (2.5m post-exposure of VPA and 3.5m post-exposure of VPA). As shown in data, significant improvement some social impairments persisted until adulthood, ($p<0.01$,bonferrnoni's correction) , no change in WT zebrafish. while no improvement in motor deficits ($p>0.05$,bonferrnoni's correction).

Conclusions: Our research may suggest a potential therapeutic strategy targeted inhibition of HDAC to treat social deficits associated with autism.

403.006 *(Poster)* Structural High-Resolution MRI Assessment of the Neuroanatomy in 9 Novel Mouse Models Related to Autism.

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Background: Autism is extremely heterogeneous, in behaviour, genetics, and neuroanatomy. We have established an MRI database of mouse models related to autism, which allows the investigation of neuroanatomy in a large model autism population. Recently, we have started to create some models in collaboration with The Centre for Phenogenomics (TCP) and the International Mouse Phenotyping Consortium (IMPC), allowing both behaviour and neuroanatomical screens. This study summarizes the differences found in 9 novel mouse models related to autism, namely, *Katnal2, L2hgdh, Nexmif, Otc, Pah, Rab39b, Ranbp17, Upf3b, and Ypel2.*

Objectives: To assess neuroanatomical differences in 9 novel autism gene candidates with structural MRI.

Methods: Nine novel loss-of-function mouselines related to autism were produced by exon deletion using Cas9 RNA-guided nuclease in C57BL/6NCrl zygotes. These lines were maintained on a C57BL/6NCrl background. In total 163 mice were examined for this study, 40 WT and 10-20 mixed sex from each genotype. The age of the mice was P70 ± 4 (mean ± sd).

MRI Acquisition – A multi-channel 7.0 Tesla MRI scanner was used to acquire anatomical images of the brain. A T2-weighted, 3-D fast spin-echo sequence was used. This sequence yielded an image with 40 µm isotropic voxels (3D pixel) in ~14 h.

Data Analysis – To visualize and compare any differences the images from each group were registered together. Volume differences were then calculated in individual voxels or 182 different regions (Dorr et al. 2008, Ullmann et al. 2013, and Steadman et al. 2014). Multiple comparisons were controlled for using the False Discovery Rate (FDR) (Genovese et al., 2002).

Results: Figure 1 highlights the voxelwise effect size difference for each individual model compared to the WT mice. Regional differences were calculated for each of the 9 different lines, and of the 182 regions examined,15 were found to be significantly different for *Katnal2*, 124 for *L2hgdh*, 4 for *Nexmif*, 0 for *Otc*, 6 for *Pah*, 75 for *Rab39b*, 0 for *Ranbp17*, 112 for *Upf3b*, and 14 for *Ypel2*. The drastic differences are quite intriguing in the L2hgdh, Rab39b, and Upf3b models, but some of the more subtle difference are also interesting. *Katnal2* seems to have a specific deficit in CA3, and the ventricular system, *Nexmif* also show a hippocampal, the differences in *Pah* seem to be localized to the motor cortices and the cerebellum, and differences in *Ypel2* are localized to the striatum. Interestingly, in spite of all the differences found neuroanatomically, minimal behavioural findings are reported for these mice (mousephenotype.org). The only relevant behavioural findings are an increased hyperactivity and fear conditioning deficit in the *Upf3b* mice, but the IMPC behavioural tasks are limited and autism related tasks still need to be assessed.

Conclusions: Mesoscopic neuroanatomy assessed with MRI provides a first look at the differences caused by autism relevant mutations. These nine models highlight several different aspects of autism that warrant further investigation, such as total brain differences common in other mouse models related to autism (Ellegood et al. 2015), and striatal differences possibly relevant to the repetitive restricted behaviours.

403.007 *(Poster)* The Role of Methyl CpG Binding Protein (MeCP) 2 in Parvalbumin-Positive Cortical Interneurons for Processing of Socially-Relevant Sounds

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Background: Autism Spectrum Disorders (ASD) and Rett Syndrome (RTT) are characterized by impaired communication. RTT is a pervasive, neurodevelopmental disorder previously classified as an ASD and caused by loss of function mutations in the X-linked gene *Mecp2*.

Objectives: Our goal is to determine the contribution of *Mecp2* mutation to disruptions of auditory cortical circuitry and plasticity that degrade social vocal perception in a mouse model of Rett syndrome.

Methods: To achieve this goal, we will use a circuit-specific *Mecp2* mutant mouse model in combination with a behavioral paradigm that relies on vocal communication. We have identified a natural, auditory-dependent, learned maternal behavior that is impaired by *Mecp2* mutation: pup retrieval in response to ultrasonic vocalizations (USVs). USVs are high-pitched distress calls emitted by separated infant pups that trigger a retrieval response in wild-type but not *Mecp2* heterozygous females. Our previous work suggests that this difference is the result of impaired plasticity in the auditory cortex (AC) of *Mecp2* mutant animals, a brain region required to detect and interpret signals. AC inhibitory interneurons seem to be especially important for processing of socially relevant stimuli (e.g. USVs). Here we build on these findings by selectively inhibiting transcription of *Mecp2* in a specific subclass of inhibitory interneurons- those expressing the calcium-binding protein parvalbumin.

Results: We examine the effect of restricted *Mecp2* mutation in parvalbumin positive (PV+) inhibitory interneurons on pup retrieval behavior and *in vivo* neural circuit activity in the AC in response to socially relevant auditory stimuli. We have found *Mecp2* mutation restricted to this cell type is sufficient for impairing pup retrieval behavior. Further, we found AC cellular responses to pup vocalizations are altered in PV-*Mecp2* mutants compared to WT controls. These differences are specific to socially relevant sounds (i.e. USVs) as opposed to pure tones.

Conclusions: This work focuses on functional consequences of *Mecp2* mutation in auditory processing circuitry that expands our understanding of the underlying etiology of RTT, identifies targets for ameliorating the effects of these consequences, and informs pathophysiological mechanisms underlying neurodevelopmental disorders more broadly.

403.008 *(Poster)* Vagus Nerve Stimulation Paired with Sounds Alters Auditory Processing in Rodent Models of Autism

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Background: One of the major obstacles facing individuals with autism spectrum disorders (ASD) is the inability to communicate effectively. While there are many reasons for this inability, an important component appears to be a serious deficit in the ability to process speech sounds effectively. Expensive, time-consuming behavioral interventions can improve behavioral outcomes, but many individuals undergo these interventions and still experience deficits. Rodent models exhibit many of the neural abnormalities and behavioral deficits observed in ASD. Similar to individuals with ASD and Rett syndrome, both speech discrimination ability and auditory cortical responses are impaired in rodent models of ASD. The development of adjunctive interventions that can increase the benefit of rehabilitative therapies is essential to improve the lives of individuals with ASD. Vagus nerve stimulation (VNS) triggers rapid, phasic release of plasticity promoting neuromodulators, which enhances plasticity and neural responses in the auditory pathway when delivered concurrent with sound presentation.

Objectives: The aim of this study was to determine whether VNS paired with auditory training can reverse the neural and behavioral auditory processing deficits observed in two rodent models: 1) female heterozygous *Mecp2* rats, and 2) male and female rats prenatally exposed to valproic acid (VPA).

Methods: For the rodent model of Rett syndrome, heterozygous *Mecp2* females were bred with wild type males, each with a Sprague Dawley background. In our second rodent model, pregnant Sprague Dawley rats received an intraperitoneal injection of either 0.9% saline or 600 mg/kg sodium valproate on embryonic day 12.5. Behavioral and neural processing of sounds was quantified in adult offspring beginning on postnatal day 90. Rats were trained to discriminate speech sounds by responding to a target sound (ex: ‘dad’) and refrain from responding to a non-target sound (ex: ‘tad’), both in quiet and in the presence of varying levels of background noise. VNS was paired with sound presentation 300 times per day for 20 days. Following 20 days of VNS-sound pairing, multiunit responses to tones, noise burst trains, and speech sounds were recorded from primary auditory cortex (A1). Data analysis was performed blinded.

Results: Behavioral discrimination of speech sounds is impaired in both *Mecp2* rats and VPA-exposed rats compared to experimentally naïve control rats. Both models exhibit degraded A1 responses to sounds. Following VNS-sound pairing, the A1 response strength to tones, noise burst trains, and speech sounds was significantly increased compared to sham therapy. Additionally, a nearest-neighbor classifier was better able to correctly identify the sound presented based on the neural response patterns in VNS-sound paired rats compared to sham therapy rats.

Conclusions: These preliminary results suggest that VNS-sound pairing is an effective method to enhance auditory processing in rat models of ASD with degraded behavioral and neural processing of sounds. Ongoing experiments involve optimizing the efficacy of VNS-sound pairing therapy to enhance neuroplasticity and improve auditory processing in the context of ASD. Insights derived from this study may influence the development of new behavioral and sensory techniques to treat communication impairments that result in part from a degraded neural representation of sounds.

403.009 *(Poster)* Vagus Nerve Stimulation Therapy to Restore Auditory Processing in a Rat Model of Rett Syndrome

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Background: Rett syndrome is a rare neurological disorder associated with a mutation in the X-linked gene MECP2. This disorder mostly affects females, who typically have normal early development followed by a regression of skills. The *Mecp2* transgenic rat model of Rett syndrome exhibits similar symptoms shown in patients such as seizures, anxiety, breathing abnormalities, motor and auditory deficits. Individuals with Rett syndrome and *Mecp2* heterozygous rats both exhibit atypical neural and behavioral processing of auditory stimuli, which likely impacts effective speech processing. The development of therapies that can enhance plasticity in auditory networks and improve speech processing has the potential to impact the lives of individuals with Rett syndrome.

Objectives: Evidence suggests that precisely-timed VNS-sound pairing can drive robust neuroplasticity and enhance the benefits of rehabilitation. The aim of this study was to investigate vagus nerve stimulation (VNS) paired with auditory stimuli, to restore auditory processing in *Mecp2* transgenic rats.

Methods: Seventeen female *Mecp2* heterozygous rats and 8 female wild-type (WT) littermates were used in this study, and were obtained by breeding a *Mecp2* heterozygous Sprague Dawley female with a wild-type Sprague Dawley male. Female breeders were obtained from Horizon Discovery (SAGE labs), using zinc-finger nuclease technology that generated a 71 base pair deletion in Exon 4. The rats were exposed to multiple tones paired with VNS 300 times per day for 20 days. VNS was delivered as a 500-ms train of 15 pulses at 30 Hz. Each biphasic pulse was 0.8mA in amplitude and 100 μs in phase duration. These parameters are identical to previous studies. Auditory cortex responses were examined in heterozygous *Mecp2* rats following 20 days of VNS-tone pairing or no therapy. Of the 17 *Mecp2* rats, 2 were excluded from the study due to breathing complications during recording.

Results: Our data shows that *Mecp2* mutation alters auditory cortex responses to sounds compared to WT controls, consistent with a previous study in our lab (Engineer et al 2015). VNS tone pairing in *Mecp2* rats improves response strength to both tones and speech sounds compared to untreated *Mecp2* rats. Additionally, VNS tone pairing improved neural classifier consonant identification accuracy.

Conclusions: VNS is safe, FDA approved, and has already been utilized in clinical trials treating neurological disorders (Dawson et al 2016, Kimberley et al 2018, Kilgard et al 2018). These results demonstrate that VNS could be an effective therapy that could enhance auditory function, and ultimately improve the quality of life of individuals with Rett syndrome.

403.010 *(Poster)* Attention Atypicalities in Prenatal Valproate Rat Model of Autism Spectrum Disorder

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Background: Autism is a childhood developmental disorder characterized by deficits in social cognition and communication, restricted interests and repetitive behaviors. In addition, a wide range of changes in attentional abilities are also reported in human studies. Early attentional deficits have been proposed to play a causal role in the development of core symptoms that lead to diagnosis by the age of 3 or beyond. It is not clearly known that whether disruptions in the GABAergic neurotransmitter system during critical developmental time window would cause abnormal oscillatory pattern in the attentional circuit causing attention deficit in VPA rats.

Objectives: The present study aimed to assess attentional functions in a prenatal valproate (VPA) exposure model of autism spectrum disorder (ASD) in male and female rats. The study has also tested the underlying neural mechanisms of changes in attention in these rats.

Methods: The prenatal VPA model was validated by carrying out a battery of behavioural experiments such as social interaction, repetitive behaviour, anxiety, empathy and sensorimotor reflexes. We further carried out a detailed evaluation of attentional functions using five-choice serial reaction time task (5CSRTT), and measured different aspects of attentional and inhibitory control in rodents. We also carried out a large sample study of preattentional functions in order to characterize diversity on the ASD spectrum, and did a detailed evaluation of developmental milestones in VPA rats. To understand the mechanisms underlying attentional deficits in ASD, we did a immunohistochemical evaluation of GAD67, $GABA_A$ receptors α1 and β3 in the orbitofrontal cortex (OFC) and the posterior parietal cortex (PPC) – two regions that are involved in reward and attentional processing and also implicated in ASD pathophysiology. Finally, we carried out simultaneous spike and local field potential recordings in the OFC and PPC during rest and during attentional task performance.

Results: We found impaired 5-CSRTT performance in both male and female VPA rats who also showed abnormalities in social approach and empathy (pro-social behaviour) but no signs of anxiety, motivational or motor deficits. These rats had reduced expression of: GAD67 in OFC, GAD67 and β3 in PPC and increased expression of α1 in both regions suggesting disrupted GABAergic mechanisms. During attentional task, VPA rats showed reduced firing rates of OFC and PPC neurons and reduced coherence between these regions in theta, beta and gamma frequency bands.

Conclusions: The prenatal VPA model of ASD exhibits robust attentional deficits at behavior level associated with dysfunctions in GABAergic system. The impaired functional connectivity between OFC and PPC regions was reflected through asynchronous network interactions. The study, thus, contributes to the field of attention and reward processing network and provides evidence pertaining to the neural mechanisms of atypical attentional processing due to prenatal valproate exposure.

403.011 *(Poster)* Attention Orienting in the Neuroligin-3 Mouse Model of Autism

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Background: A deficit in attention orienting may be one of the earliest features in people with Autism Spectrum Disorder (ASD). Attention orienting is comprised of two components - exogenous and endogenous orienting. Exogenous orienting of attention is a stimulus-driven process in which one's attention is drawn automatically to salient external stimuli. Endogenous orienting of attention represents a goal-directed process in which expectations and/or knowledge of an individual determine where and when one's attention is given. To date, the neural mechanisms underlying the atypical attention orienting in autism remain unclear.

Our previous study successfully developed the Posner task for mice using touchscreen technology. It remains unknown whether ASD-associated genetic mutations will alter the attentional performance of mice in this task. Norepinephrine (NE) has been suggested to increase subjects' alertness in attention tasks. Nevertheless, it is unclear whether NE-modulating medications, such as atomoxetine (ATO), will improve attention orienting in mice with ASD-associated genetic mutations.

Objectives: Our objective was to investigate attention orienting in mice with and without the ASD-associated R451C (arginine to cysteine residue 451 substitution) mutation in neuroligin-3 (NL3) using the newly developed mouse Posner task. This study also aimed to test the effects of NE medications on these mice in this task.

Methods: Twenty NL3 mice and twenty wild-type (WT) mice were trained and tested in automated touchscreen chambers. Half of the mice in each cohort were randomly assigned to either the exogenous and or endogenous condition.

Mice were trained to sustain their nose-poke to a central dim square until the display of a peripheral target (a bright square). They were rewarded with strawberry milkshake for nose-poking the target. The targets were either validly or invalidly cued. In the exogenous tasks, the cue was a flash of light at the sides. In the endogenous tasks, mice were trained to learn a spatially-predictive image presented at the centre. In the probe, the validity of cues was 50% in the exogenous tasks, and 80% in the endogenous tasks. Effects of ATO (3mg/kg) on the response times and accuracy were assessed.

Results: In both tasks, mice showed higher accuracy and shorter response times in the validly versus invalidly cued trials. This effect is consistent with results in the human Posner task. There was no significant difference in performance between NL3 and WT mice on the measures of response times or accuracy. In the exogenous task, ATO increased response times and decreased accuracy similarly in both NL3 and WT mice. In the endogenous task, administration of ATO increased accuracy in NL3 mice compared to WT mice, with no effect on response times.

Conclusions: Our study did not find significant differences between NL3 mice and WT mice in attention orienting. Following the administration of ATO, however, NL3 mice showed better performance relative to WT mice in the endogenous task. Our findings support the use of Posner paradigm in mice, which has implications for understanding the neural mechanisms underlying the attention-orienting network in ASD.

403.012 *(Poster)* Autism Relevant Behavioral Deficits in Mice with Conditional Knockout of Pten in Parvalbumin-Positive Interneurons

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Background: Numerous genes have been implicated in the etiology of autism. *PTEN*, one of the autism-associated genes, originally identified as a tumor suppressor gene, negatively regulates cell proliferation and growth. *PTEN* germline mutations have been identified in individuals with Autism Spectrum Disorder (ASD), and may account for up to 5% of ASD cases. *Pten* is widely expressed in both glutamatergic and GABAergic neurons during development and adulthood. Since deletion of the *Pten* gene is embryonically lethal, conditional knockout mice have mainly been investigated. Mice with neuronal specific knockout of *Pten* in a subset of postmitotic neurons in the cortex, hippocampus, and cerebellum, exhibit abnormal autism-relevant behaviors. Conditional knockout of *Pten* from GABAergic cortical interneurons leads to preferential loss of somatostatin (SST)-interneurons and an increased ratio of parvalbumin (PV)/SST interneurons. In addition, single copy *Pten* deletion from PV-interneurons (PV-INs) impairs the formation of perisomatic inhibition. These lines of evidence demonstrate a central role of *Pten* in inhibitory cell development. However, the functional consequences of *Pten* knockout in PV-INs have not been addressed.

Objectives: Evidence from study of both postmortem human brain tissue and animal models suggests that neural circuits composed of PV-INs are key contributors to the pathology and symptoms of ASD. The aim of this study is to examine behavioral phenotypes in mice with conditional knockout of *Pten* in PV-INs.

Methods: *Pten*$^{loxp/loxp}$ mice were crossed with PV-Cre mice to generate PV-Cre$^{+/+}$/*Pten*$^{loxp/+}$ breeders. Both male and female littermates of PV-Cre$^{+/+}$/*Pten*$^{loxp/loxp}$ (PV-*Pten*-KO), PV-Cre$^{+/+}$/*Pten*$^{loxp/+}$ (PV-*Pten*-Het) and PV-Cre$^{+/+}$/*Pten*$^{+/+}$ (PV-*Pten*-WT) mice (2 - 3 months old) were used for behavioral tests. Locomotion was assessed by open field tests. Motor coordination/learning was assessed during three trials of accelerating rotarod tests for 2 consecutive days. The experimenters were blinded to genotype during data collection.

Results: In rotarod tests, the latency of fall off the rod in PV-*Pten*-Het mice during the first two trials did not differ to that in PV-*Pten*-WT mice. Starting from the third trial, the latency of fall in PV-*Pten*-Het mice was significantly reduced when compared to PV-*Pten*-WT mice. Rotarod performance in PV-*Pten*-KO mice was remarkably impaired, as the latency to fall off the rod was shorter than both PV-*Pten*-Het and -WT mice over six trials. Interestingly, in open field tests, there was no significant difference among genotypes in distance traveled. Compared with PV-*Pten*-WT mice, PV-*Pten*-KO but not PV-*Pten*-Het mice spent more time in the center area of open field tests (KO: n = 5; Het: n = 17; WT: n = 9).

Conclusions: Conditional deletion of autism-associated gene *Pten* in PV-INs results in anxiolytic-like behaviors and deficits in motor coordination/learning. More general locomotion is not affected by *Pten* knock-out in PV-INs. These findings suggest that *Pten* in PV-INs plays an important role in regulating anxiety and motor function. Further investigations will focus on other autism-relevant behaviors.

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403.013 *(Poster)* Cardiac Comorbidities and Their Effect in Autism Spectrum Disorder

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with an occurrence rate >1%, highly heterogeneous in etiology and symptomology. Although it is associated primarily with neurodevelopmental and behavioural deficits, it has various associated comorbidities, amongst which cardiac comorbidities are common. Cardiac abnormalities range from mild defects to severe congenital heart disease (CHD). Accumulating evidence suggests that the presence of severe cardiac abnormalities contributes to the observed neurodevelopment.

Objectives: Our work aims to explore the association between neuroanatomy and cardiac abnormalities, in a set of ASD-related mouse models. Here we present findings from the cardiac phenotyping of these models.

Methods: Cardiac phenotyping of 60-day old male mice from 12 prominent ASD-related mouse models is in progress, using ultrasound biomicroscopy (UBM) (VisualSonics Vevo 2100 system; Toronto, ON). Of that data, the sample processed includes: 9 mutant *Chd8*, 9 mutant *Arid1b*, 16 mutant *Shank (exon 4-9)* (Heterozygote), 11 mutant *Shank3 (exon 4-9)* (Homozygote), 3 wild-types. UBM metrics obtained include aorta diameter, EA ratio, velocity time integral (VTI), heart rate (HR), as well as left ventricular (LV) diameter, posterior and anterior wall thickness (systole and diastole). For all metrics, except for HR, the average of three measurements was used, which were taken from different cardiac cycles in the same ultrasound trace. LV measures were obtained in both long and short axis views, while aorta diameter was measured both from the left and right side of the heart. Multiple HR measurements were also obtained from the LV, EA and VTI traces, but were not averaged together (tested individually). A linear model was run on the sample comparing these metrics between the five groups. A significance level of 0.05 was chosen. False discovery rate (FDR) correction for multiple comparisons was performed.

Results: With a significance level of 0.05, significant differences were found for LV anterior wall thickness (Arid1b, Shank3-Het and Shank3-Hom vs wild-type), aorta diameter (Shank3-Hom vs Arid1b) and heart rate (Chd8, Shank3-Het and Shank3-Hom vs Arid1b). For other measures, trending differences were found between all groups, which didn't survive FDR correction.

Conclusions: Cardiac dysfunction is one of the comorbidities of ASD. Moreover, brain development is abnormal in CHD newborns, pre and post operatively. Thus, for a set of ASD-related mouse models, we expect that an abnormal cardiac phenotype would have an effect on neurodevelopment. From the comparative analysis on the sample UBM data (five metrics and five groups), significant differences were found in LV anterior wall thickness, aorta diameter and HR. For all other metrics, differences were found with uncorrected p-values at a 0.05 significance level, which didn't survive FDR correction, probably due to limited sample size. These results may change once the full dataset is collected and the analysis is repeated. Even more, for further analysis, more complex statistical models will be used, accounting for additional factors such as mouse weight and litter size.

403.014 *(Poster)* Circadian Rhythms in Models of Tuberous Sclerosis Complex

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Background: Sleep dysfunction is a common manifestation autism spectrum disorders (ASD) however, the mechanisms underlying this association remain unclear. Tuberous Sclerosis Complex (TSC) is a monogenetic cause of ASD.Tuberous Sclerosis Complex (TSC) is a monogenetic neurodevelopmental disorder that manifests with many cognitive, behavioral, and psychiatric symptoms, including sleep dysfunction that collectively comprise the TSC-Associated Neuropsychiatric Disorders (TAND). Sleep dysfunction is very common in TSC and exacerbates seizures, mood, and daytime function. Little is known however, about the biological mechanisms that link sleep and TSC-related brain abnormalities. The circadian system governs 24-hour oscillations in sleep-wake cycles, hormone secretion, metabolism, and physiology governed by a molecular transcriptional-translational feedback loop in which the transcription factor BMAL1 is essential. We have taken advantage of cellular and mouse models of TSC to identify biochemical, cellular, and behavioral links between dysfunction of the TSC/mTOR signaling pathways and the core circadian clock protein BMAL1.

Objectives: The goals of this presentation are to: 1) review the mechanistic relationships between TSC, mTOR signaling, and the circadian clock; 2) define how abnormal BMAL1's proteostasis and post-translational modifications are associated with TSC; and 3) present findings that link TSC/mTOR dependent gene expression to the circadian clock and; 4) suggest approaches by which we may use circadian biology to identify novel therapeutics for TSC and other ASDs associated with circadian dysfunction.

Methods: We use a combination of cell biology, neurobiology, biochemistry, CRISPR mouse engineering and animal behavior to identify the dysfunction of the circadian clock in TSC mutant cells and animals.

Results: We show that modulation of BMAL1 post-translational state and proteostasis are abnormal in TSC. Manipulation of these molecular defects can mitigate behavioral and lifespan phenotypes in mouse models.

Conclusions: Together, our work suggests that manipulation of the circadian clock may represent a previously untapped therapeutic target for TSC and perhaps other related mTOR-opathies associated with ASD.

403.015 *(Poster)* Developmental Hyperserotonemia Induced Alterations in Cerebellar Neuronal Circuitry and Motor Function.

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Background: Developmental hyperserotonemia (DHS) is considered the most consistent neurochemical finding reported in Autism Spectrum Disorder (ASD). This increased level of serotonin is of particular interest during development, at which time the neurotransmitter plays an active role in brain development, by promoting dendritic elaboration, synaptogenesis, neurogenesis, cortical organization and autoregulation of the serotonergic system. Accordingly, it has been hypothesized that during the early stages of neural development, abnormally increased amounts of serotonin could induce developmental abnormalities in various neural networks relevant to autistic behaviors. Of these behaviors are deficits in social cognition, disordered communication, restricted interests and repetitive behaviors. Furthermore, abnormalities in basic motor control, skilled motor gestures, and motor learning, are common in ASD. These behaviors have been attributed to a possible defect in the pre- and postnatal development of neural networks including the cerebello-thalamo-cortical pathway, which is involved in motor learning, automaticity of movements, and higher cognitive functions. It has been well established that cerebellar abnormalities are one of the most common structural and functional changes observed in ASD. Common cerebellar pathologies include dysplasia, variable loss of cerebellar Purkinje cells, and increased numbers of reactive neuroglia in the cerebellum and cortical brain regions. While evidence exists for some genetic underpinning of these changes, our initial work has demonstrated DHS can induce morphological changes in subpopulations of cerebellar neurons. With the investigations presented here, we intend to fill a critical void in our understanding of the role in which serotonin plays in the neuropathological and behavioral changes associated with ASD.

Objectives: The overall goal of this investigation is to better understand the effects of developmental hyperserotonemia (DHS) on cerebellar neuronal populations and behavioral expressions commonly linked to Autism Spectrum Disorder (ASD), and to continue to evaluate the DHS animal model as a model for ASD. We aimed to assess ASD linked behavioral expression through our investigation of motor coordination and motor learning in the DHS animal population. We also aimed to evaluate changes in Purkinje cell population numbers and connectivity following DHS treatment.

Methods: DHS and control animal motor coordination were assessed through repeated balance beam task performance. Animals were divided into groups that assessed the task performance and improvement while comparing the effects of an early motor skill training regimen. Following motor assessments, histological analysis of the posterior lobe of the cerebellum as performed using immunohistochemical and unbiased stereological techniques.

Results: Our preliminary results indicate that DHS treated animals' express decreases in motor task performance as well as a loss of posterior lobe Purkinje cells and glutamatergic climbing fiber synaptic connections. Our initial evaluations indicate some rescue of motor task performance and an increase in climbing fiber synaptic connections through an early intervention motor training regimen.

Conclusions: The current investigation into the DHS animal model for ASD has provided additional evidence of the putative effect excessive serotonin can have on the developing nervous system and subsequent behavioral expressions. We believe this work has furthered our understanding of the complex disorder and opened new lines of inquiry for investigation.

403.016 *(Poster)* Disruption of Csde1 Interferes Neurogenesis in Prenatal Developing Brain and Causes Autistic Behaviors

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Background: Autism spectrum disorder (ASD) is a group of neurodevelopmental disorders with substantial genetic and clinical heterogeneity. Our previous study found that disruptive variants of *CSDE1* lead to ASD. *CSDE1* encodes an RNA-binding protein that regulates RNA stability and translation processes. *Csde1* knockout mice are embryonic lethal at embryonic day 10 (E10).

Objectives: Although *CSDE1* is a high-risk ASD gene, the underlying roles and mechanisms of *CSDE1* in neurodvelpment and behaviors are largely unclear. We sought to investigate the roles of *Csde1* in cortical develpment and autistic behaviors using conditional knockout mice.

Methods: Nervous system conditional knockout mice ($Csde1^{fl/fl}$;$Nestin^{Cre}$) were generated by CRISPR-Cas9 techonology ($Csde1^{fl/fl}$) and crossed with Nestin-Cre mice. Immunofluorescence was used to investigate the phenotypes during cortical development. RNA-seq was performed to identify the differential expressed genes in embryonic cortex. $Csde1^{fl/fl}$ mice were then crossed with Nestin-CreERT2 mice to generate $Csde1^{fl/fl}$;$Nestin^{CreERT2}$ mice. Tamoxifen (100mg/kg) was given to induce knockout of Csde1 in $Csde1^{fl/fl}$;$Nestin^{CreERT2}$ mice at P21 via 1 daily intraperitoneal injection for 5 days. Three-chamber test, open-field exploration test, light-dark box test and marble-burying test were used to measure the autistic behaviors on $Csde1^{fl/fl}$;$Nestin^{CreERT2}$ mice.

Results: The $Csde1^{fl/fl}$;$Nestin^{Cre}$ mouse died at postnatal day 0 (P0). By immunofluorescence, we observed significant reduction of proliferating cells (neural progenitor cells and intermediate cells) at E16.5 in KO mice compared with $Csde1^{fl/fl}$ and $Csde1^{fl/+}$;$Nestin^{Cre}$. At E18.5 days, the number of cells in the deeper layer and the upper layer of cortex was significantly reduced in the KO mice compared with WT and HET. Transcriptome analysis at E16.5 revealed a dramatic differential expression pattern between $Csde1^{fl/fl}$;$Nestin^{Cre}$ and $Csde1^{fl/fl}$, while no substantial difference was observed between $Csde1^{fl/fl}$;$Nestin^{Cre}$ and $Csde1^{fl/+}$;$Nestin^{Cre}$. Gene ontology and pathway analysis showed that genes downregulated by Csde1 knockout are involved in regulation of cell cycle, DNA replication, Notch signalling pathway. Upregulated genes by Csde1 knockout were enriched for ribsome and synapse or synaptic plasticity related genesets. Behavior testing on $Csde1^{fl/fl}$;$Nestin^{CreERT2}$ mice were performed at P60. Our preliminary data showed that $Csde1^{fl/fl}$;$Nestin^{CreERT2}$ mice present deficits in social interaction, repetitive behavior and hyperactivity.

Conclusions: Csde1 mediates cortical neurogenesis likely via direct or indirect regulation of cell cycle. Disruption of Csde1 during postnal neurogeneisis might cause a series of autistic behaviors indicating a critical role of Csde1 in the development or function of postnally generated neurons.

403.017 *(Poster)* Effects of Gestational Diabetes and Metformin Exposure on Autism-like Behaviors and Oxytocin Signaling in Mouse Offspring

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Background: Gestational diabetes mellitus (GDM) was associated with an increased risk of autism was recently reported. In light of this, reports that the anti-diabetic drug metformin may help to control GDM raises the exciting possibility that its use might also curb autism. Yet use of metformin in pregnancy is still new, and it is readily transported across the placenta, so concerns have been raised about potential long-term adverse effects on offspring. A prior study demonstrated gestational metformin exposure reduced social interaction preference of male mouse offspring in absence of GDM. Therefore assessment of the impact of prenatal exposure to metformin in the context of GDM is warranted.

Objectives: To model GDM in mice and examine the effects of prenatal metformin exposure on male and female offspring brain oxytocin receptors, serum oxytocin levels and social interaction preferences and repetitive burying to show how GDM and metformin interact to affect these endpoints.

Methods: Mouse dams with pharmacologically induced GDM (by streptozotocin (STZ)), or high fat-high sucrose (HFHS) diet and their respective controls were treated with metformin (≈200 mg/kg/day) in drinking water or untreated water throughout pregnancy. Mouse offspring were tested for social interaction preferences in three chamber tests at 7-8 weeks old. Behavior data was collected by observers trained to measure a specific behavior (sniffing or time in chambers), and who were unaware of the treatment groups. The offspring mice were also tested for repetitive behavior via a marble-burying test. Following behavior tests the offspring were euthanized and their brain and serum was collected for measures of oxytocin receptor density and oxytocin levels.

Results: Overall the STZ treated dams had fewer litters born than dams from the other groups. No differences in social interaction preference were evident among treatment groups. For males, the mean ± SEM preferences were: control 63.2 ± 7.5 sec, metformin alone 39 ± 12.1 sec, STZ alone 53.3 ± 23.1 sec, and STZ metformin 58.6 ± 14.5 sec (N = 4-14). Female offspring had similar results. Likewise males and females exposed during gestation to HFHS diet ± metformin also exhibited no differences between groups by measure of sniffing time. Small numbers of surviving offspring were found in untreated STZ and HFHS groups. By contrast metformin appeared to increase the fertility of the dams in both the STZ and HFHS diet groups. There were no differences among treatment groups or sexes in marble burying, which averaged 5.6 ± 1.2 for male and 5.9 ± 1.8 for female offspring (N = 4–17). Metformin treatment increased oxytocin receptor density in the cingulate cortex and reduced serum oxytocin levels in male offspring without GDM.

Conclusions: While gestational metformin by itself impaired social interaction preference in male mice, when exposure occurred in the context of STZ or HFHS diet induced GDM, it was without a significant effect. Gestational metformin exposure alone also impacted oxytocin signaling in male offspring, but not in female offspring. However, in context of GDM metformin exposure did not significantly increase autism-like behaviors.

403.018 *(Poster)* Emergence of Sleep Problems in a Shank3 Mouse Model

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Background: Sleep problems affect a higher proportion of children with autism spectrum disorder (ASD) compared to typically developing children and are a strong predictor of severity of ASD core symptoms as well as behavioral problems. Children with ASD have difficulty falling and staying asleep from very young ages, resulting in chronic sleep deficiency throughout the developmental period. Studies in animal models suggest that sleep is important for brain development and function, but little is known about what causes sleep disturbances in ASD.

We focused our studies on *SHANK3*, a high confidence ASD gene candidate. Individuals with Phelan-McDermid Syndrome (PMS) carry deletions in chromosome 22q13.3, a region that includes *SHANK3.* Approximately 85% of PMS patients have an ASD diagnosis and we found that about half report chronic sleep problems, but the link between *SHANK3* mutations and poor sleep is not understood. Using a mouse model of PMS, we found that adult mice with mutation in *Shank3* (Shank3ΔC) have sleep problems that mirror insomnia symptoms in PMS patients. In PMS, sleep problems increase in early childhood and are maintained to adulthood. We hypothesize that loss of SHANK3 disrupts the normal development of sleep patterns, leading to problems falling and staying asleep.

Objectives: Determine the developmental emergence of sleep problems in Phelan-McDermid syndrome, and in *Shank3* mutant mice.

Methods: In this study, we used questionnaire data to guide our studies in mouse models to understand how sleep problems develop in ASD. We obtained sleep questionnaire data from PMS individuals with *SHANK3* mutations from the PMS Foundation International Registry. Sleep loss in mice and humans elicits specific changes in electroencephalographic (EEG) activity patterns that can be used to track sleep patterns and physiological markers of sleep need. In Shank3ΔC and control mice, we collected EEG and electromyographic (EMG) data to determine sleep-wake patterns, and used sleep-deprivation to induce periods of high sleep need.

Results: We find that *SHANK3* mutations are associated with sleep disturbances in both humans and mice. Children with PMS develop sleep problems between 5-12 years of age, including problems falling asleep, repeated awakening, and reduced sleep time. Similarly, we find that adult Shank3ΔC mutant mice have reduced sleep time, delayed sleep initiation following sleep deprivation, and reduced low-frequency EEG activity in non-rapid eye movement (NREM) sleep relative to littermate control mice. We find that adult responses to sleep deprivation emerge during adolescence in mice. Prior to this transition, low-frequency EEG activity during NREM sleep is normal in juvenile Shank3ΔC mice.

Conclusions: We show that sleep problems in PMS individuals emerge during early childhood. Sleep problems in Shank3ΔC mice also change across development. Adult Shank3ΔC mutant mice sleep less but have difficulty falling asleep following sleep deprivation. Changes in EEG activity in Shank3ΔC mice are present in adults but not juveniles, suggesting that they are the result of abnormal post-natal development. Overall, our study shows that SHANK3 is an important modulator of sleep during development.

403.019 *(Poster)* FMR1 KO Mice Exhibit Abnormal Rearrangements in a Synaptic Protein Interaction Network Following Activation of Glutamatergic Receptors

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Background: Cells utilize dynamic signaling networks to process information from multiple signaling inputs and synthesize coordinated responses. Despite the importance of signaling network dynamics, however, the logic underlying information flow through these networks is not well understood. Previously, we developed the quantitative multiplex co-immunoprecipitation (QMI) platform, which allows for the simultaneous and quantitative measurement of the amount of co-association between large numbers of proteins. Using QMI, we characterized the activity-dependent dynamics of a synaptic protein interaction network (PIN), with the goal of understanding the network level mechanisms underlying synaptic plasticity. We show that stimulation of distinct glutamate receptor types results in different modular sets of PIN rearrangements. Interestingly, this same targeted PIN is also disrupted in multiple models of ASD. As altered synaptic plasticity is a hallmark of various forms of ASD, these data raise the possibility that basal network disruptions in synaptic PINs are the result of an inability to correctly process glutamatergic stimuli. We hypothesize that the activity-dependent dynamics of our targeted synaptic PIN are disrupted in many forms of ASD, resulting in altered synaptic plasticity. To test this hypothesis, we will utilize the FMR1-/y knockout (KO) model of Fragile X (FXS) syndrome as this model is well-studied, with clear pathological mechanisms, demonstrated baseline PIN abnormalities, and known defects in mGluR5 signaling

Objectives: To identify specific deficits in information processing underlying altered glutamatergic signaling in the FMR1-/y KO model of FXS.

Methods: FMR1$^{-/y}$ KO and WT cortical neurons were stimulated with NMDA, DHPG, or aCSF control and changes in synaptic protein interactions were quantified by QMI. Similarly, cortical slices from P7, P17, and P60 FMR1$^{-/y}$ KO and WT male mice were treated with NMDA, DHPG, or aCSF control x 5 min and changes in synaptic protein interactions were again quantified by QMI. Principal component analysis (PCA) was utilized to reveal strong patterns in our QMI datasets. Interactions that were significantly different between groups were identified by a combination of weighted correlation network analysis (CNA) and adaptive non-parametric with an empirically determined alpha cutoff (ANC).

Results: PCA analysis of all interactions showed that FMR1$^{-/y}$ KO neurons or cortical slices treated with aCSF were shifted towards WT-DHPG, suggesting hyperbasal mGlur5 signaling. In addition, DHPG treatment failed to elicit separation from aCSF controls in FMR1$^{-/y}$ KO neurons and slices. By comparison, WT-NMDA and KO-NMDA showed both significant separation from controls, and strong overlap with each other.The interactions identified as significantly different between FMR1$^{-/y}$ KO aCSF and WT aCSF showed some variation between neurons and each age of cortical slices. We did however observe a consistent decrease in Homer_mGluR5 co-association.

Conclusions: Here, we showed that in a mouse model of FXS with known deficits in mGluR5 signaling, NMDA induced PIN rearrangements in KO animals was indistinguishable from controls. By comparison, mGluR5 signaling was clearly disrupted. Our results demonstrate a novel way of approaching intracellular signaling at the level of PINs, illustrate the molecular logic with which the synapse encodes its input states, and highlights specific mechanisms of logic-circuit disruption associated with ASDs.

403.020 *(Poster)* Global Electroencephalography and Sleep Characterization As Translational Biomarkers in an Angelman Syndrome Model

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Background: Angelman Syndrome (AS) is a rare (~1:15,000) neurologic disorder characterized by a wide range of symptoms including seizures, sleep disturbances, ataxia, motor deficits, developmental delay, impaired communication skills, intellectual disabilities, and microcephaly (Wheeler et al., 2017; Williams et al., 2006; Jiang et al., 1998). Due to the high prevalence of seizures (>80%) and sleep abnormalities (20-90%) in the AS population, electroencephalography (EEG) is a prominent tool used in clinical work and has shown abnormalities in epileptiform spike-wake discharges, increased delta waves of AS individuals, and reductions in REM sleep and sleep efficiency (Korff et al., 2005; Minassiam et al., 1998; Miano et al., 2004).

Objectives: The present experiments were designed to build upon previous clinical and preclinical findings of abnormal epileptiform spike-wake discharges, power spectral differences, and sleep dysfunctions by applying a scalp-based EEG approach over depth field potentials to the characterize excitability, seizure phenotypes, sleep-wake cycling, and spindle production.

Methods: Inbred, C57Bl/6J males were paired with heterozygous *Ube3a*$^{-/+}$ females, resulting in offspring with the maternal transmission of the *Ube3a* mutant allele (*Ube3a*$^{m-/p+}$) and their wildtype (*Ube3a*$^{m+/p+}$) littermates. At 8 weeks, mice were anesthetized and implanted with a wireless telemetry device designed to measure EEG and EMG in freely moving animals (DSI). To capture global EEG, two biopotential leads were attached to surgical screws 1.0mm anterior and 3.0mm posterior to the left and right of Bregma respectively. EMG activity was measured via two leads placed in the trapezius muscles of the animal. One-week post-surgery, subject EEG, EMG, and temperature were recorded for either a 24 or 48-hour baseline. Mice recorded for 24-hours were induced with 80 mg/kg pentylenetetrazole while EEG data from mice recorded for 48-hours was analyzed for sleep-wake cycles. EEG analysis and seizure characterization were evaluated using custom written scripts in Python.

Results: *Ube3a*$^{m-/p+}$ mice had increased delta power when compared to *Ube3a*$^{m+/p+}$ controls, replicating power spectral differences reported clinically. *Ube3a*$^{m-/p+}$ mice also displayed clear, robust phenotypes of atypical EEG activity and sleep disturbances commonly associated with AS.

Conclusions: Our results extend earlier field potential depth recordings (Sidorov et al., 2017, Born et al., 2017), with the advantage of a translational approach that will provide critical data necessary to further investigate the possibility of a cross-species AS EEG biomarker and will serve as a paramount output measure in numerous innovative therapeutic interventions, including antisense oligonucleotides, artificial transcription factors, and stem cell based viral deliveries.

403.021 *(Poster)* Impaired Oxytocin Release and Altered Synaptic Properties of Hypothalamic Oxytocin Neurons in Shank3-Deficient Rats

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Background: Mutations in the *SHANK3* gene are a leading cause of Phelan McDermid Syndrome (PMS) and account for up to 1-2% of total autism spectrum disorder (ASD) cases. Oxytocin was proposed as a potential therapeutic for treating ASD, although results from clinical trials were ambiguous. It has been suggested that variability in an individual's response to oxytocin could be attributed to underlying neurobiology associated with oxytocin release. We wanted to examine this in a rodent model that carries a mutation in the *Shank3* gene (*Shank3*$^{-/-}$ rat). We have previously demonstrated that lack of *Shank3* in this model impairs long-term social recognition memory and is accompanied by deficits in synaptic plasticity in the hippocampal and medial prefrontal cortex circuitry. Interestingly, both behavioral and synaptic plasticity deficits were reversed by acute treatment with oxytocin.

Objectives: In this project we are testing our hypothesis that social memory deficits in the *Shank3*$^{-/-}$ rats are due to functional impairments in the oxytocin system resulting from the lack of *Shank3*.

Methods: To examine the electrophysiological properties of oxytocin neurons in the *Shank3*$^{-/-}$ rats, we used viral vectors that label oxytocin neurons with a fluorescent marker and recorded electrical activity using in vitro slice electrophysiology. We used immunohistochemistry to quantify the number and intensity of signal from oxytocin neurons. To measure the total levels of oxytocin peptide in the hypothalamus of *Shank3*$^{-/-}$ rats, we used *in vivo* microdialysis.

Results: First, compared to their wild-type (WT) littermates, we found that *Shank3*$^{-/-}$ rats have a statistically significant shift to a larger distribution of amplitudes in both miniature and spontaneous excitatory postsynaptic potentials. These results suggest that *Shank3* mutation impairs synaptic transmission in oxytocin neurons. Second, while we did not observe an overall change in the number of oxytocin neurons, we did observe a statistically significant increase in oxytocin intensity in the hypothalamus of *Shank3*$^{-/-}$ rats, suggesting impaired processing of oxytocin. In order to determine if these changes impact the release of oxytocin, we measured oxytocin levels during the presentation of a social stimuli, as this has been previously shown to stimulate oxytocin release. As expected, we found that oxytocin levels did increase during social interaction in WT littermates. However, we did not detect any increase in *Shank3*$^{-/-}$ rats, suggesting impaired release of oxytocin.

Conclusions: Altogether, our findings suggest that *Shank3* mutation impairs the processing and release of oxytocin and that this may underlie the social memory impairments that we have reported in *Shank3*$^{-/-}$ rats. These findings are significant as they suggest that central release of oxytocin may be also impaired in human subjects with a *SHANK3* mutation and that these subjects may specifically benefit from treatment with oxytocin or with therapeutics that induce the endogenous release of oxytocin. Future studies are aimed at addressing the mechanisms by which *Shank3* deficiency leads to impairments in the oxytocin system and determining if restoring oxytocin neuronal function using chemo-genetic techniques or restoring *Shank3* expression itself in the hypothalamus is sufficient to reverse the social behavioral deficits observed in the *Shank3* rat model.

403.022 *(Poster)* Intranasal Oxytocin Improves Social Behavior in Laboratory Beagle Dogs (Canis familiaris)

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Background: Over the past several years the domestic dog (*Canis familiaris*) has become increasingly proposed as a model for comparative and translational neuroscience, including autism spectrum disorder (ASD). The translational value of a dog model stems from the recognition that dogs, during domestication, evolved a human-directed social competence and thus the phenotypic similarity between the dog and human symptoms are much higher than between the rodent and human symptoms. Moreover, these conditions occur naturally in dogs, and as such, the symptoms may be more homologous to the human condition and more likely to have similar etiology. It has also been shown that the oxytocin system plays a key role in modulating social behaviors in both dogs and humans.

Objectives: The aim of the present study was to investigate the effect of intranasal oxytocin in laboratory Beagle dogs in a test battery developed to assess social competence in this species.

Methods: A social competence test battery (short screening test, SCT) was established that included the following 9 indicator situations: free exploration of the testing environment, initiations of social contact by a familiar and an unfamiliar experimenter, food motivation, eye contact training, potentially threatening object (moving toy car), pointing and gaze following, choice based on human emotion, and threatening approach (by human). Thirty-six Beagles (all older than 1 year, 22 males and 14 females) participated in the study. Dogs received a single intranasal dose of 32 IU (8 puffs) oxytocin (Syntocinon, Novartis) and physiological saline (placebo) in a double-blind, cross-over design (using a 1-month wash-out period) 35-45 min before participating in the SCT. Subjects' behavior was video recorded during the SCT and 45 variables of the 9 situations were scored off-line by two independent, blinded observers. Generalized linear mixed model was used to analyse the main effects of treatment and repetition as well as the interaction of these factors on dogs' behavior (using the standard α=0.05 cutoff). This study was approved by the Local Ethical Committee of Gedeon Richter Plc. and was carried out in strict compliance with the European Directive 2010/63/EU regarding the care and use of laboratory animals for experimental procedures.

Results: Significant treatment effects were found in two indicator situations (initiation of social contact and threatening moving object). Dogs, after oxytocin administration, showed an increased responsiveness to social contact initiated by the familiar experimenter. Oxytocin also increased first reaction latency to the potentially threatening object and decreased the frequency of looking at the familiar experimenter.

Conclusions: Oxytocin clearly improved certain aspects of social behavior in a homogenous group of laboratory Beagle dogs based on the indicator situations of the SCT. The SCT can be used to investigate social competence in laboratory dogs and it may have the potential to detect pro-social effects of investigational compounds.

403.023 *(Poster)* Loss of Kmt5b Results in Structural Changes at the Skeletal Muscle Neuromuscular Junction

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Background: Genomic studies have highlighted the *KMT5B* (*SUV420H1*) gene as a significant target of disruptive variation in humans with intellectual disability, autism spectrum disorder, and developmental delay in motor coordination. KMT5B is a histone methyltransferase enzyme responsible for di-methylation of mono-methylated lysine residues at position 20 of histone H4 tails. Double-knockout of Kmt5b and its paralog Kmt5c in skeletal muscles of mice caused cell necrosis and an increase of internally nucleated muscle fibers, an indication of muscle fiber degeneration. *In vivo* studies further suggested that Kmt5b may maintain the quiescent muscle stem cell pool, which is required in cases of muscle injury. Thus, we hypothesized that motor delays in patients carrying pathogenic germline *KMT5B* variation are due to structural changes in skeletal muscle. Previous studies proposed that Kmt5b loss in mice is associated with muscle degeneration. Myopathies such as Duchenne Muscular Dystrophy, characterized by progressive muscle degeneration, exhibit increased fragmentation of the nerve and decreased synaptic area at the neuromuscular junction (NMJ), the nerve contact point for skeletal muscle innervation, resulting in denervation.

Objectives: To identify NMJ morphological changes associated with constitutive *Kmt5b* loss.

Methods: To model constitutive Kmt5b loss, mice with a lacZ gene trap cassette inserted into the intron between Kmt5b exons 4 and 5 on a C57BL/6N background (KMT5B$^{tm1a(KOMP)Wtsi}$) were used. Littermate breeding produced wild-type (WT) and heterozygous (HET) offspring, which most closely resembled the genotypes observed in the *KMT5B* patient population (disruptive heterozygous).

Due to sex biases in autism diagnosis and in psychomotor development, we chose to study both sexes independently. Eighteen female and 21 male mice (WT and HET), were transcardially perfused at postnatal day 42 with paraformaldehyde before dissection of the soleus (SOL).

Immunohistochemistry used whole-mount muscle tissues with antibodies specific for neurofilament medium and synaptic vesicle 2 for identification of nerve structure and tetrarhodamine α-bungarotoxin for identification of the muscle structure. Confocal imaging (40X; Nikon Ti-E inverted microscope with Yokagawa spinning disk) was used to quantify total NMJ area and fragmentation (discontinuity, continuity, and branch points) of both the nerve and muscle using the BinaryConnectivity plugin with ImageJ software.

Results: Characteristics of SOL muscles were compared using two-way ANOVA (independent factors: sex and genotype). In female mice, nerve branch points were significantly increased in HET mice compared to WT mice (two-way ANOVA $F(1,35) = 9.007$, $p = .004$; Sidak's post-hoc test $p = 0.036$). Other nerve fragmentation measures showed similar trends: discontinuity (two-way ANOVA $F(1,35) = 3.527$, $p = 0.068$) and continuity (two-way ANOVA $F(1,35) = 3.942$, $p = 0.055$). Combining sex groups, muscle discontinuity increased in HET mice compared to WT mice (two-way ANOVA $F(1,35) = 6.460$, $p = 0.015$).

Conclusions: Our results indicate an increase in fragmentation of the nerve and a sex biased effect in our *Kmt5b* HET model, suggesting that structural differences may contribute to motor abnormalities and developmental delays in individuals carrying disruptive *KMT5B* variation. Further studies examining muscle contraction and NMJ health may provide greater insight into Kmt5b's role in developmental motor delay.

403.024 *(Poster)* Maternal Vs. Paternal Mthfr Deficiency As a Risk Factor for Social Deficit and Seizure Susceptibility in Offspring Mice.

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Background: The pathophysiology behind Autism Spectrum Disorder (ASD) is thought to be multifactorial, involving genetic and environmental factors. Various maternal traits have been linked to the development of ASD, including polymorphism of the *Mthfr* gene, which was found in high prevalence in mothers of ASD patients. Recently, paternal traits, such as age at conception, have also been shown to contribute to the risk of ASD development.

One of the proposed mechanisms for the development of ASD is Inhibitory/Excitatory (I/E) imbalance, supported by significant alternations in the GABA pathway in ASD and animal models of ASD. Further support for this hypothesis is the high incidence of epilepsy seen in ASD patients.

In previous studies we showed that in mice maternal *Mthfr*+/- genotype is correlated with both ASD like behavior and alternation in the I/E balance in the offspring.

Objectives: To investigate the role of paternal vs. maternal *Mthfr* deficiency in the development of ASD in the offspring and on the I/E balance.

Methods: Study design: *Balb/c Mthfr*+/- (HT) mice were mated with C57BL *Mthfr*+/+ (WT) mice to generate WT and HT, F1 offspring. Five groups representing maternal:paternal:offspring genotypes were created: 1.WT:WT:WT (n=6) 2.HT:WT:WT (n=8) 3.HT:WT:HT (n=8) 4.WT:HT:WT (n=5) 5. WT:HT:HT (n=5). Three-month-old male offspring were tested.

Sociability was evaluated using the "Social proximity" test. I/E balance was examined by: 1. susceptibility to seizures induced by Pentylenetetrazol (PTZ). 2. The density of Parvalbumin (PV)+ inter-neurons (sub-population of inhibitory neurons) in the cingulate cortex.

Results: Social deficit was found in all offspring of *Mthfr*+/- parent, affected by maternal and paternal genotypes, both reducing number of social interactions by >40% compared to the offspring of WT ($F_{1,34}= 17.08$, $p<0.001$ and $F_{1,34}= 16.619$, $p<0.001$).

A trend of increased susceptibility to seizures induced by PTZ was found in offspring of *Mthfr*+/- deficient mother ($p=0.07$) and father ($p=0.05$), suggesting alternation in the I/E balance. Lastly, we found changes in the inhibitory system shown by an alternation in the laminar distribution of PV+ neurons in the cingulate cortex in offspring of *Mthfr*+/- parents. Density of PV+ neurons was found to be increased in layer 1 and decreased in layers 4-5 in offspring of *Mthftr*+/- father and mother compared with offspring of two *Mthfr*+/+ parents ($P<0.01$, $P<0.05$).

Altogether, the results of our study show that paternal *Mthfr* genotype influences ASD-like behavior and the I/E balance in the offspring as much as maternal genotype.

Conclusions: These findings could hint that *Mthfr* induced changes in the germ cells mediate the mechanism by which *Mthfr* deficiency affects ASD development. The parental *Mthfr* genotype effect does not seem to be attributed only to the lack of *Mthfr* in the intra-uterine environment as suggested before, but peri-conceptional alternations may be sufficient to predispose the developmental trajectories towards ASD.

We propose our model is multi-factorial, with the development of ASD resulting from several different factors that arise from *Mthfr* genotype.

403.025 *(Poster)* Murine Hearing-in-Noise Testing (HINT) Using Conspecific Ultrasonic Vocalizations (USVs)

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Background: Progress on treatments for communication difficulties in ASD has been hindered by lack of animal models with reliable assays of communication processing. Currently, mouse models of ASD have been frequently studied, but the focus has been specifically on the output and repertoire of social vocalizations (Burkett et al. 2015). Moreover, the ability to identify relevant speech signals in one's environment is clearly important for early social development, but also continues to play a critical role in learning and adaptive functioning across the lifespan. For example, a recent study of children with ASDs found that atypical scores on the Short Sensory Profile's Auditory Filtering domain were significantly related to poor academic performance and inattention to cognitive tasks (Ashburner et al, 2008). Children and adolescents with ASD also exhibit significant difficulties hearing in background noise, or auditory filtering.

Objectives: We investigated auditory filtering capabilities using our hearing-in-noise test for the mouse, which makes use of the acoustic startle to assess the mouse's ability to detect prepulse signals/targets presented in quiet or embedded in masking noise. Our prepulse signals/targets were either traditionally used noise bursts or novel conspecific ultrasonic vocalizations (USVs).

Methods: We modified established methods to test acoustic startle abilities behaviorally (Ison et al., 2017) to develop a hearing-in noise test for the mouse (mouse HINT). Our mouse HINT test made use of the acoustic startle response (ASR) and the ability of prepulses to inhibit the ASR [i.e., prepulse inhibition (PPI)] to assess the mouse's ability to detect prepulse signals presented in quiet or embedded in masking noise. We determined signal-to-noise thresholds to both a noise burst (NB) and ultrasonic vocalization (USV) stimuli in quiet and in broadband noise. We assessed these differences to ten different conspecific mouse USVs separately or acoustical combined as "mouse babble" and tested in three mouse strains: C57Bl/6; FVB, 129SvEv, and C57Bl/6 x 129 SvEv. In addition, as mouse pups lacking the CNTNAP2 gene [CNTNAP2 (-/-)] emit less retrieval calls, and exhibit reduced repertoire of syllable vocalizations (Burkett, et al. 2015), we examined USV detection capabilities in mice lacking the CNTNAP2 gene.

Results: We determined there were mouse strain differences in USV discrimination abilities, yet for all strains tested the combination of 10 USVs ("mouse babble") was the most effective startle stimulus in both quiet and background noise, and was more effective as a prepulse stimulus than a noise burst commonly used in ASR testing. Moreover, CNTNAP2 (-/-) mice exhibited less robust startle responses to mouse "babble" in both quiet and background noise.

Conclusions: We conclude conspecific USVs are a more robust and salient auditory target to study prepulse inhibition of acoustic startle than noise burst targets, and the CNTNAP2 (-/-) ASD mouse model not only has limited USV production, but also exhibits limited USV detection and discrimination capabilities. This type of analysis may provide a basis for future therapeutic test platform aimed at reducing auditory behavioral deficits.

Behavioral Genetics

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404.001 *(Poster)* Altered Sensory Processing Predicts Reduced Adaptive Functioning in Individuals with and without Autism - a Twin Study

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Background: Altered sensory processing in individuals with Autism Spectrum Disorder (ASD) are gaining increasing attention in recent years and are now included in the DSM-5 diagnostic criteria. Studies indicate that altered sensory processing, such as over-reactivity or hypo-sensitivity to sensory input, can negatively influence an individual's ability to independently master daily living situations (adaptive functioning), which is commonly reduced in individuals with ASD. However, more research is needed to differentiate the effects of sensory processing vs ASD or other neurodevelopmental disorders (NDD) on adaptive functioning. Further, little is known regarding genetic and environmental in influences on this association.

Objectives: We aimed to investigate the potential impact of sensory processing on adaptive functioning beyond the effects of clinical diagnoses and intellectual ability. In addition, we modelled this association both across the sample and within twin pairs in order to assess a potential impact of familial factors.

Methods: We recruited 299 twins (148 pairs; one triplet, 174 monozygotic; aged 10-36 years), of which 62 fulfilled diagnostic criteria for ASD and 61 for other NDDs while 176 did not fulfil diagnostic criteria for any NDD. Sensory processing was assessed using the Adult/Adolescent Sensory Profile (AASP), a 60-item self-report measure differentiating four sub-scales (low registration, sensory sensitivity, sensory seeking and sensory avoiding). Adaptive functioning was assessed using the parent-report Adaptive Behavior Assessment System-II (ABAS-II) and the scaled general adaptive functioning score was used. The association between the four AASP domains and general adaptive functioning was modelled both across the sample and within twin pairs using linear regression analysis while adjusting for ASD as well as other NDD diagnosis and intellectual ability (assessed using the Wechsler Intelligence scale for adults or children). Across individuals, age and sex was also controlled. In order to investigate the possibility that sensory processing affects adaptive functioning differently in individuals with and without ASD, we re-run the models while adding the interaction between AASP sub-scale and ASD diagnosis status (1, 0).

Results: Across the sample, but not within twin pairs, sensory sensitivity and sensory avoiding reduced adaptive functioning beyond diagnoses (b=-.3, SE=.1, p<.005). ASD diagnosis predicted reduced adaptive functioning most strongly, both across individuals (b=-25, SE=3 p<.0001) and within-pairs (b=-19, SE=4, p<.0001). Only the interaction between sensory seeking and ASD diagnosis was significant, and post-hoc analysis revealed a negative association (b=-.8, SE=.3, p<.01) between sensory seeking and adaptive functioning only in individuals diagnosed with ASD but not in individuals with other NDDs or no NDD.

Conclusions: Alterations in certain domains of sensory processing, namely sensory sensitivity and sensory avoiding, predict lower adaptive functioning, even beyond ASD/NDD diagnosis and intellectual ability. This indicates that being unusually sensitive to sensory input or avoiding sensory input more might reduce an individual's ability to independently function in daily life. Only for sensory seeking, the association was different in people with vs without ASD diagnosis, indicating that sensory seeking behaviors in people with ASD diagnoses might be less compatible with adaptive functioning and potentially of a different quality than in individuals without ASD diagnosis.

404.002 *(Poster)* Characterizing the Relationship between Social Impairment and Autism Symptomatology in FOXP1 Syndrome

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Background: FOXP1 syndrome, a rare genetic disorder caused by deletions or mutations of the Forkhead-Box P1 (FOXP1) gene, has been identified as a single gene cause of autism spectrum disorder (ASD). Individuals with FOXP1 syndrome present with an array of neurodevelopmental and behavioral features that span across the spectrum of ASD symptoms, and cause adaptive functioning impairments. Socialization, an adaptive skill at the core of ASD defined as someone's ability to understand and maintain relationships, is universally affected in FOXP1 despite only 25% of individuals meeting full ASD criteria. Factors influencing socialization in ASD broadly are not fully understood and have been the focus of extensive research given its therapeutic implications. To this end, characterizing the relationship between the ASD phenotype in FOXP1 syndrome and socialization impairments stand to provide insight into social functioning in ASD.

Objectives: To characterize the relationship between ASD symptom domains in FOXP1 syndrome and impairment in socialization.

Methods: Eleven caregivers of children with FOXP1 syndrome (7 female; ages 3-15; 25.0% ASD) completed the Social Responsiveness Scale-Second Edition (SRS-2), the Behavior Assessment Symptom for Children (BASC), the Repetitive Behavior Scale-Revised (RBS-R) and the Vineland Adaptive Behavior Scales, 3rd edition (Vineland-3). The SRS-2 provides an objective measure of symptoms associated with autism and produces two subscales which align with DSM-5 criteria: social communication and interaction (SCI), and restrictive interests and repetitive behaviors (RRB). The RBS-R quantifies repetitive behaviors in ASD. The Socialization subscale of the Vineland-3 assesses interpersonal relationships, play and leisure, and coping skills. Associated behavioral features were measured with the BASC. Symptoms known to cause impairments in social functioning were also included for analysis. Pearson coefficient correlations (2-tailed) were used to examine relationships between variables of interest, with significant values compared using Fisher's r to z transformations.

Results: Restrictive and repetitive behaviors were significantly and negatively correlated with the Socialization subscale of the Vineland-3 (SRS-RRB, r = - 0.7, p = 0.009; RBS-R, r = - 0.8, p = 0.03). However, no significant association (all $p > 0.05$) was found between the SRS-SCI subscale, nor with any of the SRS treatment subscales (awareness, cognition, communication and motivation). The adaptive composite of the Vineland was significantly correlated with RBS-R total score (r = - 0.7, p = 0.03). The BASC Hyperactivity was the only clinical scale significantly correlated with the socialization subscale of the Vineland-3 (r = -0.7, p = 0.04). Fisher's transformations didn't find differences between values (all $p>0.5$).

Conclusions: Our results indicate that for children with FOXP1 syndrome repetitive and restrictive behaviors, but not deficits in social communication, are the culprit for impairment in social functioning. Further, as it has been reported in idiopathic ASD, hyperactivity was negatively correlated with social functioning. Interestingly, this association did not extend to other externalizing symptoms. These findings have meaningful implications for the evaluation and treatment of children with FOXP1 syndrome and shed light into the complex interaction between genetics, clinical features and adaptive functioning in ASD. Future studies should include additional observations and measures of cognitive function.

404.003 *(Poster)* Disentangling Autism Heterogeneity through Multivariate Genetic Analyses

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Background: Autism spectrum disorders (ASD) are complex, heritable and highly heterogeneous neurodevelopmental conditions, and nearly half of the total variance in ASD liability can be attributed to common genetic variation. Clinical symptoms often co-occur with other disorders and there is mounting evidence for a considerable genetic heterogeneity between ASD diagnostic subcategories. Recent research showed that common risk variants appear to be similarly relevant to both high- and low-functioning ASD, as well as to patients with and without *de novo* mutations, involving at least partially distinct aetiological mechanisms. Here, we investigate whether clusters of co-occurring ASD symptoms vary in their common genetic architecture and manifest as multiple, distinct, overarching genetic factors when studying a representative sample of individuals with ASD.

Objectives: In this Simons Foundation-funded study, we aim to disentangle autism heterogeneity through multivariate genetic analysis of co-occurring ASD symptoms using structural models and a case-only design.

Methods: Co-occurring ASD symptoms were collected through online assessment from ~5000 unrelated ASD patients of Caucasian ancestry with genome-wide genetic data (Infinium Global Screening Array-24 v.1.0; Simons Foundation Powering Autism Research for Knowledge (SPARK)). A total of 41 phenotypes related to cognitive, motor, social and language abilities and coexisting psychiatric diagnoses, collected using a Basic Medical Screening Questionnaire, a Background History Form, the Lifetime Social Communication Questionnaire (SCQ), the Repetitive Behavior Scale-Revised (RBS-R), and the Developmental Coordination Disorder Questionnaire (DCDQ), were selected for analysis. Within-sample SNP-heritability (SNP-h_s^2) and genetic correlations (r_{gs}) were estimated using Genome-wide Complex Trait Analysis (GCTA) software, capturing here polygenic heterogeneity. Multivariate genetic-relationship-matrix structural equation modelling (GSEM) was used to model shared and unique genetic aetiologies of co-occurring phenotypes. All traits were adjusted for age, age squared, sex and principal components.

Results: Among SPARK participants with ASD, we find evidence for within sample heterogeneity with respect to RBS-R based ritualistic behaviour (SNP-h_s^2=0.37, SE=0.12, p=0.0016). A similar trend was found for multiple age of onset phenotypes and subscales of the RBS-R and DCDQ (SNP-h_s^2 range=0.18- 0.30), while there was little evidence for within-sample heterogeneity with respect to cognitive ability and trained skills like bladder control, as captured by common variation. The strongest genetic correlations were observed between oppositional defiant disorder and sameness behaviour (r_{gs}=1, SE=0.44, p= 0.0042), between ritualistic and self-injurious behaviour (r_{gs}=0.78, SE=0.25, p= 0.0086), and between reported language delay/disorder and restricted behaviour (r_{gs}=-0.98, SE=0.51, p= 0.0072). Initial GSEM models provide evidence for the existence of a common genetic factor that is shared between language delay/disorder and specific RBS-R subscales.
Conclusions: This study provides evidence for genetic heterogeneity within the common genetic architecture of ASD and identifies genetic links between co-occurring symptoms that suggest symptom-specific overarching genetic factors.

404.004 *(Poster)* The Genetic and Environmental Architecture of the Association between Synesthesia and Autistic Traits - a Twin Study

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Background: Synesthesia is a non-pathological sensory condition where certain sensory stimuli lead to additional sensations in the same or a different sensory modality. Synesthesia is a heritable condition and prevalent at ~4% of the general population. Further, it co-occurs with Autism Spectrum Disorder (ASD) and similar to individuals with ASD, synesthetes differ from the general population in their perceptual profiles including sensory sensitivity and attention to details. This suggests that there might be a link between the two conditions. However, the genetic and environmental contributions to this association are unknown. Moreover, previous studies indicate that synesthesia is more strongly associated with autistic traits from the non-social domain (restricted/repetitive patterns of behaviors and interests; RRBI), while studies in this research area sparse.
Objectives: We investigated the genetic-environmental architecture underlying the association between synesthesia and ASD in an ongoing population based twin study. Further, we explored whether the association might be restricted to the RRBI trait domain.
Methods: For this preliminary analysis, we selected all to date collected same-sex twin-pairs from the Child and Adolescent Twin Study in Sweden (CATSS) who completed a short screening for synesthesia at age 18yrs (N=288 twin pairs of which 128 were monozygotic and 159 were dizygotic) when filling in a large online survey on mainly their mental and physical health. On the synesthesia screening, participants rated whether and to what extent they believe to experience eight different types of synesthesia and the total sum score was used as synesthesia trait measure. Twins also completed the Autism-Tics, ADHD and other Comorbidities inventory (A-TAC), which assesses autistic traits and co-morbid problems. Classic twin modelling was conducted in R (OpenMx), modelling the impact of additive genetics (A), shared environment (C) and non-shared environment (E) on the association between synesthesia traits and ASD traits. Further, non-parametric correlations were used to explore the association between synesthesia traits and the three domains of the autistic traits measure from the A-TAC.

Results: The association between synesthesia and ASD was largely genetic (95%) and the shared environment component (including all non-genetic factors that make twins similar to each other) was dropped since including it did not improve model fit (p=.9). The correlation between synesthesia and general ASD traits was small (Spearman's rho=.1; p=.008) and driven by the RRBI sub-scale alone (Spearman's rho=.1; p=.003) while the other two sub-scales (social and communication domains) did not correlate with synesthesia (Spearman's rho=.04; p>.1).
Conclusions: We conclude that the association between self-reported synesthesia traits and self-reported autistic traits is small, largely genetic, and driven by the RRBI domain of the autism spectrum. The results need to be replicated in a larger sample. However, they do provide a first insight into the genetic and environmental contribution to the association between synesthesia and ASD.

Behavioral Neuroscience

POSTER SESSION — **BEHAVIORAL NEUROSCIENCE**
405 - Behavioral Neuroscience Posters

405.001 *(Poster)* A Behavioral and Neural Analysis of Inhibitory Control in Toddlers and Preschoolers with and without ASD

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Background: Impairments in executive function (EF), higher-order cognitive functions that underlie goal-directed behaviors, have been identified in many children with Autism Spectrum Disorder (ASD). However, behavioral studies have not shown how or when EF impairments may develop in this population. Electrophysiological measures (i.e., electroencephalogram (EEG)) may increase understanding of brain-behavior relationships related to prefrontal cognitive processes, such as EF (Bell & Cuevas, 2012). However, this combined approach to measuring EF among preschoolers with ASD has not yet been examined.
Objectives: To compare EF development on a behavioral and neural level in children (two- and four-year-olds) with and without ASD.

Methods: Two- and four-year-old children with ASD (n=31) and typically developing (TD) controls (n=35) completed lab-based tasks that measured EF. Consistent with previous studies, EF behavior was assessed by performance on two looking tasks (A-not-B; Bell & Adams, 1999 and A-not-B with invisible displacement (ID); Morasch & Bell, 2011). The total number of correct reversals summed across both tasks was used as the primary measure of inhibitory control of a prepotent response, a principal component of EF. Higher scores indicated better performance. Additionally, the relation between autism symptoms and EF was assessed based on scores from the Autism Diagnostic Observation Schedule collected at the baseline visit (ADOS-2; Lord et al., 2008). Finally, EEG data was recorded on a 128-channel Hydrocel Geodesic Sensor net during EF tasks (A-not-B: two-year-olds n=17, four-year-olds: n=36; A-not-B with ID: two-year-olds: n=14, four-year-olds: n=28). Four minutes of continuous EEG data was collected using NetStation software (Electrical Geodesics Inc., Eugene, OR) during EF tasks. EEG data will be processed using the BEAPP (Levin et al., 2018) pipeline. The 6-9Hz alpha frequency will be examined following prior studies (e.g., Morasch & Bell, 2011).

Results: A series of ANCOVAs controlling for developmental level showed that the TD group performed significantly better than the ASD group on the collapsed EF score ($F(1,65)=31.29$, $p<.001$; TD: $M=6.80$ $SD=2.157$, ASD: $M=3.48$ $SD=2.35$) and the individual EF tasks: A-not-B ($F(1,58)=21.97$, $p<.001$, TD: $M=5.16$ $SD=1.37$, ASD: $M=3.11$ $SD=2.00$) and A-not-B with ID ($F(1,57)=10.28$, $p=.002$; TD: $M=2.10$ $SD=.98$, ASD: $M= 1.00$ $SD=.85$). Additionally, a bivariate correlation indicated a significant negative moderate relation between the total ADOS Score and EF ($r(15)=-.489$, $p<.05$) among two-year-olds with ASD; no relation was detected among four-year-olds.

Conclusions: Results of the current study suggest that young children with ASD display EF impairment. Results also showed a relation between autism symptoms and EF. Specifically, two-year-olds with more severe autism symptoms showed greater impairments in EF, consistent with the developmental level for which the A-not-B task was designed. Research has indicated that executive dysfunction is common among those with ASD. Individual differences in emerging EF within this population may provide a means of understanding heterogeneity in early symptom expression. In the coming months, we will continue to collect and analyze EEG data from this EF task, which will be presented with behavioral data. This may increase understanding of neurocognitive processes within ASD preschoolers on a behavioral and neural level.

405.002 *(Poster)* Altered ERPs during Reversal Learning Provides Clues to Behavioral Rigidity in Fragile X Syndrome

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Background: Fragile X Syndrome (FXS) is the most common inherited intellectual disability and monogenic cause of autism spectrum disorder. Behavioral flexibility, or the ability to shift and maintain new behavioral responses based on changes in environment, is highly impaired in FXS. Behavioral rigidity may look like resistance to change in routines and increased anxiety in novel or unexpected situations. Parent-report measures and neuropsychological test document behavioral flexibility deficits in FXS. Still the component neural processes underlying these deficits remain unclear. With limited mechanistic understanding, treatment development and symptom relief is stalled.

Objectives: Using a Reversal Learning EEG paradigm, we aimed to identify brain processes affecting behavioral rigidity in FXS. Ultimately, we hope to help the identification of potential translational biomarkers of behavioral rigidity in FXS in order to enhance disease understanding and advance treatment development.

Methods: Fifteen participants with full-mutation FXS (8 female, aged 15-45 years) and 15 typically-developing controls (TDC; age- and sex-matched) completed a deterministic reversal learning paradigm during continuous EEG recording using the 128-channel EGI system. Participants were instructed to select the box in the correct location (as indicated by coin). Unexpected reversals in behavioral response preference (as indicated by red 'X') occurred randomly following 3-5 consecutive correct responses. Data were epoched from -500 to 800 ms with respect to the onset of feedback stimuli (coin or red X). We examined three ERP components, each occurring following feedback onset: N1, P3a, P3b. ERPs were defined as the minimum or maximum amplitudes in a time window centered on the grand average peak amplitude +/- 50 ms. Average amplitude and latency of each peak were calculated for each participant.

Results: Individuals with FXS performed as well as TDC based on the number of reversals achieved. N1, P3a amplitudes were greater for FXS than TDC, for both reversal and non-reversal feedback. P3b was of greater amplitude and occurred later in the FXS group relative to TDC group for both trial types. Parent-rated social avoidance and stereotypy predicted P3b amplitude and latency during reversal trials.

Conclusions: Though individuals with FXS performed as well as controls during a reversal learning task, individuals with FXS demonstrated hyper-responsiveness to visual feedback stimuli. This is consistent with findings of sensory hyper-responsiveness previously identified in sensory and association cortices, suggesting cortical hyper-excitability also is present in the frontal-striatum-parietal circuitry critical for behavioral flexibility. Differences in the time course and power related to task updating suggest individuals with FXS may require prolonged duration and use different cortical mechanisms to process feedback when determining whether a subsequent behavior change is needed. Importantly, these brain-based biomarkers were linked to parent-reported clinical features of behavioral rigidity. Clinically, our findings indicate 1) visual feedback regarding the continuation (or not) of behavior may be overwhelming and 2) it may be subsequently harder to decide what to do with the feedback information, thus requiring additional time to process feedback and change behavior. Together, our findings implicate targeting hyper-responsiveness and task updating processes for future therapeutic interventions and translation to preclinical models.

405.003 *(Poster)* Altered Striatum Centered Brain Structures in SHANK3 Deficient Chinese Children with Genotype and Phenotype Profiling

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Background: *SHANK3* deficiency represents one of the most frequent, monogenic risk factor for autism spectrum disorder (ASD) and *SHANK3* caused ASD presents a unique opportunity to understand the underlying neuropathological mechanisms of ASD.

Objectives: To investigate the neuromorphometry and clinical characteristics of Chinese children with *SHANK3* deficiency by neuroimaging and neurobehavioral evaluation.

Methods: This is a case control study. Subjects were recruited and conducted from Aug 1, 2015 to Aug 31, 2017 in the Neurodevelopment Clinic of Children's Hospital of Fudan University. Among the total of 72 children participating in the study, 14 children have confirmed *SHANK3* genetic mutations, 26 have idiopathic ASD without *SHANK3* and other common genetic defect, and 32 were typically developing children as controls. Genetic tests, comprehensive clinical and neurobehavioral evaluations, as well as brain imaging were conducted for these subjects. Genetic mutations including chromosomal deletions and point mutations of *SHANK3* were identified or confirmed by MLPA, chromosome microarray, WES or Sanger sequencing methods. Comprehensive clinical and neurodevelopment evaluations including diagnostic evaluation of ASD were performed by experienced development pediatrician or certified ADOS and ADI-R administrators. Differences in quantitative grey matter indices were assessed using voxel-based morphometry (VBM) while in white matter were analyzed with tract-based spatial statistics.

Results: Phenotypically, we described several previously unreported clinical features and manifestations including nostril eversion (100%), sensory stimulus seeking (64%), dental abnormalities (43%), hematological problem (21%) and prominent granulation tissue (7%), as well as common features of *SHANK3*-related ASD and chromosome 22q13.3 deletion (i.e. Phelan-McDermid syndrome, PMS) consisting of hypotonia, global developmental delay, and mild dysmorphic features.

For the grey matter, VBM analysis revealed decreased gray matter volume (GMV) in dorsal striatum, amygdala, hippocampus and parahippocampal gyrus ($P < 0.05$, corrected for family-wise error, FWE). For the white matter, tract-based spatial statistics (TBSS) results demonstrated decreased FA in multiple tracts mainly with projection fibers and association fibers, including internal capsule, external capsule, cerebral peduncle, sagittal stratum, and etc. ($P < 0.05$, FWE corrected).

Conclusions: For the first time, we report that the disrupted striatum centered brain structures, both in grey and white matter, are associated with *SHANK3* deficient children. Monogenic samples of current study offer specific insights into the neuroimaging studies of ASD. The discovery may suggest a path for future functional connectivity studies to allow for more in-depth understandings of the abnormal neural circuits and the underlying neuropathological mechanisms.

405.004 *(Poster)* Neuroimaging Evidence of Social Subtypes of Autism Spectrum Disorder

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Background: Research into the neurobiology of autism spectrum disorders (ASD) is complicated by the broad heterogeneity of the disorder, leading to inconsistent or irreproducible results. The Research Domain Criteria (RDoC) framework proposed by NIMH provides an alternative, dimensional look at social processes affected in ASD, providing a mechanism for exploring the heterogeneity and identifying social subtypes of the disorder.

Objectives: The Social Responsiveness Scale (SRS) provides a measure of dimensions of social cognition that are known to be impaired in ASD. We used the ABIDE database to discover evidence of social subtypes of ASD based on different patterns of profiles of SRS subscale scores (Social Awareness, Social Cognition, Social Communication, Social Motivation), and determined whether these subtypes have distinct neurobiological profiles as evidenced by resting state functional connectivity.

Methods: We extracted clinical and resting state functional connectivity data from the ABIDE database for all subjects with SRS total scores and subscale scores. The resulting sample included 332 individuals with ASD and 396 neurotypical individuals. We analyzed profiles of SRS subscale scores normalized by the total SRS score to control for ASD severity. We used finite mixture modeling to analyze the ASD sample assuming two or more groups with distinct profiles of SRS subscale scores. We performed resting state functional connectivity seed-to-voxel analyses using Conn toolbox with 2 seeds in the default mode network (medial prefrontal cortex and posterior cingulate/precuneus) and 2 seeds in the salience network (anterior cingulate cortex and right anterior insula). We identified regions of significant differences in connectivity between the entire ASD group and neurotypical group, and performed similar analyses between each identified subtype and the neurotypical group.

Results: We identified four distinct social subtypes with different profiles of SRS subscale scores: groups with 1) similar deficits across subscales (low awareness, low motivation; N = 98, 28.5%); 2) relative deficits in social awareness but relative strength in social motivation (low awareness, high motivation; N = 40, 12.8%); 3) relative strength in social awareness but deficit in social motivation (high awareness, low motivation; N = 89; 26.5%); and 4) relative strengths in both social awareness and social motivation (high awareness, high motivation; N = 105, 32.2%). The overall ASD group showed significant underconnectivity within the default mode network, and significant regions of underconnectivity within the salience network and between the salience network and regions in language networks, attentional networks, and visual processing regions. Each subtype had unique connectivity patterns contributing to the overall group connectivity differences, including some differences in connectivity that were not seen in the overall group.

Conclusions: We found evidence of distinct social subtypes of ASD with unique contributions to the overall functional connectivity differences between individuals with ASD and neurotypical controls. These subtypes, identified using a dimensional representation of social processes similar to the RDoC framework, may explain some of the heterogeneity and irreproducibility of neuroimaging findings in ASD. Better characterization of these subtypes may identify more homogeneous groups of individuals with ASD that allows for better development of targeted treatments for these subpopulations.

405.005 *(Poster)* Scaling Motor Output to a Dynamic Visual Target Is Impaired in Children with Autism Spectrum Disorder

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Background: Visuomotor integration (VMI) impairment may be a core feature underlying social and motor impairments associated with Autism Spectrum Disorder (ASD). In children with ASD, functional connectivity between visual and motor areas is lower vs. TD controls and tasks requiring rapid integration of visual input into motor commands, such as imitation, are impaired. A simple method to examine the nature of VMI impairments in ASD is to examine motor responses when VMI demands are low vs. high. In this study, children were asked to match grip-force output with either a static target force (low-VMI demand) or a dynamic target force (high-VMI demand). It was hypothesized that error in the dynamic task would be greater in the ASD vs. TD groups with no group differences observed for the static task.

Objectives: The purpose of this study was to examine the effect of increasing VMI demands on the motor output of children with ASD.
Methods: Thirty-nine (ASD=18; TD = 21) right-handed children (7-17 years old) participated in this study. There was no significant difference in age between groups (TD = 11.9±2.7; ASD = 12.6±2.7; $p = 0.23$). First, participants completed three maximal voluntary isometric contractions (MVIC) squeezing a force transducer between their index finger and thumb. The best of three attempts was recorded as the MVIC. Next, the static and dynamic force tracking tasks were performed. The static force tracking task involved maintaining a cursor within a target set at 15% of the participants MVIC for 20-s. The dynamic task involved tracking a ramp-up target from 0-25% MVIC over 10-s followed by a ramp-down from 25-0% MVIC over 10-s. The between-trial rest period was 20-s. Five trials were performed and relative root mean square error [rRMSE(%)] was calculated. A two-way ANCOVA was conducted to examine GROUP (ASD vs. TD) and TASK (static vs. dynamic) specific differences on rRMSE. Age was used as a covariate for the two-way ANCOVA.
Results: There was a statistically significant (group x task) interaction observed on relative error, $F_{(1,73)} = 4.418$, $p = 0.039$, partial $\eta^2 = 0.057$. Main effects of task revealed no group differences in the static task ($p = 0.36$), but a significant effect was observed in the dynamic task ($p = 0.0002$).
Conclusions: Here, we show that children with ASD are more impaired during a dynamic vs. a static grip-force control task compared to TD controls. The findings suggest impaired integration of dynamic visual input into motor commands. Future studies should examine: (1) associations of dynamic grip-force tracking with imitation and social skill measures to better understand the link between VMI impairment and core features of ASD; and (2) cortical activation patterns during dynamic force tracking to better understand the neurological basis of dynamic VMI deficits in children with ASD.

405.006 *(Poster)* The Correlation between Parental Stress and Temperament in Young Children at Elevated Likelihood of Autism

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Background: Caregivers of children with autism spectrum disorder (ASD) have more parenting stress than those of children with other developmental disorders (Estes et. al., 2009). High parental stress can negatively impact child outcomes and a family's response to early intervention. Furthermore, levels of parent stress may be related to child characteristics, such as temperament. Temperament factors measured in infancy show considerable stability into toddlerhood (Casalin et al., 2012), making child temperament and parental stress important considerations in parent-mediated early interventions.
Prior research indicates that the most affected temperament domain in children with ASD is effortful control, and its subdomains of attention focusing, attention shifting, and inhibitory control (Janes 2001; Konstantareas & Stewart 2006; Landry 1998). Additionally, parents report that children with ASD have greater negative affect, displaying more discomfort and less sootheability than children without ASD (Konstantareas & Stewart 2006). We therefore hypothesized that aspects of temperament that characterize children diagnosed with ASD, namely effortful control and negative affect, would significantly correlate with stress in parents of 14-month-olds at elevated likelihood of ASD (EL-ASD).
Objectives: The aim of the present study was to better understand how child temperament is associated with parent stress in young toddlers at EL-ASD.
Methods: We conducted a correlational analysis to determine the relationship between parent stress and child temperament. Our sample included ninety-six children identified via screening with the First-year inventory as at EL-ASD (65.6% male, 34.4% female, mean age = 13.74 months) and a parent of each child. Parents completed the Early Childhood Behavior Questionnaire (ECBQ) and Parental Stress Scale (PSS). The ECBQ (temperament measure) comprises 107 questions in 3 broad temperament domains: surgency, negative affectivity and effortful control. The PSS has 18 questions answered on a Likert scale, covering topics such as whether the respondent feels overwhelmed with parenting responsibilities, embarrassed by their child's behavior, and happy as a parent.
Results: There was a significant negative correlation between the total parent stress score and the effortful control domain mean score ($r = -.313$, $p < .002$), as well as several subdomain scores under effortful control: cuddliness ($r = -.284$, $p < .005$), inhibitory control ($r = -.245$, $p < .016$) and low intensity pleasure ($r = -.239$, $p < .019$)
Conclusions: Effortful control, one of the most affected temperament domains in children with ASD, was most strongly negatively correlated with parental stress in young toddlers at EL-ASD. The inhibitory control subdomain was significantly negatively correlated with parental stress, whereas attention focusing and attention shifting were not (although these are significantly affected in children with ASD). The effortful control subdomains of cuddliness and low intensity pleasure were also significantly correlated with parental stress; however, no correlation was found between parental stress and negative affectivity, despite reports that children with ASD have greater negative affectivity than children with other disabilities. Future research could investigate whether parent-mediated intervention strategies that target children's development of effortful control, including inhibitory control, cuddliness and low intensity pleasure, may contribute to some reduction in parental stress.

405.007 *(Poster)* Title: Heart Rate Variability in Children with Autism Spectrum Disorder

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Background: Reduced heart rate variability (HRV) is regarded as one reliable index of autonomic dysfunction for cardiovascular risk. It has been linked to poorer physical, mental and social well-being outcomes and has been suggested as a potential biomarker for social development. Although the pathophysiology of autonomic nervous system (ANS) function in young children with autism spectrum disorder (ASD) is not well understood, a number of studies have found reduced HRV in comparison to neurotypical children.

Objectives: The objective of this current study was to measure and compare resting-state HRV parameters in children diagnosed with ASD and neurotypical children. We predicted that resting–state HRV measures would be reduced in ASD compared to neurotypical cohort. We further predicted that medication status and severity of symptoms would additionally moderate HRV responses.

Methods: A total of 86 children diagnosed with ASD, aged between 3 and 12 years were compared to 44 neurotypical children of similar age. Twenty-seven of participants were prescribed psychotropic medication, which included selective serotonin reuptake inhibitors (SSRIs) (*n*=26) and serotonin and norepinephrine reuptake inhibitors (SNRIs) (*n*=10). Laboratory assessment of HRV involved five minutes of non-invasive baseline electrocardiogram (ECG) assessments while participants viewed an age-appropriate non-verbal animation. Time-domain and frequency-domain HRV measures were analysed. ASD symptoms severity was assessed using the Autism Diagnostic Observation Schedule-Second Edition (ADOS-2) and Social Responsiveness Scale (SRS-2).

Results: Results indicated that children with ASD showed lower HRV compared to neurotypical children on two of the four HRV measures; high frequency (HF) and root mean square of successive difference (RMSSD). Interestingly, however, sub-group analysis suggested this difference was only significant for those children receiving psychotropic medication, in comparison to neurotypical children. Our data also suggested that there was no evidence to suggest a relationship between HRV and social impairment symptoms in the ASD group, with only the repetitive- behaviour domain of the ADOS associated with some HRV measures, RMSSD.

Conclusions: Overall, our finding suggests lower HRV in children with ASD relative to neurotypical children, but this difference may be specific to those children taking psychotropic medication. Moreover, our results only provide limited evidence that HRV was associated with the severity of symptoms. This study supports further investigation of HRV as a possible surrogate physiological marker associated with autonomic dysfunction and, potentially, severity of ASD symptoms. These results may help us understand what underlies autonomic nervous system dysfunction and the potential pathophysiological mechanisms leading to increased cardiovascular risk in ASD.

Biomarkers (molecular, phenotypic, neurophysiological, etc)

PANEL SESSION — BIOMARKERS (MOLECULAR, PHENOTYPIC, NEUROPHYSIOLOGICAL, ETC)
202 - The Autism Biomarkers Consortium for Clinical Trials: Final Analyses

Panel Chair: James McPartland, *Child Study Center, Yale University School of Medicine, New Haven, CT*

Discussant: Lisa Gilotty, *NIMH, Rockville, MD*

The Autism Biomarkers Consortium for Clinical Trials (ABC-CT) is a US-based network designed to develop objective measures to sensitively and validly quantify ASD symptomatology and its change in clinical trials and to stratify ASD into meaningful subgroups. This symposium presents, for the first time, results from analyses of the complete ABC-CT sample, comprising 399 children aged 6 to 11 years, at three time points spanning six months. This panel brings together research centers distributed across the US, with male and female panelists ranging from early career faculty to tenured researchers. The first lecture will provide an overview of study design, with focus on unique elements of the approach to biomarker development and outcomes in terms of FDA biomarker qualification. The second lecture will present clinical data from the full sample with an emphasis on defining and detecting clinically meaningful change during a naturalistic study, and the third and fourth lectures will provide biomarker results obtained from EEG and eye-tracking, respectively, with an emphasis on factors that influence shorter term test-retest reliability and longer term stability. The discussion will focus on the state of biomarker development for ASD, challenges for this field, and novel approaches to overcoming these challenges.

202.001 *(Panel)* The Autism Biomarkers Consortium for Clinical Trials: Study Design and Progress to Biomarker Qualification

J. McPartland[1], *S. J. Webb*[2], *F. Shic*[3], *A. Naples*[1], *C. Sugar*[4], *M. Murias*[5], *G. Hellemann*[6], *D. Senturk*[6], *J. Dziura*[7], *C. Brandt*[7], *R. Bernier*[2], *K. Chawarska*[1], *G. Dawson*[8], *S. Faja*[9], *S. Jeste*[4] *and C. A. Nelson*[10], *(1)Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, (3)Center for Child Health, Behavior and Development, Seattle Children's Research Institute, Seattle, WA, (4)University of California, Los Angeles, Los Angeles, CA, (5)Duke Center for Autism and Brain Development, Department of Psychiatry and Behavioral Sciences, Duke University, Durham, NC, (6)UCLA, Los Angeles, CA, (7)Yale University, New Haven, CT, (8)Department of Psychiatry and Behavioral Sciences, Duke Center for Autism and Brain Development, Durham, NC, (9)Boston Children's Hospital, Boston, MA, (10)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background: Autism spectrum disorder (ASD) is a highly prevalent neurodevelopmental condition for which there are currently no biomarkers validated for use in clinical trials. The objective of the Autism Biomarkers Consortium for Clinical Trials (ABC-CT) is to investigate the utility of well-evidenced electroencephalography (EEG) and eye-tracking (ET) measures as potential biomarkers for clinical research.

Objectives:

The goals of the ABC-CT are to: (1) evaluate candidate biomarkers in terms of feasibility of implementation, cross-site reliability of data collection, construct validity, discrimination between ASD and typical development (TD), stratification within ASD, developmental stability/sensitivity to change, and predictive value; (2) compare biomarkers to conventional clinician and caregiver assessments; (3) create a public repository spanning genetics, biomarkers, and clinical and behavioral information; and (4) establish an infrastructure optimized for the conduct of future clinical trials.

Methods: The ABC-CT main study commenced in October 2016, with an objective of recruiting 200 rigorously characterized children with ASD (6-11 years; IQ 60-150) and 75 typically developing (TD) control subjects into a longitudinal naturalistic design with three time points (Baseline, 6 weeks, 24 weeks). A biomarker protocol was carried out identically at each timepoint at five sites in accordance with Good Clinical Practice standards. Biomarkers (4 EEG, 5 ET, blood draw) were selected based on strength of existing evidence and relevance to social-communication. Data were collected and analyzed with a high level of methodological rigor, with an explicit pre-specified statistical plan designating a single dependent variable as primary for each biomarker and specifying directional hypotheses of between group effects. A unique study governance brought together diverse expertise spanning academia, government, industry, and collaborating consortia to facilitate progress from discovery to biomarker qualification.

Results: ABC-CT main study data collection was completed in May, 2019. Recruitment milestones were exceeded, and longitudinal attrition was minimal, with 399 children (280 with ASD, 119 TD) enrolling in the study and 374 (260 with ASD, 114 TD) completing the study. Data acquisition procedures were highly successful, with valid data acquisition rates averaging approximately 90% across biomarker data modalities, and 77% of probands contributing genetic samples. In May, 2019, a Letter of Intent for an EEG biomarker, N170 Latency to Upright Human Faces, was accepted into the FDA's Center for Drug Evaluation and Research Biomarker Qualification Program. In November, 2019, a second Letter of Intent was submitted for an ET biomarker, the Oculomotor Index of Orienting to Human Faces. Panels in this symposium will provide report of data from full study sample across time points.

Conclusions: The ABC-CT and similar consortia are advancing the goal of clinically practicable biomarkers by investigating well-evidenced biomarkers in large, well-characterized cohorts in the context of a longitudinal design. Progress is evidenced by engagement with regulatory agencies in developing the first biomarker qualification plans for neurodevelopmental conditions. The use of economical, scalable biomarker technologies holds promise for eventual deployment in a broader range of clinical and research contexts.

202.002 *(Panel)* The Autism Biomarkers Consortium for Clinical Trials: Clinical Characteristics and Evaluation of Clinical Measures Commonly Used in Clinical Trials

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Background: The investigation of interventions for ASD has traditionally relied on clinician rating scales and parent surveys, which are not necessarily sensitive to treatment-related changes and introduce potential for bias when used to measure interventions that are difficult to mask from clinicians and families. The design of the ABC-CT provides an opportunity to directly compare these measures with respect to test-retest reliability, discriminant and convergent validity, and sensitivity to intensity and changes in treatment as usual. The project also provides an opportunity to examine the feasibility of collecting reliable clinical data over three timepoints by a five-site consortium.

Objectives: To examine the characteristics of the final ABC-CT sample as well as the final analyses of the battery of clinical social communication measures and a lab-based measure of face recognition. We report convergent validity, discrimination of diagnostic status, test-retest validity, and sensitivity to naturalistic treatment intensity and changes.

Methods: The final sample included 280 children (65 girls) with ASD and 119 (36 girls) with typical development (TD). Ages ranged from 6 to 11 years over the course of the study with no difference between diagnostic groups, $F(1,397)=0.0$, $p=.85$. Groups were stratified based on age and best estimate of cognitive functioning on the Differential Ability Scales (DAS-2; Elliott, 2007). FSIQ scores ranged from 60-150 for the group with ASD, $M=96.6(18.1)$. Children without ASD had significantly higher IQ, $M=115.1(12.5)$, $F(1,397)=103.4$, $p<.01$. Clinical measures included: CGI-Severity (Guy, 1976), Vineland-3 (Sparrow, Cicchetti, Saulnier, 2017), PDDBI (Cohen et al., 2003), SRS-2 (Constantino, 2012), and AIM (Kanne et al., 2014). A lab-based measure of facial recognition, NEPSY-II Memory for Faces subtest (Korkman, Kirk, & Kemp, 2007), was also administered at each time point. An intervention history measure was developed to evaluate the intensity of interventions received beginning 6 weeks prior to baseline and continuing throughout the 24 week study period.

Results: Clinical measures generally had moderate to strong correlation with one another (rs=.45-.73, ps<.001), suggesting excellent convergent validity within the group with ASD. As expected all measures were also sensitive to group status (Fs>53.3, ps<.001), although the CGI was not administered for TD children. The lab based measure, NEPSY-2 Memory for Faces, also discriminated groups, $F(2,214)=16.50$, $p<.001$, and had small to moderate correlations with clinical measures (rs=.08-.42). Overall, test-retest reliability across a 6-week period was variable across measures and groups (ICCs=.35-.98). Analyses to examine the sensitivity of these clinical measures to treatment as usual are in progress.

Conclusions: ABC-CT provides a direct comparison of standard clinical measures that are commonly utilized in clinical trials for ASD as well as a lab-based social measure of face recognition. This information may be useful in guiding selection of social measures for clinical trials by confirming which traditional measures are feasible in a multisite trial and comparing convergent validity, discrimination of groups, and test-retest reliability. Of particular interest will be the sensitivity of these measures to naturalistic changes in treatment as usual during the school-aged period. The ABC-CT "scorecard" approach may enable better selection of primary outcomes for future studies.

202.003 *(Panel)* The Autism Biomarkers Consortium for Clinical Trials: EEG Biomarker Analyses

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Background: The Autism Biomarkers Consortium for Clinical Trials (ABC-CT) EEG protocol aims to identify social-communicative brain biomarkers relevant to ASD, using measures of signal strength (i.e., modulation of EEG spectral power and event-related potential latency/amplitude). Previously, we reported interim primary dependent variable (DV) results: all DVs demonstrated construct validity and appropriate distributional qualities. The Faces experiment primary DV also showed excellent group discrimination. Test-Retest was acceptable for primary DVs from Resting, Faces, and VEP. Biomotion DVs were less successful. The ABC-CT has now completed the main study acquisition and includes a final sample of 399 participants with ASD (n=280) and TD (n=119).

Objectives:

To report on the final analyses for the ABC-CT EEG battery and the pre-specified primary and secondary DVs. We focus on acquisition validity, discriminant validity, and relation to clinical status at each time point, as well as test-retest reliability.

Methods: EEG was collected during: (A) Resting (or calm viewing), (B) Faces (based on the EU-AIMS face experiment), (C) VEP (checkerboard), and (D) Biological Motion Perception (Biomotion / point light displays of walkers) using standardized EEG equipment, experimental control, and recording parameters (Webb et al., 2019). Valid data was based on completion of 50% of the Resting EEG experiment. Acquisition rates were high with Time 1=97% ASD, 98% TD, Time 2=96% ASD, 91% TD, and Time 3=90% ASD, 96% TD, as manualized (Santhosh et al., 2019). ERP data processing (for Faces, VEP, and Biomotion) were conducted via Matlab, utilizing automated artifact detection and custom programs for component abstraction; EEG data processing used HAPPE (Gabard-Durnam et al., 2018). Our DVs included Resting=slope of the power spectrum, alpha power, and gamma power; Faces=latency of the N170 and P1 to upright faces; VEP=amplitude of the P1; Biomotion=N2 and P300 amplitude to biological motion.

Results: Valid DV rates were between 81-92% for *slope*, 70-97% for *N170 latency to upright faces*, 79%-95% for VEP *P1 amplitude*, and 65%-88% for *N2 amplitude to biological motion*. There was a >20% difference in acquisition rates between the TD and the ASD group for Faces and Biomotion. Focusing on the *N170 latency to upright faces*, our primary outcome variable, we found a significant group difference in latency ($F=11.6$, $p<.01$ AUC=.563), with faster responses in the TD than ASD group. Test-retest was good ($r=.68$, $p<.01$). The *N170* was correlated with age (rs=-.35 to -.49) and was not related to sex (ps=ns).

Conclusions: Through standardized acquisition processes, site training, and timely feedback, we were able to acquire at least one EEG experiment on >90% of children with ASD. We had similar levels of data retention across site and age, but decreased rates in the ADS group for longer ERP experiments. The Faces experiment shows strong promise as a biomarker of social attention. All DVs demonstrated construct validity and appropriate distribution. In our presentation, we will provide parallel analyses for all the EEG DVs as well as an updated "biomarker report card" to guide selection of these DVs for different contexts of use in clinical trials.

202.004 *(Panel)* The Autism Biomarkers Consortium for Clinical Trials: Eye-Tracking Biomarker Analyses

F. Shic[1], *A. Naples*[2], *S. J. Webb*[3], *G. Hellemann*[4], *C. Sugar*[5], *D. Senturk*[4], *M. Murias*[6], *E. Barney*[1], *B. Li*[7], *M. Kim*[8], *K. J. Dommer*[9], *J. Dziura*[10], *R. Bernier*[3], *K. Chawarska*[2], *G. Dawson*[11], *S. Faja*[12], *S. Jeste*[5], *C. A. Nelson*[13] *and J. McPartland*[2], *(1)Center for Child Health, Behavior and Development, Seattle Children's Research Institute, Seattle, WA, (2)Child Study Center, Yale University School of Medicine, New Haven, CT, (3)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, (4)UCLA, Los Angeles, CA, (5)University of California, Los Angeles, Los Angeles, CA, (6)Duke Center for Autism and Brain Development, Department of Psychiatry and Behavioral Sciences, Duke University, Durham, NC, (7)Computer Science and Engineering, University of Washington, Seattle, WA, (8)University of Virginia, Charlottesville, VA, (9)Seattle Children's Research Institute, Seattle, WA, (10)Yale University, New Haven, CT, (11)Department of Psychiatry and Behavioral Sciences, Duke Center for Autism and Brain Development, Durham, NC, (12)Boston Children's Hospital, Boston, MA, (13)Boston Children's Hospital/Harvard Medical School, Boston, MA*

Background: The Autism Biomarkers Consortium for Clinical Trials (ABC-CT) eye-tracking (ET) protocol aims to identify oculomotor biomarkers of social-communicative information processing relevant to autism spectrum disorder (ASD) through recording of patterns of eye fixation in multiple task contexts. Eye tracking was collected using an SR Eyelink 1000 Plus eye tracker on both days of the protocol and included the following paradigms: (A) Activity Monitoring, (B) Social Interactive Scenes, (C) Static Images of Social Scenes, (D) Biological Motion Preference (BMP), (E) Pupillary Light Reflex (PLR). (A)-(C) were combined based on principal component analysis from the Feasibility stage of the study into a composite variable, the Oculomotor Index of Orienting to Human Faces (Oculomotor Index), which served as our primary dependent variable (DV) for the ET protocol. Previously (Shic et al., 2017), we reported interim main study primary dependent variable (DV) results demonstrating construct validity and appropriate distributional qualities of dependent variables, as well as excellent group discrimination and test-retest performance.

Objectives:

To report on the final analyses for the ABC-CT experiments in the ET battery and their pre-specified primary and secondary dependent variables. We will report on acquisition validity, discriminant validity, relation to clinical status at each time point (Time 1, Time 2 + 6 weeks, Time 3 +24 weeks), and test-retest reliability.

Methods: Valid trial data was based on 50% valid data acquisition and calibration uncertainty below 2.5 visual degrees, with 25% trial validity required for paradigm validity and 1 paradigm required for participant validity. Rates of acquisition (participant validity) continued to be high with >99% data acquisition at all time points as assessed using manualized quality control procedures (Barney et al., 2018).

Results: The ABC-CT main study includes a final sample of 399 participants with ASD (n=280) and typical development (TD; n=119). Paradigm validity rates were above 97% for all time points for all paradigms excepting PLR (82.6%-98.3%), with slightly less validity in the ASD as compared to TD group. In terms of discriminant validity and test-retest for primary experiment outcome variables, ranked from highest to lowest in Cohen's d: Activity Monitoring (T1=1.04, T2=.96, T3=.95; Test-Retest (TR): .81-.85); Oculomotor Index (.80, .84, .80; .84-.86); Social Interactive (.93, .58, .83; .44-.47); Static Scenes (.53, .53, .39; .59-.69); Biomotion |d|<.22, TR .28-.46; PLR |d|<.31, TR .80-.83. Aggregating across timepoints, correlations within the ASD group with clinical phenotype were modest, maximal rho=-.29 for Activity Monitoring looking at heads to ADOS calibrated severity score.

Conclusions: Valid ET data were obtained on nearly all children. Oculomotor Index and the components of the index continued to show strong promise as a biomarker of social attention in ASD. Markers show significant between group differences and high test-retest reliability. Relationships with phenotypic characteristics in ASD were highly significant but modest in effect size. In our presentation, we will provide parallel analyses for all the ET DVs as well as provide an updated "biomarker report card" to guide selection of these measures (and DVs) for different contexts of use in clinical trials.

ORAL SESSION — BIOMARKERS (MOLECULAR, PHENOTYPIC, NEUROPHYSIOLOGICAL, ETC)
304 - Metabolic and Biochemical Markers in Pregnancy and Early Childhood

304.001 *(Oral)* Attenuation of Sex Differences in Placental Markers during Pregnancy Is Associated with the Development of Autism and Related Traits in Children

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Background: Males are more likely to be diagnosed with autism, despite greater awareness of under-diagnosis or misdiagnosis of autism in females. Sexual dimorphism in the prenatal endocrine environment may be a significant contributing factor. Sex steroid hormones, including androgens and estrogens, are elevated in the fetal circulation of autistic males and correlate with the development of autistic traits (Baron-Cohen *et al.*, 2019) .Placental function is also sexually dimorphic, with male placentas producing more steroid hormones and having greater risk for complications. Placental regulatory proteins, such as soluble fms-like tyrosine kinase (sFlt-1) and placental growth factor (PGF) are also significantly different when the fetus is male in the 1st trimester (Brown *et al.*, 2014).

Objectives: To investigate in maternal serum:

1. If placental proteins are different between male and female pregnancies in the 2nd-3rd trimester.
2. If levels of these placental proteins correlate with autistic traits.
3. If levels of these placental proteins correlate with autism likelihood.

Methods: First trimester sFlt-1 and PGF concentrations were assessed in maternal serum samples of pregnant women, at 10-12 weeks (1st trimester) and 24-28 weeks (2nd-3rd trimester) of gestation, who consented to take part in the "Generation R" birth cohort, in Rotterdam, the Netherlands. Subsequent assessment of autistic traits in the children at age 6 was based on 18-item abridged version of the Social Responsiveness Scale (SRS). Diagnosis of autism was based on specialist medical records. The final sample consisted of n= 3,767 singleton pregnancies with a completed SRS assessment and n=56 confirmed autism cases in males. Values of SRS and concertation values of hormones were log-transformed and extreme outliers were windorised to reduce skewness. Linear regression analysis was stratified for sex and based on two models, with SRS as the dependent variable: 'Model 1' accounted for the age at the time of SRS testing. 'Model 2' accounted for age of child at SRS testing, age of mother, birth weight (adjusted for gestational age), placental weight, maternal ethnicity & educational attainment.

Results: PGF was significantly higher ($p<0.001$), while sFlt-1 was significantly lower ($p<0.001$) for male pregnancies in the 2nd time-point. Preliminary analysis suggests that PGF levels and the rate of increase for PGF, both correlated to SRS scores in females (Model 1: $p<0.001$, Model 2: $p<0.03$, for both). This finding persisted in analyses restricted to pregnancies without complications, without a diagnosis of autism and with only parents of Caucasian ethnicity. In males, PGF increase was borderline significant in the 1st model ($p=0.021$) but not when all covariates were included in the 2nd model. There was no correlation between sFlt-1 levels and SRS scores. When clinically diagnosed cases were assessed separately, autistic males had significantly lower sFflt-1 levels, when compared to neurotypical controls ($p=0.03$). There was no difference in the levels of PGF between them and male neurotypical controls.

Conclusions: Attenuation of sex differences in the levels of placental markers is associated with later autistic outcomes in children, according to male-like patterns (increased PGF, decreased sFlt-1).

304.002 *(Oral)* Maternal Multiple Metabolic Disorders, Plasma Branched-Chain Amino Acids, and the Risk of Child Autism Spectrum Disorder: Evidence of Sex Difference

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Background: Maternal obesity and diabetes are known risk factors for ASD, and are also associated with branched-chain amino acids (BCAAs). However, the association of maternal multiple metabolic disorders (MMD), alone or in combination with BCAAs, with child ASD has not been well-studied.

Objectives: Bringing several lines of research under a life course framework, we sought to examine joint associations of maternal MMD and BCAAs on child ASD using a prospective birth cohort design.

Methods: We examined 789 mother-infant pairs (89 with ASD), a subset of the Boston Birth Cohort, from a predominantly urban, low-income, minority population. Based on pre-pregnancy overweight or obesity, type 2 or gestational diabetes, high-density lipoprotein cholesterol (HDL<50mg/dl), and hypertensive disorders, mothers were grouped into MMD (score≥3) or no MMD (score<3). Liquid chromatography-tandem mass spectrometry (LC-MS/MS) was used to quantify maternal postpartum plasma BCAAs collected 24-72 hours postpartum. A composite BCAA score was created using factor analysis, and dichotomized at the median. Logistic regression was then used to examine joint associations of maternal MMD and BCAAs on child ASD risk. Differential associations by child's sex were also examined.

Results: The median composite MMD score was 1 (IQR: 0-2). Mothers with an MMD score ≥3 were at a significantly greater risk for having a child with ASD (crude OR: 2.03 95% CI: 1.11-3.71), though this significance was lost upon adjustment with pertinent variables. Maternal high MMD score and above median BCAA concentrations synergistically increased the risk of ASD (adjusted OR: 3.01, 95% CI: 1.44-6.30), and the association was limited to males (crude OR: 5.25, 95% CI: 2.27-12.17; $p_{interaction}$=0.03). ASD risk was highest among children with all three risk factors: male sex, high MMD score, and above-median BCAA score (adjusted OR: 16.09, 95% CI: 6.02-43.04) compared to children without any of these factors (Figure 1). A similar, yet weaker, association was observed among children with other developmental disorders for this comparison (adjusted OR: 4.17, 95% CI: 2.19-7.93). Further, the combination of female sex, high MMD score, and above-median BCAA score was also significant for children with other developmental disorders (adjusted OR: 2.15, 95% CI: 1.20-3.86).

Conclusions: Our findings provide new evidence of joint associations between maternal MMD and BCAA biomarkers on child risk of ASD. They also provide insight on the early life origins of sex differences in ASD. Further studies are warranted to confirm these findings.

304.003 *(Oral)* Serum Biomarker Indicates Higher Maternal Insulin Resistance during Pregnancies of Males, but Not Females, Who Develop Autism

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Background: Prenatal metabolic syndrome (PNMS) exposure (i.e., diabetes and hypertension during pregnancy) is associated with increased autism spectrum disorder (ASD) risk, which may be attributable to inflammation and steroid dysregulation. Higher PNMS severity precipitates preterm birth. Low maternal sex hormone binding globulin (SHBG) levels indicate insulin resistance and precede clinical manifestations of gestational diabetes and hypertension. Low maternal serum SHBG in early 2nd trimester has been linked to ASD among offspring born at term.

Objectives: Using maternal SHBG levels as a proxy for insulin sensitivity, (1) compare insulin sensitivity during pregnancies that differ by PNMS exposure, offspring ASD status, and pregnancy duration and (2) determine whether insulin sensitivity associated with PNMS exposure, offspring ASD status, and gestational duration are moderated by fetal sex.

Methods: ASD case status were identified among index offspring of Utah's First and Second Trimester Evaluation of Risk (FASTER) study participants who consented to future use of banked early second trimester maternal serum. ASD case status was determine by the Utah Registry of Autism and Developmental Disabilities, which was enriched with cases identified through Utah's participation in CDC's Autism and Developmental Disabilities Monitoring Network. Birth certificate data identified PNMS exposure (i.e., preexisting/gestational diabetes, preexisting/gestational hypertension, and preeclampsia), sex, gestational age, maternal age, pregnancy weight gain, and pre-pregnancy BMI. Maternal serum was stored at -80°C, thawed on wet ice, and aliquoted into pre-cooled tubes. SHBG was measured using RayBiotech (Norcross, GA) ELISA kits. A one-way Analysis of Variance was formulated to quantify the association between a five-level measure of ASD/PNMS exposure: levels 1-4 reflected exposure status in term pregnancies [i.e., ASD-/PNMS- (N = 11), ASD-/PNMS+ (N=8), ASD+/PNMS- (N=28), and ASD+/PNMS+ (N=25)] and the fifth level reflected exposure in preterm pregnancies (pASD+/PNMS+, N=5). Analyses included covariates described above as well as gestational age at serum sampling, and were repeated after stratifying by sex. Post hoc tests used the Scheffé method.

Results: The overall model was significant ($F_{(9,66)}$=4.11, p=0.0003) as was the main effect of ASD/PNMS exposure on serum SHBG concentrations ($F_{(4,66)}$ =7.53, p =<0.0001). A dose-response pattern emerged: increasing ASD/PNMS exposure was associated with decreasing SHBG concentrations. After multiple comparison adjustment, mean SHBG concentrations differed significantly between the ASD-/PNMS- and the pASD+/PNMS+ (mean difference = 154.21, 95% CI = 27.10-281.33, p = 0.009), ASD+/PNMS+ (mean difference = 120.62, 95% CI = 40.07-201.17, p = 0.0006), and ASD+/PNMS- (mean difference = 105.98, 95% CI = 30.76-181.20, p = 0.001) groups. When stratified by sex, similar findings were identified for males; however, the overall model for females was insignificant ($F_{(4,16)}$=0.80, p=0.61) (Figure 1).

Conclusions: Males who develop ASD experienced significantly higher maternal insulin resistance than unaffected males as indicated by lower SHBG levels irrespective of whether clinical manifestations of PNMS emerged. Males with ASD and PNMS exposure born preterm had similar findings. This supports the presence of insulin resistance as a common metabolic milieu in early 2nd trimester among affected males. However, SHBG levels from pregnancies of females were not significantly responsive to ASD or PNMS exposure status.

304.004 *(Oral)* Prediction of Autism Risk Based on Dysregulation of Energy and Amino Acid Metabolism

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Background: Autism spectrum disorder (ASD) is an etiologically heterogeneous disorder with considerable clinical variability among affected individuals. The complexity of the disorder hampers diagnosis, frequently delaying therapeutic interventions. Stratification of a heterogenous ASD population based on metabolic phenotypes (metabotypes) such as altered energy and amino acid metabolism creates an opportunity for the development of diagnostic tests. We previously reported on stratification of 17% of the ASD subjects enrolled in the Children's Autism Metabolome Project (CAMP, ClinicalTrials.gov Identifier: NCT02548442) based on tests for dysregulation of plasma levels of branched chain amino acids. In this work, we extend our approach to develop metabolic tests that stratify ASD based on metabotypes of both altered energy and amino acid metabolism.

Objectives: The study sought to use quantitative plasma metabolite analyses to identify alterations of amino acid and energy metabolism able to stratify ASD subjects into distinct metabotypes that may be clinically actionable.

Methods: Plasma samples from 708 ASD and typically developing (TYP) children, age 18-48 months, were analyzed from CAMP which enrolled 1100 children from 8 centers across the US. The Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) was performed by research reliable clinicians to confirm ASD diagnoses. Thirty-nine metabolites of plasma amino acid and energy metabolism were measured using analytically validated quantitative mass spectrometry-based methods. A discovery set of CAMP subjects (ASD=253, TYP=104) was utilized to set diagnostic thresholds for metabolic tests that identify metabotypes associated with ASD. Tests meeting minimum diagnostic performance criteria (> 5% sensitivity and > 95% specificity) were then evaluated in an independent replication set of CAMP subjects (ASD=246, TYP=105). Tests meeting minimum diagnostic performance in both discovery and replication sets were then optimized into a test battery by removing correlated metabotype tests which identified similar subjects.

Results: In both the discovery and replication studies, 34 metabotype tests associated with increased risk of ASD based on ratios of metabolites were identified. Ratios of metabolites containing: 1) lactate or pyruvate, 2) succinate, 3) α-ketoglutarate, 4) glycine, 5) ornithine, and 6) 4-hydroxyproline in combination with other metabolites were grouped into six clusters based on correlation of ratio measurements. Within these six clusters, ASD subjects were often positive for more than one metabotype. Optimization of the 34 metabotype tests by reducing test redundancy within clusters generated a battery of 14 tests with a diagnostic performance of 50% (CI 45%-54%) sensitivity and 92% (CI 88%-96%) specificity in the CAMP population.

Conclusions: The analysis revealed novel, reproducible metabotypes of ASD. The optimized metabotype test battery can be used as a screening test to identify children at risk for ASD. Combining a metabotype-based modality with a behavioral screening such as M-CHAT/F creates an opportunity to identify those at risk of ASD using both biological and behavioral measures. Utilization of metabotype-based tests further raises the possibility for more precise treatment of ASD based on individual metabolic profiles.

POSTER SESSION — BIOMARKERS (MOLECULAR, PHENOTYPIC, NEUROPHYSIOLOGICAL, ETC)
406 - Biomarkers (molecular, phenotypic, neurophysiological, etc) Posters

406.001 *(Poster)* 2D:4D Ratio and Autism Spectrum Disorder in Brunei

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Background: Despite the global increase in the prevalence of autism spectrum disorders (ASD), relevant research studies are lacking in Brunei Darussalam. Various studies have shown a significant association between a lowered 2D:4D ratio (ratio of second digit/index finger to the fourth digit/ring finger) and ASD, making it one of the potential phenotypic biomarkers for early detection of autism, which is important for early intervention and management.

Objectives: The objective of this study is to explore the association between 2D:4D ratio and ASD in Brunei Darussalam, as a potential phenotypic biomarker to complement early ASD diagnosis.

Methods: We conducted a case-control study comprising 28 ASD and 62 typically developing (TD) children in the case and control group, respectively (age range: 3 to 11 years old; median age: 6 years). Median 2D:4D ratios were measured, compared and analysed between the two groups. Logistic regression models were used to explore potential associations between the median 2D:4D ratio and ASD in respective gender, for both left and right hands, independently.

Results: Our study shows that the median 2D:4D ratio of left hand in ASD males is significantly lower than those in TD males, after adjusting for ethnicity and age [Odds Ratio (OR) = 0.57 (95% Confidence Interval (CI): 0.31 - 0.96); $p = 0.044$]. For females, there is no association of ASD with the median left hand 2D:4D ratio [OR = 3.09 (95% CI: 0.98 - 19.86); $p = 0.144$] or the median right hand 2D:4D ratio [OR = 1.23 (95% CI: 0.42 – 3.88); $p = 0.702$]. Our study also shows a significant positive correlation and/or a reduced asymmetry between the average 2D:4D ratio of left hands and right hands in ASD males (Pearson's correlation (r) = 0.48; 95% CI: 0.076 – 0.75, $p = 0.023$).

Conclusions: There is significant association between a lowered median 2D:4D ratio of the left hand (in males only) and ASD diagnosis. Once validated in a larger sample size, a lowered median 2D:4D ratio on the left hand may be a potential tool to complement ASD diagnosis for males in our study population. There is no association between the median 2D:4D ratio (left or right hands) and ASD in females and this could be due to the small female sample size and/or the possibility of different aetiology for ASD in females. The reduced asymmetry between the average 2D:4D ratio of left and right hands observed in ASD males only (this effect was not observed in ASD females) also suggests the importance of considering gender-specific biomarkers for ASD diagnosis.

406.002 *(Poster)* Clinical, Phenomic and Genomic Effects on Salivary Microtranscriptome and Microbiome Measures in Autism

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Background: Several clinical, demographic, and ethnogeographic factors are associated with increased risk for autism spectrum disorder (ASD), including birth complications, social adversity, preterm pregnancy, and alterations in BMI, among others. Whether such variables also influence the ability to identify sensitive and specific biomarkers of ASD is an important consideration for developing optimal tools to aid in early diagnosis.

Objectives: We sought to test whether variations in population admixture and mitochondrial haplogroup were associated with more than 36 additional clinical, demographic, and functional outcome factors as well as abundance levels of more than 1100 non-coding human RNA and bacterial taxa and RNA in saliva microtranscriptome data from 692 children age 18 months – 6 years of age with consensus DSM-V diagnoses of ASD (n=383). These data were compared with an age- and gender-matched group of children with non-ASD developmental delay or neurotypical development (n=309).

Methods: Saliva samples and detailed medical, demographic and functional outcome measures were obtained. Medical and demographic features included pregnancy and birth complications, birth stage, BMI, self-reported ethnicity, history of allergies, sinus infections, fever, vision or hearing loss, asthma, eczema, physical or dental problems, history of ADHD, GI problems, sleep problems, family relatives with ASD, Vineland Adaptive Behavior Scale scores, and Autism Diagnostic Observation Scale (ADOS) scores. Saliva DNA exome sequence data, mitochondrial haplogroup data, and microtranscriptome features, including precursor and mature microRNA, Piwi-interacting RNA, small nucleolar RNA, long noncoding RNA, and microbial RNA and taxa were identified using next generation sequencing following by rigorous variant calling, normalization and filtering to identify the most robust genetic and genomic features. Multivariate analysis of variance (ANOVA) was then used to identify variables that were affected by Admixture, Diagnosis, or Admixture x Diagnosis interactions.

Results: 10 different mitochondrial Admixture haplogroups were identified in the subjects, and displayed a robust effect on self-reported ethnicity as well as specific risk factors. For example, significantly higher levels of birth complications were seen in mitochondrial haplogroup L, and significantly higher rates of eczema and lower rates of first degree relatives with ASD were seen in haplogroup L3. No overall effect of Admixture on Diagnosis was detected. However, other features with a significant effect of Admixture included several miRNAs, piRNAs, and Campylobacter, Carnobacterium, and Actinomyces taxa. A total of 169 features showed a significant effect of Diagnosis ($q<0.05$), including several let-7 miRNAs, Micrococcus, Actinomyces, and Rothia taxa, as well as Gender, Pregnancy and Perinatal Complications, Sleep Problems, and Gender. Only 18 features showed a significant interaction of Diagnosis x Admixture. These included 15 piRNA features and 3 microbial RNAs related to Acyl carrier protein, Transketolase, and IMP dehydrogenase.

Conclusions: Our results indicate that several medical and demographic features appear to influence salivary microtranscriptome and microbial data as well as the general risk for ASD. Additional studies are needed to further explore the specific mechanisms that might underlie such interactions.

406.003 *(Poster)* A Multi-Omic Analysis of Peripheral Blood from Children with ASD and Ileocolonic Inflammation

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Background: Gastrointestinal (GI) symptoms are a common co-occurring medical issue in children with autism spectrum disorder (ASD). We have previously described unique GI mucosal biomarkers specific for ASD-associated ileocolitis in children. It is not yet known whether unique biomarkers are also present in the blood of these individuals. Identification of a validated blood-based biomarker of ASD-associated ileocolitis would allow for earlier identification of co-morbid GI disease and earlier GI intervention in affected patients. Moreover, it would provide insight into the relevant genes and metabolic pathways in ASD-associated ileocolitis.

Objectives: In an effort to enable a more complete understanding of the biology that underlies GI inflammation in children with ASD, the goal of these studies was to use an integrated omics approach to evaluate blood-based gene expression and serum metabolite relative abundance in GI-symptomatic children with ASD that have a demonstrated histologic ileocolitis.

Methods: The study cohort was comprised of whole blood and serum from 22 children with ASD who were undergoing clinically-indicated ileocolonoscopy for chronic GI symptoms, and 24 non-ASD (typically developing, TD) children undergoing ileocolonoscopy for a variety of GI symptoms. All children with ASD had histologic inflammation of the ileum, colon, or both. The TD controls used for this study were selected based on absence of histologic inflammation anywhere in the GI tract and absence of a neurodevelopmental disorder. Molecular profiling in peripheral blood (transcriptome) and serum (metabolome) from children with ASD (and ileocolitis) and TD children (without ileocolitis) was performed to identify differentially expressed transcripts and metabolite abundance levels that may serve as a proxy for GI inflammation.

Results: Differential gene expression analysis (using whole genome microarray) identified a large number of both up- and downregulated transcripts (**Figure 1A-B**). The significantly upregulated transcripts in ASD were enriched for pathways including ECM-receptor interaction, intestinal immune network, fatty acid biosynthesis, hematopoiesis, serotonin transporter activity, platelet degranulation, platelet activation, signaling and aggregation, and cytokine signaling. The significantly downregulated transcripts in ASD were enriched for pathways such as arachidonic acid metabolism, linoleic acid metabolism, extracellular vesicle-mediated signaling, NOD pathway, aryl hydrocarbon receptor pathways, and oxidative ethanol degradation. From the metabolomics data (**Figure 1C-D**), fatty acid metabolism (acyl carnitines), phenylalanine and tyrosine metabolism were uniquely associated with ASD, whereas steroidal metabolism and xanthine metabolism were uniquely associated with TD controls. Integration of transcript and metabolite data revealed enrichment of caffeine metabolism, purine nucleotide metabolism, and glucose alanine cycle.

Conclusions: On one hand, the gene-expression signatures revealed molecular signaling pathways, while on the other hand the metabolomics data revealed the metabolic biosynthetic and catabolic routes of ASD. Both datasets point to dysregulation of fatty acid and lipid metabolism spanning the two omics layers. Such complementary multi-omics efforts have proven useful to understand the disease mechanisms in greater detail and to facilitate rapid hypothesis generation in the context of ASD.

406.004 *(Poster)* Examining the Relationship between Autonomic Functioning in Preschool-Aged Children with ASD and Social-Emotional Deficits

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Background: Children diagnosed with Autism Spectrum Disorder (ASD) often experience learning difficulties, produce inappropriate reactions to social cues, and are impulsive. Externalizing and internalizing behaviors, particularly agitation, disruption, and anxiety, can also be exhibited by children with ASD. Autonomic nervous system (ANS) functioning, as measured by heart rate (HR) and respiratory sinus arrhythmia (RSA), has been studied as a biomarker for social-emotional functioning (Neuhaus, Bernier, & Beauchaine, 2014). Higher levels of autonomic dysregulation are related to impaired social-emotional and behavioral regulation in children (Crowell, et. al., 2006), as well as symptoms of overactivity, aggression, and anxiety (Chalmers et al., 2014; Rukmani et al., 2016). However, the relationship between physiological arousal and symptoms of externalizing behaviors and anxiety in children with ASD is not well understood.

Objectives: The present study aims to examine the relationship of ANS functioning in preschool-aged children with and without a diagnosis of ASD with overactive, aggressive, and anxious behaviors directly observed during a play-based assessment.

Methods: Preliminary data were collected from 38 children, aged 2-5 years, who participated in an ongoing study examining physiological arousal and behavioral functioning in preschoolers. Participants were categorized into two groups: children with a clinical diagnoses of ASD (N=21) and typically developing (TD) children (N=17). Baseline physiological data, including average HR and RSA, were collected while the participant watched a preferred 5 minute video. The ADOS-2 comparison score, used to measure ASD symptom severity, and “Other Abnormal Behaviors,” used to measure anxiety, disruptive behavior, and overactivity on a scale of 0-3, were measured across all participants.

Results: Preliminary results indicate that children with ASD demonstrate lower levels of baseline RSA (M = 5.87; SD = 1.26) and higher baseline HR (M = 117.63, SD = 18.34) than TD children (M = 6.57; SD = 1.14 and M= 108.59; SD=15. 04 respectively). The majority (52.4%; N = 11) of children with ASD displayed overactive behaviors during the ADOS-2. Disruptive behavior was observed in 23% (N = 5) of children with ASD and 12% (N = 2) of TD children during the ADOS-2. Anxiety was observed in 14% (N = 3) and 12% (N= 2) of children with and without ASD, respectively. Autism symptom severity was negatively related (r = -.424) to baseline RSA in the ASD group and positively related (r = .404) to overactivity observed in the ADOS-2. Lower levels of baseline RSA were associated with more disruptive behaviors (r = -.349) observed during the ADOS-2 across participants. Higher levels of baseline RSA were associated with more symptoms of anxiety (r =.697) in children with ASD.

Conclusions: Children with ASD are at an increased risk for comorbid symptoms of anxiety, attention deficits, and disruptive behaviors, suggesting that children who display more severe symptoms of ASD have greater behavioral challenges and physiological dysregulation. Children with ASD and co-occurring behavioral challenges are likely to face more social-emotional barriers; therefore, the contribution of physiological functioning in social-emotional behaviors should be considered when developing targeted interventions that focus on the improvement of social-communication skills.

406.005 *(Poster)* A Randomized Controlled Trial of Reading Intervention and the Brain in Children with Autism Spectrum Disorder

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Background: Research investigating different profiles of children with reading difficulties have found that children who have adequate decoding abilities but reading comprehension deficits make up a specific subgroup of children with reading disorders (Catts et al., 2005). It is likely that a large number of children with autism spectrum disorder (ASD) fall within this category (Murdaugh et al., 2016; 2017). Reading comprehension problems in ASD children have been addressed in only a handful of studies. While these studies showed improvement in reading comprehension in ASD, they were not based on a model that specifically addresses the primary cognitive and neural issues associated with language comprehension.

Objectives: The primary goal of this randomized controlled functional MRI study is to examine the impact of a visual imagery-based reading intervention in on functional connectivity of the brain’s reading network in ASD children with reading comprehension difficulties.

Methods: Functional MRI data were collected during tasks of word similarities and verbal absurdities from 25 children (age 8-13 years) each at two time points: 1) an experimental group of ASD children who underwent scanning before and after reading intervention (ASD-EXP); and 2) a waitlist control group of ASD children who after the first scan waited out the intervention period before their second scan (ASD-WLC). The children with ASD were identified as having difficulties with reading comprehension as indexed by having average word decoding abilities but poor comprehension (Slosson Oral Reading Test - Revised (SORT-R) reading score of at least 37th percentile and/or a Gray Oral Reading Test – Fourth Edition (GORT-4) accuracy score of at least 25th percentile, a GORT-4 comprehension score below 37th percentile).The intervention consisted of 4-hour sessions, 5 days a week for 10 weeks, adding up to a total of 200-hours of face-to-face instruction. fMRI data were collected on a 3 tesla Siemens MRI scanner.

Results: The ASD-EXP group showed significantly greater improvement in reading comprehension [paired-t(12) = 3.20, p= 0.007] from pre to post-intervention. The ASD-EXP group of children showed significantly greater activity from pre-to-post intervention in the angular gyrus, fusiform, thalamus, precentral, and temporal regions during word similarities task. In verbal absurdities task, the ASD-EXP group showed increased activity in superior parietal and middle frontal areas from pre to post intervention. Increased brain activity in these regions were found to be significantly correlated with improvement in comprehension, as measured by GORT-4.

Conclusions: This study targets neuroplasticity of brain areas underlying reading and tests the impact of intensive imagery-based intervention using instructional procedures based on Dual Coding Theory (Sadoski & Paivio, 2001) to increase language comprehension in children with ASD. These findings provide compelling evidence for the efficacy of a reading intervention in children with ASD that specifically targets an area of intact functioning, visual processing, and uses it to teach compensatory strategies to aid in improving reading comprehension. Data collection for this project is ongoing.

406.006 *(Poster)* Neurophysiological Markers of ASD: Examining the Relationship between Electroencephalography and ADOS Scores in High-Risk Toddlers

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Background: Resting-state electroencephalography (EEG) has shown to be a useful tool for studying the relationship between neurophysiological and behavioral functioning in early childhood development. This non-invasive technique is especially advantageous for research on toddlers with autism spectrum disorder (ASD), given the lack of task-specific demands. Preliminary work has shown that in six-month-olds at elevated familial risk for developing ASD, various power and asymmetry measures can be combined to predict autism diagnosis at 18-months on the Autism Diagnostic Observation Schedule (ADOS-2). Hyperactive frontal power, depleted temporal power, and cortical left asymmetry have emerged as the most indicative markers (Bosl et al. 2018; Gabard-Durnam et al., 2015) We sought to expand on this work by examining the association between power and asymmetry measures with ADOS-2 domain sub scores in 18-36-month-olds at high risk for ASD.

Objectives: To explore the extent to which resting-state EEG measures relate to ADOS scores in toddlers at high risk for ASD.

Methods: EEG data was collected using a 128-channel net during the baseline visit as part of a larger caregiver-implemented early intervention study, evaluating the effects of a treatment program on various clinical, eye-tracking, and EEG measures. Here, we examined the associations between power and asymmetry at mid-frontal (F3, F4), lateral frontal (F7-F8), frontoparietal (FP1, FP2), temporal (T7, T8), and parietal (P3, P4) regions with ADOS-2 domain scores (communication, reciprocal social interaction, play, and stereotyped behaviors) using Kendall's rank correlations. Participants (N=5; 40% female) were between the ages of 18 and 36 months (M=28.6 months, SD=7.02) and screened positive on the Modified Checklist for Autism in Toddlers (M-CHAT) prior to being enrolled in the study. EEG measures were examined in theta (4 to 6 Hz), low alpha (6 to 9 Hz), high alpha (9 to 13 Hz), and beta (13 to 30 Hz) frequency bands, and asymmetry scores were calculated by subtracting right hemispheric power from left (i.e. F4-F3).

Results: Results revealed a significant positive relationship between right frontoparietal high alpha power and ADOS-2 reciprocal social interaction scores, τ_b=.800, p=.05 and a moderate negative correlation between right temporal low alpha power and ADOS-2 communication scores, τ_b =-.447, p=.29. Regarding asymmetry, negative correlations were identified between both mid-frontal low alpha asymmetry and mid-frontal beta asymmetry with ADOS-2 reciprocal social interaction scores, τ_b =-.800, p=.05 and τ_b =-.800, p=.05, respectively. There was also a strong negative correlation between frontoparietal theta asymmetry and stereotyped behaviors, τ_b =-.738, p=.077.

Conclusions: These preliminary findings suggest that certain EEG power and asymmetry measures may relate to core ASD social-communication symptoms, as indexed by the ADOS-2. These results are consistent with prior findings linking EEG measures to ASD symptoms in high-risk groups and further support frontal power and asymmetry as useful markers of ASD; this time in 18-month-olds. Future studies should continue to examine the extent that EEG can be utilized as a tool for assessing autism risk and for tracking developmental progression as a function of age or applied interventions.

406.007 *(Poster)* Abnormal Head Growth during Early Fetal Development Is Associated with Autism Spectrum Disorder

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Background: Current diagnosis of autism spectrum disorder (ASD) is based on the clinical evaluation of abnormalities in social behavior, which are usually not apparent until the second year of life. Nevertheless, emerging evidence suggests that signs of atypical development can be detected in ASD cases before their first birthday and even before birth. Prenatal ultrasonography, which is widely used for screening for fetal anomalies and obstetric complications during pregnancy, could be an excellent tool to discover fetal biomarkers associated with ASD. Nevertheless, only a few studies examined prenatal ultrasonography data in the context of ASD risk, and their findings are limited, controversial, and not specific.

Objectives: The two main objectives of this study are:

1) to identify prenatal ultrasonography biometric measures associated with ASD risk;

2) to determine whether any of these measures are associated with specific cognitive and behavioral phenotypes among children with ASD.

Methods: We conducted a retrospective case-sibling study of children with ASD (cases) from the National Autism Research Center of Israel and their healthy siblings (controls). Ultrasonography biometric measures from the 2nd and 3rd pregnancy trimesters of these sibling pairs (i.e., Head circumference [HC], Bi-Parietal Diameter [BPD], Abdominal Circumference [AC], and Femur Length [FL]) were converted to gestation-matched standardized Z-scores and were compared between cases and controls using paired T-test. Further, conditional logistic regression models were used to assess the independent association of ultrasonography measures with ASD after adjusting to the fetus's gender and mother age. Finally, we examined the correlation between the ultrasonography biometric measures and various cognitive and behavioral phenotypes (e.g., DSM-V severity, ADOS score, IQ, etc.) among children with ASD.

Results: Overall, 153 case-sibling pairs were included in this study. Of these, 64 pairs (42%) had ultrasonography data from both 2nd and 3rd trimesters, while another 46 and 43 pairs had data from either the 2nd or 3rd trimesters respectively. We found that during the 2nd trimester of pregnancy, fetuses later diagnosed with ASD had a significantly larger head compared to their siblings, especially when contrasted to the growth of other body parts (**Table 1**). However, this difference attenuate during the 3rd trimester (**Table 2**). Interestingly, both HC and BPD were mildly but significantly correlated with ASD severity according to DSM-V criteria ($r = 0.23$-0.35; $p<0.05$), but not with their ADOS score or their IQ.

Conclusions: This is the largest study to date and the first case-sibling study that assesses the association of ultrasonography biometric measures with ASD. Our results indicate that fetuses later diagnosed with ASD have abnormal head growth during early fetal development, and this abnormality is associated with a more severe ASD outcome. Integrating these findings with molecular data about brain development in utero may shed light on specific neurological mechanisms underlying ASD outcomes.

406.008 *(Poster)* Validation of Rapid Interactive Screening Test for Autism in Toddlers

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Background: Autism Spectrum Disorder (ASD) is a group of complex neurodevelopmental disorders, and its incidence has increased rapidly in recent years. More than 70% of individuals with ASD need lifetime care, and the CDC has called it a national healthcare crisis. There is growing evidence that early diagnosis has a significant impact on the prognosis of these individuals who have ASD. The Rapid Interactive screening Test for Autism in Toddlers (RITA-T, 2015) is a recently developed test for early ASD screening on toddlers from 18 to 36 months, which is fast, easy to perform and less expensive. Moreover, its feasibility and variation in sensitivity have never been assessed in an Asian population.

Objectives:

1.To validate the new screening technique, RITA-T, for ASD screening in children 1-6 years old. RITA-T results will be compared with results from ADOS.

2.To use this test in a population of young Asian children to determine its utility among this ethnic group as compared with the general population.

3.To use eye-tracking device on toddlers to determine potential differences in fixation duration for various objects and human faces.

Methods:

Participants: Total n=40 individuals aged 1- 6 years (mean = 3.53 year). These subjects were recruited through clinics and other areas and were identified to be high risk for autism by one or more caretakers.

Collection: RITA-T was administered with the ADOS, which was chosen based on observes during a single visit.

Stats: ROC Curve analysis was performed to validate the effectiveness as well as the cut-off score of RITA-T as a diagnostic screening for ADOS. Linear regression line for ADOS composite score and RITA-T to confirm the feasibility of RITA-T among the Asian population.

Results:

The area under the curve for the ROC curve of RITA-T vs. ADOS on all races is 0.891 (>0.5). RITA-T score of 10 is the optimal cut-off score for ASD screening reference. The PPV for RITA-T score above 13 is 1. Patients with RITA-T score higher than 18 has 100% positive predictive value of diagnosing with ASD.

The linear regression for Asians has a positive correlation as for the linear regression for the overall population, which indicates that RITA-T predicts ADOS among Asians as effective as it also does in the overall population.

ASD toddlers and non-ASD toddlers have different focuses for areas of interest on each screen, which is defined by fixation duration and fixation count.

Conclusions:

RITA-T is an effective ASD screening method to us before the ADOS on Asian and other races.

During patient recruiting, age and sex were not evenly distributed and lacked NT toddlers leads to small group size in each age and sex-matched group for further statistical analysis.

For further research, more age and sex-matched ASD and NT subjects are needed to confirm the ASD diagnostic screening effectiveness of RITA-T; as well as explore the ceiling effects, especially with higher intelligence ASD. Additional toddler subjects are needed to differentiate a cut-off score for ASD screening reference on toddler.

406.009 *(Poster)* Altered Autonomic Functions and Gut Microbiome in Individuals with Autism Spectrum Disorder (ASD): Implications for Assisting ASD Screening and Diagnosis

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Background: A growing body of literature suggests the presence of autonomic nervous system (ANS) dysfunction in patients with Autism Spectrum Disorder (ASD). As both are parts of the gut-brain axis, gut microbiome factors and the autonomic indices can serve as non-invasive markers indicating the state of the gut-brain axis in ASD. To our knowledge, no previous studies have explored the relationship between ANS and gut microbiome in patients with ASD, nor has the use of combined autonomic indices and gut microbiome factors been used in the context of classifying ASD and neurotypical subjects.

Objectives: To characterize autonomic function among ASD patients in comparison to their paired family controls and explore the ASD gut-brain-axis, we examined the relationship between gut microbiome markers and autonomic indices, as well as the correlation between the gut-brain-axis and clinical presentation of ASD. Moreover, we assessed the predictive capability of gut-brain-axis biomarkers in subtyping ASD cases.

Methods: We recruited 20 patients diagnosed with ASD (7-25 years, 2 of which are siblings) along with 19 first-degree relatives as neurotypical controls. Autonomic indices were measured via Empatica E4 wristband, which determines indices such as IBI, HR, EDA, BVP, and body temperature. Characterization of the gut microbiota was done via high fidelity 16S rRNA amplicon gene sequencing based on collected stool samples of all subjects.

Results: We found that IBI is significantly lower in ASD patients compared to neurotypical controls (paired t-test, $P < 0.004$). Moreover, in the use of combined autonomic-microbiome markers for classification of ASD and neurotypical subjects, a logistic regression model evaluated via ROC curve yielded high sensitivity and specificity for the classification ($AUC = 0.947$).

In examining ASD comorbidities and their relevance to autonomic dysfunction, significant inter-group differences were found in experiencing sleep disturbance among ASD and neurotypical subjects (Fisher's exact test, $P < 0.0005$). Then, we identified autonomic functions that are uniquely altered in ASD subjects with sleep disturbances (Mann-Whitney U test; Temp: $P < 0.1$, BVP: $P < 0.1$).

Conclusions: We hope that the information generated by our research will help to promote the development and validation of more accurate diagnostic tools and effective therapeutic interventions for patients with autism.

406.010 *(Poster)* Association of Brain GABA Concentrations with Anxiety and Other Co-Occurring Psychiatric Symptoms in Adults with Autism Spectrum Disorder

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Background: Individuals with autism spectrum disorder (ASD) are at increased risk for a range of psychiatric anxiety disorders (Gadow *et al*., 2015; Siminoff *et al*., 2008) although their pathogenesis remains poorly understood. Recent studies have implicated GABA in ASD (Brix et al., 2015; Lam, Aman, & Arnold, 2006; Mahdavi et al., 2018; Rojas, 2014), however, research has generally failed to consider the implications of co-occurring psychiatric symptoms, particularly among adults. A recent meta-analysis found evidence supporting lower GABA concentrations (averaged across brain regions) in adults with ASD, MDD, and schizophrenia (Schur et al., 2016), thus raising questions about diagnostic specificity.

Objectives: The aim of the present study was to examine the association of brain GABA concentrations with psychiatric symptom severity among adults with ASD.

Methods: Participants were 16 adult males (18-45 years) with ADOS-defined ASD and IQs ≥80. (1) Single voxel J-editing H-MRS was acquired on Siemens Biograph 3T scanner for the metabolite GABA, which was performed with one voxel ($30\times30\times20$ mm^3) in the anterior cingulate cortex using a TR/TE of 2000/68 ms with a spectral bandwidth of 2 kHz, 384 spectral average and 16 water reference. Prior to the scan, participants completed the Beck Depression Inventory-2 (BDI-2), Adult Self Report Inventory-4 (ASRI-4), the Kaufman Brief Intelligence Test Second Edition (KBIT-2), and the Social Responsiveness Scale-2 (SRS-2).

Results: GABA levels were positively correlated with the severity of self-reported symptoms of generalized anxiety (ASRI-4; r=.629, p=.009), somatization disorder (ASRI-4; r=.510, p=.044), ADHD: Inattention (ASRI-4; r=.532, p=.034), borderline personality disorder (ASRI-4; r=.535, p=.033) and depression (BDI-2; r=.513, p=.042), but were not associated with severity of ASD, as assessed with the ADOS-2 (r=.086, p=.752) or SRS-2 (r=.038, p=.888), or IQ (r=.393, p=.132). After controlling for IQ, GABA levels were correlated with severity of generalized anxiety (ASRI-4; r=.590, p=.021) and somatization disorder (ASRI-4; r=.563, p=.029) subscales.

Conclusions: Research findings suggest that ASD is associated with dysregulation of brain GABA levels, but the results of the present study suggest that it may be premature to rule out the possibility that co-occurring psychiatric symptoms, particularly anxiety, may explain at least in part this association. GABA was not significantly associated with either IQ or ASD severity, possibly because our sample comprised high functioning adults with ASD. Moving forward, additional MRS studies with larger samples, as well as relevant comparison groups, will be necessary to further understand these associations.

406.011 *(Poster)* Atypical Saccadic Velocity in Children with Comorbid ASD and ADHD

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Background: Saccade velocity requires precise motor control and depends on tonic inhibition of pontine burst cells, which is blocked by the superior colliculus during saccade initiation. Thus, saccade velocity can serve as an indicator of motor dysfunction in neurodevelopmental disorders. Studies investigating saccadic velocity in individuals with autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (ADHD) have yielded mixed results and have not been studied in children with both ASD and ADHD.

Objectives: We investigated *peak* and *mean* velocity in ASD, ADHD, comorbid ASD+ADHD, and typically developing (TD) children. We hypothesized children with neurodevelopmental disorders would show atypical saccade behaviors compared to TD children. We also hypothesized that saccade velocity would be associated with diagnostic classification and individual differences in behavior as measured by Vineland-3 (VABS) and Aberrant Behavior Checklist-C (ABC).

Methods: The sample included 54 children aged 36-95 months (M=67.62, SD=16.01): ASD (n=13; M IQ=76.46), ADHD (n=9; M=112.44), ASD+ADHD (n=16; M IQ=92.06), and TD (n=16; M IQ=114.81). An eye-tracking task consisted of a 3-minute video which included episodes of an actor using joint attention (JA), making dyadic bids (DB), making a sandwich (SW) and moving toys (MT). The dependent measure was saccadic velocity = pixels moved during an individual saccade/saccade duration in seconds.

Results: T-tests were used to test group effects. The TD group did not significantly differ from the three diagnostic groups. The ASD+ADHD group demonstrated higher *peak* velocity than the ASD-only group (MT, p=0.02) and the ADHD-only group (JA, p=0.02). Linear regression controlling for age and IQ revealed increased *peak* velocity was associated with any ASD diagnosis (JA, p=0.01) and with any ADHD diagnosis (MT, p=0.04) when assessing the entire sample. Among children with ASD, slower *peak* velocity was associated with more impaired motor skills (JA, p=0.02; SW, p=0.05) and communication skills (SW, p=0.03). Slower *mean* velocity was associated with more impaired communication skills (full video, p=0.02; JA, p=0.009) and adaptive behavior (full video, p=0.03). Among children with ADHD, decreased *mean* velocity was associated with increased hyperactivity symptoms (JA, p=0.05).

Conclusions: We found that children with comorbid ASD+ADHD demonstrated faster *peak* velocity in MT than ASD-only and faster *peak* velocity in JA than ADHD-only. Children with ASD tended to exhibit higher *peak* velocity during an episode with high social content (JA), whereas those with ADHD exhibited higher *peak* velocity during an episode with high nonsocial content (MT). Among children with ASD, slower *peak* velocity was associated with communication and motor impairments; slower *mean* velocity was also associated with communication and adaptive behavior impairments. Finally, for children with ADHD, slower *mean* velocity was associated with higher levels of hyperactivity. Saccadic behavior helps us to understand the complex, automatic biological processes that contribute to behavioral outcomes and sensorimotor decision making. This study provides evidence that individuals with comorbid ASD/ADHD have distinct gaze behavior that is present in both social scenes and in nonsocial scenes, providing a potential motor signature that distinguishes them from individuals with ASD alone or ADHD alone.

406.012 *(Poster)* Blood Biomarker Discovery in Autism Spectrum Disorder Using the Somascan Platform

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and social interaction, and restricted, repetitive patterns of behavior, interests or activities. Although ASD is characterized as a behavioral disorder, research has identified widespread changes in the genome, immune, and endocrine systems of children with ASD at both the systemic and cellular levels. Thus, many putative biological markers are being investigated using multiple approaches, to identify ASD blood biomarkers that may enable earlier detection and aid in the development of therapeutic interventions. Since proteomic analyses have indicated that the levels of many blood proteins are altered in ASD, a panel of proteins may provide a useful blood biomarker.

Objectives: The aim of this study was to perform a proteomic analysis of serum from boys ages 1.5 to 9 years of age, with and without ASD, in order to identify a panel of proteins characteristic of ASD.

Methods: Subjects included 76 boys with ASD (mean age 5.57, SD 1.66 years) and 78 typically developing boys (mean age 5.80, SD 1.99 years). ASD subjects underwent a diagnostic assessment using the ADOS and ADI-R. Clinical diagnosis was made based upon these assessments and overall clinical impression using DSM-IV/DSM-5 criteria. Controls were screened with the Adaptive Behavior Assessment System (ABAS-II) or the Vineland Adaptive Behavior Scales. Fasting blood samples were obtained using routine venipuncture and processed to collect sera following a standardized SOP. Samples were frozen in cryovials at -80^{o}C until analysis. Proteomic analysis was performed using SomaLogic's SOMAScan^{TM} assay 1.3K platform. The measurement data were log10-transformed and normalized across the samples. A machine learning method, Random Forest (RF), was used to identify a protein panel with the highest importance for ASD prediction. For the protein panel, a logistic regression-based prediction model was trained and tested in a 5-fold cross-validation scheme.

Results: A total of 1317 proteins were measured, with 192 excluded from analysis due to calibration insensitivity, leaving 1125 proteins to be analyzed. The mean decrease in Gini (MDG), a measure of variable importance for the RF, was chosen to identify important proteins. With an MDG threshold >0.5, the RF selected 12 proteins of the highest importance resulting in a subset of data consisting of 12 proteins. A logistic regression model was trained and tested after randomly splitting the subset data into training (80%) and test (20%) data for 100 times. A model evaluation metric, area under curve (AUC), was calculated for each model and was as high as 0.813±0.077. Using Gene Ontology (GO), functional enrichments for the selected proteins included cell response to growth factors, cell proliferation, morphogenesis, regeneration, vasculogenesis, signal transduction, and protein signaling.

Conclusions: These data suggest that a panel of serum proteins may be useful as a blood biomarker for ASD. Further analyses by integrative machine learning is on-going to examine whether demographic variables (including age and behavioral/diagnostic sub-scores) will further increase the prediction power measures including AUC, precision and recall. Verification of the protein classifier with independent test sets is warranted.

406.013 *(Poster)* Changes in EEG Coherence in Adolescents and Young Adults after the PEERS Intervention

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Background: ASD is a developmental disorder that affects social communication and behavior. There is consensus that neurological differences present in individuals with ASD. Further, theories emphasize the mixture of hypo- and hyper-connectivity as a neuropathology in ASD, however, there is a paucity of studies specifically testing neurological underpinnings as predictors of success on social skills interventions.

Objectives: The primary aim was to examine whether changes in neural connectivity occurred in young adults who participated in PEERS®, versus a control group of age and gender matched individuals with ASD who did not complete PEERS®.A second aim was to understand whether changes in EEG coherence were related to changes at the behavioral level.

Methods: Thirty young adults (18-27 years, FSIQ > 70) with ASD participated in the 16-week PEERS® intervention program. Electroencephalograms (EEG) were performed in an eyes-open resting state. Prior to as well as upon completion (pre and post) of PEERS®, young adults and social coaches completed self-report surveys: Quality of Socialization Questionnaire (QSQ), Social Responsiveness Scale (SRS), and Test of Yound Adult Social Skills Knowledge (TYASSK). Eight regions of interest, frontal, temporal, parietal, and occipital lobes in each hemisphere, were calculated and averaged (Figure 1). Magnitude Squared Coherence was calculated with the MVDR method for all possible pairings (28) in the alpha band (Pre and Post). Path Analyses were used to allow for correlated outcomes and covariates.

Results: This newly collected data will be compared to previous results obtained by the authors with a sample of adolescents (n = 110). In the adolescents sample, statistically significant differences were found between the ASD EXP and the ASD WL groups at time 2 in OL-TL (β =.202, *p* <.01). Significant effects of Income were found on EEG coherences at time 2 in OR-FR (β = -0.13,*p* <.005), OR-PL (β =-.291, *p* <.01), OR-TL (β =-0.27,*p* <.003), OR-FL (β =-0.14, *p* <.001), and OL-OR (β =-0.30, *p* <.005); ADOS Total score was a predictor of EEG coherences at time 2 in TR-PR (β =-0.27, *p* <.01), OR-TR (β =-0.25, *p* <.009), OL-TL(β = -0.27, *p* < .006). Residualized time 2 score in the FR-PR coherence pair at was significantly related to the Social Skills subtest of the *SSIS* at time 2 (β =.303, *p* <.002). Significant effects of OL-PL residualized coherence(β =.318, *p* < .002), and OR-TR residualized coherence (β =.36, *p* <.008) were found on QSQ-A scores at time 2.

Conclusions: Results from young-adults will be compared to those previously obtained from adolescents, which indicated that individuals exhibiting more severe symptoms of ASD showed less coherence in “short-range” EEG pairings in social brain areas. Adolescents who received PEERS® exhibited changes in an exemplar “short-range” coherence pair that was linked to changes in their social knowledge and behavior; a replication of this finding will be tested for in young adults. The new data is expected to add to the previously found evidence that initial brain differences and risks in ASD are affected by treatment, indicating support of neuroplasticity.

406.014 *(Poster)* Comparison of Blood Heavy Metal Levels and Quantitative EEG Correlates in Children with Autism Spectrum Disorder Aged 3-12 Years and Typically Developing Children :a Cross Sectional Study

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Background: The etiological factors involved in the causation of autism remain elusive and controversial, but both genetic and environmental factors have been considered in the etiology of Autism Spectrum disorder (ASD). Heavy metals are considered as few of the possible environmental agents. The role of heavy metals is biologically plausible because they are known to disrupt enzyme functions, alter cellular signaling processes, and generate oxidative stress leading to apoptosis.

Objectives: The aim of this study was to understand contribution of heavy metal toxicity in development of Autism. Another objective was to determine quantitative EEG correlates of neuronal processing in ASD children, as compared to controls.

Methods: Total 180 children aged 3-12 years with ASD and 117 age and sex matched typically developing (TD) controls were enrolled between June 2016 and December 2018. Each child was subjected to detailed neuropsychological evaluation initially including DSM V criteria for ASD, Childhood Autism Rating Scale (CARS), Autism Behavior Check List (ABC), Child Behavior Check List (CBCL) and Development Quotient determination by Development Profile 3.One ml blood sample was collected in ultrapure Metal-free EDTA coated collection tubes and subjected to elemental analysis for chromium, manganese, lead, arsenic, zinc, iron, copper, selenium, nickel, cadmium and magnesium levels by Inductively Coupled Plasma Mass Spectroscopy.

Quantitative EEG (qEEG) correlates of neuronal processing were also analyzed using neural synchrony and time-frequency analysis, in resting state and using 4 tasks for evaluating executive function: Picture memory, Word memory, Verbal fluency and Digit span forward test. Quantitative EEG could be recorded in 61 children with ASD and 48 controls, during eyes open and eyes closed condition for 10 minutes each using 128 channel hydrocel geodesic sensor net.

Results: 180 children with ASD (153 boys, 85%, age-6.5±1.6 years, CARS-36.59±2.38, Development Quotient-59.94±5.86). ASD subjects were found to have having significantly high level of following metals in blood compared to controls: mercury (35.74±12.11 vs 4.28±2.07, p=0.001), chromium (75.01±20.04 vs 1.0±0.25, p=0.001), manganese (54.13±19.34 vs 10.52±2.99, p=0.001) and lead (128.34±42.09 vs 17.81±6.59, p=0.001). No significant difference was found between blood levels of Arsenic, Iron, Copper, Zinc, Nickel and Selenium between ASD subjects and controls. Similarly, no significant correlation between ASD severity by CARS and any blood heavy metal level could be observed. Only the increased blood lead levels correlated with increased hyperactivity score on CBCL in ASD subjects.

The spectral power of gamma, beta, lower alpha1, theta and coherence of gamma, lower alpha1 during eyes closed condition was significantly ($p < 0.0005$) lower and the spectral power of theta and coherence of lower alpha 1, theta, delta was significantly lower ($p < 0.0005$) during eyes open condition in ASD compared to TD children.

Conclusions: ASD children have different qEEG correlates, as well as, significantly higher blood mercury, chromium, manganese and lead levels as compared to typically developing children. Reduced spectral power and coherence in specific spectral bands could be used as a biomarker in children with Autism Spectrum Disorder.

406.015 *(Poster)* Connecting Brain and Behavior: Understanding GRIN2B Disruptive Mutations

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Background: Targeted and effective treatment approaches to improve outcomes and quality of life for individuals with *GRIN2B* are on the horizon, thanks to advances across the fields of genetics, molecular biology, neuroscience, and behavioral science (Stessman, Bernier, & Eichler, 2014). However, efforts to truly achieve precision medicine are thwarted by small sample sizes, as well the lack of objective, sensitive, non-invasive biological measures (e.g., neural biomarkers) that reflect underlying genetic etiology. Clinical and medical features of *GRIN2B* make standardized clinical testing difficult, including severe intellectual disabilities (100%), hypotonia (72%), motor delay (91%), and motor coordination issues (72%) common to carriers of *GRIN2B* mutations (Freunscht et al., 2013). Parent report indicates attention problems are common for children with *GRIN2B* mutations (Freunscht et al., 2013), but little is known about neural attention mechanisms.

Objectives: We sought to link a promising electroencephalography (EEG) based candidate biological indicator ("biomarker") of the attention system to the behavioral profile of children with disruptive *GRIN2B* mutations.

Methods: Participants (N = 159, see Table 1) comprised of the following groups were included in these analyses: GRIN2B (i.e., with a known disruptive *GRIN2B* mutation), No Event ASD (i.e., no known disruptive genetic event), and Typically-Development. A passive auditory oddball EEG experiment (Hudac et al., 2018) measured attention and speed of habituation as reflected by the central N1 (60-140 ms) and P3a (100-350 ms). Linear mixed-effects analyses with random effects [R 3.6, lme() package] tested group differences in condition (i.e., deviant tone/sound vs. repeated tone) and habituation (i.e., the rate of increasing N1 or decreasing P3a amplitude).

Results: Compared to children with ASD but without a known disruptive mutation, we observed even larger amplitude responses when examining children with a disruptive *GRIN2B* mutation, including N1 amplitude, $F(2,146)=13.59$, $p<.0001$, and P3a amplitude, $F(2,144)=6.98$, $p<.01$. Increased N1 and P3a responses were related to lower cognitive abilities, $ps<.0001$, and more attention problems, $ps< .05$. There were no overall habituation differences between groups for the N1, $p>.092$. There was a significant group x condition differences in linear slope of the P3a, $F(2, 20379)=3.99$, $p<.019$, that indicated a unique *GRIN2B* pattern: the increased response to frequent tones habituated rapidly.

Conclusions: The increased N1 and P3a responses in children with *GRIN2B* disruptive mutations is aligned with well-noted attention problems, including hyperactivity, impulsivity, distractibility, and short attention span (Freunscht et al., 2013). These results indicate that both early detection (N1) and later encoding (P3a) stages of the attention system may be affected in *GRIN2B* and may relate to specific behavioral challenges. It may be possible to use this information to generate different management and therapeutic strategies for improving individual outcomes.

406.016 *(Poster)* Context Modulates Attention to Faces in Dynamic Social Scenes in Children and Adults with Autism Spectrum Disorder.

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Background: Compared to typically developing (TD) controls, individuals with autism spectrum disorder (ASD) on average look less at socially informative elements of visual scenes (e.g., people, faces, gestures). Toddlers with ASD were shown to alter the level of allocated visual attention to faces depending on a context (Chawarska et al., 2012). Yet it is uncertain whether the same effects persist in older ASD population.

Objectives: To examine whether context affects allocation of visual attention in dynamic social scenes in children and adults with ASD as compared to TD controls.

Methods: Eye movements of individuals with ASD (n=94; 68 males; mean age [SD]=14.5[7.3] years) and TD controls (n=38; 25 males; age=16.7[13.6] years) were recorded while they viewed two videos presenting an actor in the center and toys in each corner of the screen (total duration=163 seconds) (Plesa-Skwerer et al., 2019). The actor was either (1) silently performing a simple activity, (2) looking at a single moving or (3) stationary toy, or (4) engaged in a viewer-directed speech. For each of the four contexts, mean total looking time normalized by the duration of video display in that context was computed. Additionally, for each context mean percentage of the total looking time (denoted % looking time) spent by participants on looking at five non-overlapping regions of interest (ROIs) in that context was computed. The ROIs included the actor's face, body, hands/activity, toys and the remaining background. Differences in % looking time between the ASD and TD groups in each context were tested using a linear mixed-effects model. Each model included % looking time as a dependent variable, and participant's age, gender, group, ROI and an interaction between the latter two factors as fixed effects. Participant identifier served as the random intercept.

Results: Mean total looking time ranged from 86.5% to 88.3% across contexts and did not differ between the two groups of participants ($p>0.24$). In each context, % looking time varied across ROIs ($p's<10^{-15}$). Although both groups showed similar viewing patterns across ROIs, individuals with ASD looked less at the actor's face when an actor was performing an activity (mean % looking time [SD], ASD vs. TD: 30.7[8.2]% vs. 34.9[5.1]%; Cohen's d=0.56; $p<0.03$) or looking at a moving toy (24.5[13.0]% vs. 33.2[13.8]%; d=0.65; $p<0.001$). Comparisons of % looking time for the core features of faces revealed a consistently lower level of visual attention to the actor's eyes and mouth across contexts in individuals with ASD than in TD controls. In no context was % looking time significantly modulated by age or gender.

Conclusions: Depending on a context, children and adults with ASD view social scenes either in the same or different manner as TD controls. In some contexts, ASD and TD populations differ in allocation of visual attention to faces. Differences in attention to faces observed from toddler years to adulthood suggest that they could be used to discriminate between ASD and TD populations across the lifespan and, thus, could serve as a biomarker of ASD.

406.017 *(Poster)* Development of an Objective Autism Risk Index Using Arabic Remote Eye Tracking Paradigm

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Background: Deficits in eye gaze are a hallmark feature of autism spectrum disorder (ASD) and are included in gold standard diagnostic instruments. More than a decade of research into abnormalities of eye gaze has confirmed social attention deficits as a key feature of ASD. Across studies, diverse stimulus paradigms have elicited social attention abnormalities, ranging from decreased fixation to others' eyes and social scenes as early as 6 months of age, to gaze abnormalities during dyadic or joint attention bids in preschoolers and older children, to aberrant gaze toward dynamic social stimuli in older high-functioning individuals.

Gaze patterns, particularly those based on dynamic temporal analysis, may be a promising objective risk marker of ASD as well as a quantitative measure of autism symptoms spanning the full continuum of behavior. Developing an Arabic version of eye tracking stimuli paradigm mimic the English ones used by previous studies to be used for Arabic speaking individuals is challenging but promising.

Objectives: The primary aim of the present study was to create an objective, eye tracking-based autism risk index using Arabic version stimuli paradigm.

Methods: Children were recruited for comprehensive multidisciplinary evaluation of ASD and subsequently grouped by clinical consensus diagnosis (ASD n=106, non ASD 100. Remote eye tracking using Arabic version stimuli. Dwell times were recorded to each priori-defined region-of-interest (ROI) and averaged across ROIs to create an autism risk index.

Results: Similar to the previous findings, the autism risk index had high diagnostic accuracy with area under the curve (AUC)= .89 and .84, 95% CIs=.80-.97 and 070-.95, was strongly associated with Autism Diagnostic Observation Schedule-Second Edition severity score.

Conclusions: The autism risk index is a useful quantitative and objective measure of risk for autism in at-risk settings. Using the Arabic remote eye tracking paradigm proved to be as effective as the English version used in previous research projects.Future research in larger samples is needed to cross-validate these findings. If a validated scale for clinical
use, this measure could inform clinical judgment regarding ASD diagnosis and track symptom improvements.

406.018 *(Poster)* Developmental Effects of Serotonin in ASD: Relationship to Core and Associated Symptoms

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Background: Compelling evidence points out the plausible association between serotonin and Autism Spectrum Disorder (ASD) (Garbarino, et al., 2018), with around 30% of children with ASD presenting hyperserotonemia (Gabriele, Sacco & Persico, 2014). Furthermore, some studies suggest that pre-pubertal children physiologically show higher levels of serotonin than those past puberty (McBride et al., 1998).

Objectives: The aims of this study are twofold: 1) to explore the relationship between serotonin and ASD symptoms, and 2), using a wide age range sample of individuals with ASD, to study the developmental effect (or lack of) for such relationship.

Methods: One hundred and eight individuals (88,9% male; 92,6% caucasian; ages 3 to 45) were recruited. Thirty-nine individuals were 12 or less years of age, while 69 were older than 12. Socio-demographic data, obstetric history, early developmental milestones, severity of ASD symptoms, associated symptoms, and platelet serotonin levels were assessed in all individuals.

Results: A statistically significant inverse relationship between serotonin and age (r = -0.269; p = 0.005) was observed. Comparing to older individuals, participants under 12 showed, on average, significantly higher serotonin levels (U = 969; p = 0.016). No association between serotonin and severity core or presence of associated symptoms was found in patients under 12 years of age. However, in the older group, hyperserotonemia was related to a delay in motor (r = 0.258; p = 0.038) and language (r = 0.455; p = 0.001) development milestones.

Conclusions: As previously reported, ASD serotonin levels were higher at younger ages. Contrary to what was expected, serotonin levels did not relate to severity of core or presence of associated ASD symptoms. Bigger samples of prepuberal participants will better inform of the relationship between level of serotonin and severity or profile of ASD symptoms. In adults, hyperserotonemia seems to index a global neurodevelopmental delay.

406.019 *(Poster)* Do Motor Abnormalities Constitute an Endophenotype of Autism Spectrum Disorder ?

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Background: It is well established that actions are composed by series of motor acts which are not independent each other, but rather interconnected in a chained organization. For example, in a reach, grasp and place action, the kinematics of the first motor act (and not only of the last one) is influenced by the final goal of the action. This fundamental property of motor organization is deficitary in autism spectrum disorder. Whether siblings of children with autism exhibit the same motor pattern is to date an open point, whose answer could support the existence of a phenotypic link between the genetics of autism and motor abnormalities.

Objectives: The aim of the present study is threefold: first, to verify the existence of an action goal-dependent modulation in typically developing children (TD) since young age (2-5) during the execution of reach-to-grasp and place actions; second, to ascertain that such modulation is absent in children with ASD; third, to investigate the behavior of unaffected siblings (SIB) in the same task.

Methods: Thirty-four children (mean age 3.8 yrs, 10 TD, 11 ASD, 13 SIB) were required to reach and grasp an object, and then place it into a container, which could be either big or small. The upper limb kinematics was recorded via inertial sensors, while the overall movement was videotaped. The duration of each motor act was computed, and submitted to a mixed ANOVA with Group (TD, ASD, SIB) and Size (Big and Small) as factors. Post hoc analysis was Bonferroni corrected.

Results: A significant Group*Size interaction was found for the reaching duration ($F(2, 31)=4.7$, $p=0.01$). Post-hoc comparisons revealed that while TD were significantly faster in reaching when the object had to be placed into the big container (640 vs 710 ms, $p=0.02$), both ASD children and their siblings did not show any modulation (ASD: 584 vs 589ms; SIB: 569 vs 560ms). The same analysis conducted on the placing duration returned a significant main effect of Size ($p<0.001$) but a no significant Group*Size interaction. Both TD and ASD presented a significant modulation for size (TD: 543 vs 753ms, $p=0.009$; ASD: 614 vs 853ms, $p=0.001$). Despite showing a similar pattern (593 vs 671ms) siblings only approached the statistical threshold ($p=0.2$).

Conclusions: Even in simple actions implying different motor intentions, young typically developing children modulate their kinematics throughout the entire actions, i.e. since the initial motor act. Showing this behaviour already in three years old children advocates for the innateness of this property within the human motor system. Children with ASD are not capable of this modulation suggesting a piece-by-piece montage of executed actions. The fact that also siblings present a similar disorganization renders this lacking modulation eligible as an endophenotype of ASD, and reinforces the role of motor deficits in the etiology of autism.

406.020 *(Poster)* Early Evidence of Attentional Biases in Infants at Elevated Likelihood for Autism

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Background: Social and non-social attention differences are hallmarks of autism spectrum disorder (ASD) that have been measured via eye-tracking. However, it is unclear how early in development these differences emerge. Recently, researchers have identified markers of risk in ASD including reduced attention to fearful faces (Wagner, Keehn, Tager-Flusberg, & Nelson, 2019) and reduced left visual field bias (Dundas, Gastgeb, & Strauss, 2012). A notable gap in this literature is the employment of child-directed speech (CDS) videos, which include dynamic social and non-social stimuli that more closely resemble real-life social situations than static pictures.

Objectives: In the present study, we aim to further our understanding of this area by examining attentional biases during three separate CDS conditions.

Methods: Infants (11 to 16 months) were recruited into one of two groups: elevated likelihood of ASD (EL-ASD) based on the dual cut-off criteria of the First Years Inventory Lite (FYI-LITE V3.1b), (Baranek, Watson, Crais, Turner-Brown & Reznick, 2014; n=21) and lower likelihood of ASD (LL-ASD) (n=20). Eye gaze patterns were collected via a Gazepoint GP3 HD eye tracker while infants passively viewed a CDS paradigm that consisted of a baseline video, three CDS videos (a puppet narrative, a book story-telling, and an adult playing with a toy using non-sensical speech), and a second baseline. Areas of interest (AOIs) were mapped for each scene to include social stimuli (i.e., human face, puppet face) and non-social stimuli (i.e., flowers, trees). Social and non-social attention was calculated as a proportion of the total time attending to the screen for each given scene within the CDS paradigm. We examined differences in social and non-social attention, overall attention and number of discrete fixations by AOI using t-tests.

Results: There were no differences in overall attention to the screen (across all scenes) between groups. During the child-directed book reading scene, children in the HL-ASD group spent significantly more time attending to faces ($p = .02$) and had more discrete fixations to the face ($p = .01$) compared to the LL-ASD group. During this same scene, the HL-ASD group spent significant less time attending to the book ($p = .02$) and had fewer fixations to the book ($p = .05$). During the puppet scene, the HL-ASD group fixated on the elephant fewer times (differences approaching significance, $p=0.08$) and spent a significantly greater portion of the time attending at the butterfly ($p=0.02$).

Conclusions: Results suggest that attentional biases may present in infants at HL-ASD. In contrast to previous studies in older children, infants in our HL-ASD group spent significantly greater time looking at faces. This may mean that high-risk infants demonstrate less screen exploration (i.e., scanning the screen visually to explore all the available objects in the field) and instead demonstrate greater attentional inflexibility. This inflexibility may manifest in the later years as attentional inflexibility towards restricted interests. We will further these analyses by examining dyadic gaze (shifting between book and face during the story-telling paradigm) and examine attention to specific facial AOIs (eyes and mouth) to further test this hypothesis.

406.021 *(Poster)* Early Social-Communicative Interventions Affects Event-Related Potentials (ERPs) in Toddlers: A Randomized-Controlled Trial

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Background: A growing amount of evidence supports the effectiveness of early intervention on the social-communicative skills of children with autism spectrum disorder (ASD).

Objectives: This randomised controlled trial (RCT) tests the effects of Project ImPACT, an early parent-run intervention targeting social-communicative skills, on the behaviour and brain activity of toddlers with Autism Spectrum Disorder (ASD).

Methods: Twenty-five toddlers (3 girls, mean age: 3.1 ±.6) with ASD have participated to date in this RCT and received either Project ImPACT or a treatment which does not focus on social-communicative abilities (TAU). Both treatments are administered at low intensity (90 minutes or less per week) for 18 weeks. Currently, 36 children have completed baseline testing, and outcome data are expected before the INSAR meeting for the entire sample. Outcome measures include ASD symptom severity (ADOS-2, BOSCC), cognitive development (M-SEL), observation of social engagement, and event related potentials (ERPs) in response to standard and deviant voice and non-voice stimuli.

ERP analysis was conducted over the mean voltages in the P1, N2, P3, and N4 time-windows at Fz and Cz sites.

For each time window, a 2(time) X 2 (group) interaction was tested using permutation-based t-test (n=5000) over the difference between baseline and outcome in the mean response to deviant stimuli. For time-windows where this interaction was significant, a comparison with a group of age-matched typically developing children (n = 16, 3 girls) was also carried on. Based on what the literature suggests to be the possible functional meaning of the components affected by treatment, their relationship with the pertinent behavioural measures was also explored.

Results: There was a significant time X group interaction in the P1 (t(1,23) = 1.915, p =.038) and N2 time windows (t(1,23) = 1.950, p =.036). For the ImPACT group, there was a significant effect of time on both components (P1: t(1,14)= 2.443, p =.031; N2: t(1,14) = 2.189, p =.048), whereas this was not the case for the TAU group.

When compared to the TD group at baseline, both groups of children with ASD showed a significantly more negative N2 component (ImPACT: t(1,29) = 1.968, p =.031; TAU: t(1,24) = 1.764, p =.049). At outcome, however, only the TAU group differed significantly from TD (t(1,24) = 2.288, p =.018). As for the P1 component, the two groups of children with ASD did not significantly differ from TD before or after treatment.

Correlation analysis indicates that P1 mean voltages at baseline are related to restricted and repetitive behaviour scores (RRB) observed in the ADOS-2 at the same time-point (r_s =-.621, p =.005), whereas P1 mean voltages at outcome relate to RRB score measured at follow-up, approximately 12 weeks later (r_s =-.563 , p =.012). The P1 gain was also related to a decrease in RRB symptom severity (r_s =-489, p =.034).

Conclusions: Effects of treatment were significant for the ImPACT group on the P1 and N2 components, which typically reflect costs of attentional shift. Consistently with this, the treatment-related increase in P1 mean voltages reflected an attenuation of behavioural rigidity.

406.022 *(Poster)* Event-Related Potential Study of Visual Oddball Test in Children with Autism Spectrum Disorder, ADHD, Comorbid Autism and ADHD, and Neurotypical Children

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Background: Autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (ADHD) are two of the most commonly diagnosed childhood neurodevelopmental disorders. Although the comorbidity was excluded in DSM IV, DSM-5 does not preclude the concurrent diagnosis of ADHD and ASD (ASD+ADHD). In recent years the prevalence of both ASD and ADHD, as well as comorbid ASD+ADHD, has increased substantially.

Objectives: This study aimed to better understand the distinctions and similarities in manifestations of executive deficits among these conditions. For this purpose we used analysis of behavioral responses such as reaction time (RT)/accuracy and event-related potentials (ERP) during performance on a visual oddball task with illusory figures. Based on our prior data and other reports, we predicted that ASD diagnosis would factor more in such executive function as error monitoring, detection and correction, while those with an ADHD diagnosis would manifest changes in the latency of ERP responses.

Methods: Participants were age-matched children (N=18 per group) with ASD, ADHD, comorbid ASD + ADHD diagnosis and neurotypical controls (CNT). EEG was collected using 128 channel EEG system. The task involved the recognition of a specific illusory shape, in this case a square or triangle, created by three or four inducer disks.

Results: Analysis of data revealed that there were no between group differences in RT to target stimuli, but both ASD and ASD+ADHD groups committed more errors; more specifically, the ASD groups had higher omission error rates than neurotypical children. Post-error RT in ASD and ASD+ADHD groups manifested as a post-error response speeding rather than the corrective RT slowing typical of the controls. The ASD and ASD+ADHD group also demonstrated an attenuated error-related negativity (ERN) component as compared to ADHD and controls. The fronto-central N100 was enhanced and less differentiated in response to target and non-target figures in the ASD and ASD+ADHD groups as compared to CNT children. In addition, several frontal ERP components in response to non-target stimuli had prolonged latencies in the ADHD group as compared to both ASD and CNT groups.

Conclusions: This comparative ERP study confirmed the utility of using electrocortical responses to elucidate differences between ASD and ADHD and their impact in dual ASD+ADHD diagnosis. This information helps define the extent of overlap among these comorbidities both in terms of symptom expression as well as underlying neuropathology.

406.023 *(Poster)* Exploring the Effectiveness of EEG-Based Biomarkers during Facial Emotion Recognition in Classifying Autism in Adulthood

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Background: Currently evaluating Autism Spectrum Disorders (ASD) is largely based on clinical judgment and behavioral assessment, however there is emerging evidence that electrophysiological biomarkers may support the diagnosis, classification, prognosis, and even treatment of ASD.

Objectives: With the goal of investigating the effectiveness of electroencephalography (EEG) as a potential biomarker for ASD, this study employed a data-driven approach to analysising frequency power as measured during a facial emotion recognition (FER) task in autistic and non-autistic adults.

Methods: Electroencephalogram (EEG) frequency power was collected for 22 autistic adults and 27 non-autistic adults while completing complex, dyamic FER task. This FER tasks involved partcipants viewing 3-7 second long silent video clips of actors expressing positive and negative facial expressions. Following the presentation of each clip, participants were asked to select from four options, which emotion they believed was portrayed in the clip. Machine learning algorithms, including Naïve Bayes, Sequential Minimal Optimization (SMO), Multilayer Perception (MLP), Decision Stump, Random Forest and Random Tree were applied to the data to investigate the accuracy of EEG based biomarkers in classifying ASD in adulthood. Further classifications were conducted based on participants' Social Responsiveness Scale scores -2 (SRS-2) and combining EEG and SRS-2 scores to determine the utility of EEG-based classification compared to a popular screening measure.

Results: Area under the receiving curve (AUC) revealed that classifier accuracy based on EEG alone ranged from 0.62 – 0.88, while accuracy on the SRS-2 ranged from 0.73 – 0.87. Classifications based on EEG and SRS-2 combined ranged from 0.72 – 0.97.

Conclusions: EEG biomarkers collected during FER may provide a prospective means of classifying ASD, offering an accuracy similar to that of the SRS-2 screening measure and similar to current diagnostic assessments. The use of EEG biomarkers and SRS-2 combined resulted in the highest accuracy. The use of EEG-based biomarkers may provide a means of assisting in diagnosis and prognosis through triangulation with traditional behavioral assessment.

406.024 *(Poster)* Habituation As an ASD Biomarker: Capturing Distinct Genetic Profiles in Drosophila and Humans

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Background: Autism spectrum disorder (ASD) and intellectual disability (ID) are highly co-morbid disorders, both associated with sensory information overload and sensory sensitivities (Joosten & Bundy, 2010; Wilson et al., 2019). Habituation is the mechanism by which sensory information is filtered at the neural level, and it represents a fundamental, evolutionarily conserved form of learning. Atypical habituation patterns are reported in ASD (Hudac et al., 2018; Vivanti et al., 2018), and may underlie cognitive and behavior hallmarks of both ASD and ID. Recent work in *Drosophila* has identified >100 orthologs of genes implicated in ID and comorbid ASD to be required for habituation learning (Fenckova et al., 2019). A better understanding of the biological mechanisms at the genetic and neural levels will elucidate the underlying pathophysiology and may help stratify children with similar biological mechanism for filtering sensory information.

Objectives: Our objective is to link gene-specific habituation profiles from *Drosophila* to human children with disruptive mutations to develop habituation as a translational biomarker for preclinical drug screening, objective clinical classification, and stratification of human cohorts.

Methods: Approximately 300 *Drosophila* orthologs were manipulated (gene-specific panneuronal knockdown) and tested in a high-throughput light-off jump habituation assay, in which we recorded the rate by which *Drosophila* continue to respond to a light-off stimulus over successive trials. *Drosophila* models were characterized as habituation deficit (i.e., no or slower decrease in response), or normal habituation. In humans, we targeted a group of children with a known disruptive mutation associated with ASD and/or ID (see Table 1). A passive auditory oddball EEG experiment (Hudac et al., 2018) measured attention and speed of habituation, and here we focus on novelty response of the P3a (100-350 ms). Linear mixed-effects analyses with random effects [R 3.6, lme() package] tested genetic group differences in condition (i.e., rare, deviant sound vs. frequent, repeated tone) and habituation (i.e., the rate of decreasing P3a amplitude).

Results: Genes with deficient habituation in *Drosophila* were in humans predominantly associated with comorbid ASD+ID (as opposed to ID without ASD), p = .001. Based upon these results, we characterized children into either habituation deficit or normal habituation in *Drosophila*. All groups exhibited a P3a novelty response indicated by a larger P3a amplitude for novel relative to frequent sounds, $F(1,3968)=238.4$, $p<.0001$. However, an interaction between habituation, condition, and group, $F(1,3968)=3.85$, $p=.049$, indicated that the habituation deficit group exhibited comparable habituation to both frequent and novel sounds, $p=.08$.

Conclusions: Habituation patterns observed in children within the habituation deficit group were atypical from prior work in TD and other children with ASD (Hudac et al., 2018) and may implicate different biological mechanisms for filtering sensory information. This work provides an argument for the evolutionarily conserved genetic architecture of habituation learning and its relevance to neurodevelopmental disorders. Together, our results raise the exciting possibility that habituation deficits can be used as a widely applicable cross-species biomarker for translational research and may aid in the identification of treatment targets.

406.025 *(Poster)* Higher Lactate Level and Lactate-to-Pyruvate Ratio Might be Potential Biomarkers in Autism Spectrum Disorder

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Background: Mitochondrial dysfunction is considered as one of the pathophysiological mechanisms of autism spectrum disorder (ASD). However, previous studies of biomarkers associated with mitochondrial dysfunction in ASD revealed inconsistent results. Also, as those studies are mainly conducted in Caucasian population, it is necessary to expand those into Asian population.

Objectives: The objective of this research is to evaluate biochemical markers associated with mitochondrial dysfunction in subjects with ASD as compared with their unaffected family members.

Methods: The participants with ASD, both biological parents and their unaffected siblings were recruited through child and adolescent psychiatric clinic at Seoul National University Bundang Hospital. The subjects were ascertained through standardized diagnostic procedures using Korean versions of Autism Diagnostic Interview-Revised (ADI-R), Autism Diagnostic Observation Schedule - 2 (ADOS-2) and social responsiveness scale (SRS). Lactate, pyruvate and lactate-to-pyruvate ratio were examined in the peripheral blood of probands with ASD (Affected Group) and their unaffected family members (biological parents and unaffected siblings, Unaffected Group). Lactate ≥ 22mg/dl, pyruvate ≥ 1.4mg/dl and lactate-to-pyruvate ratio > 25 were defined as abnormal range. The clinical variables were compared in the subjects with higher (>25) and lower (≤25) lactate-to-pyruvate ratio within Affected Group. Independent samples t-tests were used to compare baseline characteristics between two groups. Differences measurement were examined with paired t-tests for both groups. Chi-squared test (χ^2) was performed to determine the ratio of higher level of chemical variables in two groups. Statistical significance was defined as $p < 0.05$.

Results: (1) A total of 58 Affected Group (mean age 99.35 ± 54.01 months, 20.60% female, mean IQ 75.98 ± 20.67) and 137 Unaffected Group (443.43 ± 150.26 months, 51.80% female, mean IQ 103.13 ± 13.88 for siblings) were included in this study. (2) Affected Group showed significantly higher level of lactate and lactate-to-pyruvate ratio compared to Unaffected Group (lactate 19.67 ± 11.40 vs. 13.79 ± 6.17, lactate-to-pyruvate ratio 21.15 ± 18.45 vs. 15.20 ± 9.56, $p < 0.01$). The frequency of subjects with abnormally higher range of lactate level and lactate-to-pyruvate ratio was significantly higher in Affected group (lactate 31.0% vs. 9.5%, ratio 25.9% vs. 7.3%, $p < 0.01$). (3) Clinical variables including domain scores of ADOS-2, ADI-R diagnostic algorithms and total SRS scores did not reveal significant differences in two groups.

Conclusions: These results suggest that the biochemical markers related to mitochondrial dysfunction, especially higher lactate level and lactate-to-pyruvate ratio might be associated with pathophysiology of ASD. Further larger sized study using unrelated individuals is needed for controlling possible effects of age and sex on the chemical biomarkers.

406.026 *(Poster)* Identifying Clusters of Preschoolers with Autism Based on Physiological Responses to Social and Non-Social Videos and Their Relation to Phenotypic Profiles

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Background: To understand the emergence of autism symptoms, it is necessary to study mechanisms that may contribute to the compromised development of early social communication skills. Prior research suggests that engagement in social interactions is attenuated early on in autism, which could affect the development of social and language skills. Behavioural attention is, however, not the same as engagement, and studying physiological responses, such as heart rate (HR), to external stimuli can provide additional information about a child's attentional state.

Objectives: We aim to compare HR and heart rate variability (HRV) to social and non-social videos of typically developing (TD) children and children with autism. Besides a case-control approach, clustering techniques are used to look at groups of children with more similar phenotypic and physiological profiles, which are compared using categorical and dimensional analyses.

Methods: Sixty-five TD children and 67 children with autism between 2 and 5-years participated in a study where HR was measured during a screen-based battery of social and non-social videos. The first block of videos included a video of a toy and a man singing English nursery rhymes, the second block was of a woman singing nursery rhymes, once in English and once in Hungarian. Phenotypic profiles were based on the child's non-verbal, language, social and executive function skills as well as autism symptom severity. We conducted four types of analyses: 1) case-control (TD vs. autism) mixed model, 2) mixed model with four identified phenotypic clusters (TD versus ASD with (a) phenotypic scores comparable to TD, (b) mostly difficulties with executive function and social skills, (c) mostly difficulties with language and non-verbal skills, (d) low scores across phenotypic measures), 3) mixed model with three identified physiological clusters (low, medium and high arousal), and 4) principle component analysis (PCA) on the continuous physiological data to find patterns of physiological responses, which were subsequently related to phenotypic data.

Results: Case-control and autism clusters did not reveal any group differences in HR or HRV, however, there was an interaction effect between group and video in the HR models, showing that physiological arousal in children with autism increases more to the social versus non-social videos, especially over time. The physiological clusters were associated with age only and none of the phenotypic measures. This was confirmed by the PCA, which showed that the largest component, related to the child's average HR, correlated with age. The second PCA component showed an increase in HR from the first to the second block of videos; a larger HR increase was associated with poorer language skills. The third PCA component showed a modulation based on video content; children who showed a larger decrease in HR from Toy to Man and from English to Hungarian, had better language and social skills and displayed less autism symptoms.

Conclusions: A variety of techniques showed individual differences in modulation of physiological arousal, which were related to a child's social and communication behaviours. This supports the theory that atypicalities in social engagement could be related to emerging symptoms of ASD.

406.027 *(Poster)* Identifying Neurocognitive Endophenotypes in ASD: A Multi-Method, Family Study of Visual Perception and Attention

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Background: Individuals with ASD demonstrate a local visual processing bias (Van der Hallen et al., 2015) and social attention atypicalities (Frazier et al., 2017), which have also been implicated more subtly in parents of individuals with ASD (Nayar et al., 2018; Lee et al., 2019), suggesting a potential genetic influence on visual perception/attention. However, prior studies involving parents do not assess local/global visual processing explicitly nor do they comprehensively examine dynamic looking patterns of social attention. As such, the extent to which visual perception/attention constitute endophenotypes and whether atypicalities are linked to underlying neurobiology, remains unknown.

Objectives: To deeply characterize the behavioral and neural basis of visual perception and attention in individuals with ASD and their first-degree relatives.

Methods: Across tasks, participants included a maximum of 31 individuals with ASD and 34 controls, as well as 62 parents of individuals with ASD and 46 parent controls. To examine bottom-up visual processing, *Global* and *Local* fixation composite scores were generated from two interactive match-two-sample tasks administered on an eye-tracker. Top-down attention was assessed using a suite of analytical methods applied to eye tracking during presentation of a social-emotional scene, characterizing *where* and *how* participants looked. Finally, neural correlates of local/global processing were assessed with event-related potentials (ERPs, i.e., time-locked EEG responses to visual stimuli), including P1, N1, and P3 components. Composite scores of *Local/Global* processing and social attention were generated to discriminate diagnostic groups using receiver operating characteristic curves.

Results: Individuals with ASD demonstrated a greater local than global visual processing style (*Fig.1*) (p<.001), which discriminated the ASD and control groups (area under curve, AUC=.71) with moderate specificity (68%) and fair sensitivity (63%). While parent groups did not differ in *Local/Global* composite scores, ASD parents attended less towards the target match than parent-controls (*Fig.2*). The *Global* composite discriminated ASD- and control- parent groups (AUC=.56) with good specificity (72%), but low sensitivity (39%). The ASD and ASD-parent groups showed reduced social attention over time, with a linear decrease and a dynamic looking pattern (i.e., shifting away earlier and decreasing later) in the ASD (p<.10) and ASD-parent (p<.05) groups, respectively. Both groups also refixated more (repeated fixations on items already explored) toward non-salient, background objects compared to controls (ps<.05), but there were no significant differences in the transitions away from and towards social and non-social information between groups. Finally, in a subgroup with ERP data available (5 ASD/control and 16 parents), atypical N1 and lower P1 amplitudes in the occipital region were found in the ASD and ASD-parent groups, respectively, compared to controls. Occipital N1 peaks were significantly correlated with local visual processing in both ASD and ASD-parent groups only (rs>.7, ps<.05).
Conclusions: Eye-tracking and neural results demonstrated parallel patterns of reduced global perception and social attention between individuals with ASD and, more subtly, parents of individuals with ASD, compared to controls. Findings support the utility of studying social and non-social visual perception and attention to enhance understanding of underlying biological mechanisms contributing to ASD-related traits, potentially reflecting genetic liability to ASD.

406.028 *(Poster)* Increased Mitochondrial Copy Number and Differential DNA Methylation of Mitochondrial Biogenesis and Fusion Genes in a South African ASD Cohort

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Background: Mitochondrial dysfunction is implicated in the aetiology of Autistic Spectrum Disorder (ASD) and DNA methylation is known to modify gene expression in ASD. Our group previously reported differential DNA methylation of genes between ASD and controls in a South African cohort. These genes converged on mitochondrial canonical pathways consistent with mitochondrial dysfunction, which was supported by organic acid metabolomics in our cohort. Mitochondrial homeostasis is fundamental to neuronal function, and its perturbations result in a number of compensatory responses, including mitochondrial biogenesis and mitochondrial fusion.
Objectives: The first objective of this study was to quantify mitochondrial copy number and to examine mitochondrial deletions in ASD compared to controls. The second objective was to measure the DNA methylation of PPARGC1A, a transcriptional regulator of mitochondrial biogenesis. The third objective was to examine DNA methylation of STOML2 and MFN1, genes implicated in mitochondrial fusion.
Methods: DNA from 108 South African children (68 ASD and 40 controls) was extracted from buccal cells for mitochondria DNA copy number and mitochondrial DNA deletion quantification. This was done by multiplex quantitative PCR of the mitochondrial genes ND1 and ND4 and the nuclear gene β2-microglobulin. DNA methylation was quantified using targeted Next-Generation Bisulfite Sequencing (tNGBS) of PPARGC1A, STOML2 and MFN1.
Results: There was a significant difference in mitochondrial copy number between ASD and controls. There was an increase in mitochondrial copy number in ASD but this was not accompanied by mitochondrial deletions. PPARGC1A was significantly differentially methylated in ASD, and differential methylation was identified at putative transcription factor binding sites. Together, this is consistent with a mitochondrial stress response where increased mitochondrial copy number is mediated by differential methylation of a transcriptional regulator of mitochondrial biogenesis. Furthermore, differential methylation was also observed in two genes implicated in mitochondrial fusion, another mitochondrial stress response.
Conclusions: This study highlights mitochondrial dysfunction in ASD aetiology in an understudied, African population. We also show that mitochondrial copy number is increased in ASD as a stress response, and could be a biomarker of mitochondrial dysfunction in children with ASD.

406.029 *(Poster)* Magnetic Resonance Imaging Study of Children with Autism Spectrum Disorders with Regression

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Background: ASD is heterogeneous in both etiology and phenotypic expression. Regression is frequently described in ASD. Network anomalies have been shown in ASD. However, limited comprehensive studies have been conducted in patients with ASD with regression， only one about language regression using DTI study.
Objectives: The objective of this study was to analysis the changes of diffusion tensor imaging (DTI) parameters in white matter of ASD children with (ASD-R) and without (ASD-NR) regression using tract-based spatial statistics (TBSS). To explore the network topological properties in ASD children with (ASD-R) and without (ASD-NR) regression.
Methods: In this study, 29 ASD-R (male/female: 21/8; age: 40.24±12.78 months) and 68 ASD-NR (male/female: 60/8; age: 35.65±11.25 months) were recruited. Structural networks were constructed using diffusion tensor imaging and T1-weighted imaging on a 3-T magnetic resonance system. Based on the tract-based spatial statistics analysis of fiber bundle tracing, the FA value of each subject was analyzed, and the merged FA skeleton of the whole group was obtained. Randomize statistics were used to compare the differences of FA skeleton between the two groups. We utilized graph theory to characterize the white matter structure networks. Statistical analyses were performed using IBM SPSS (version 20).
Results: 1. Covariate analysis was performed on the FA values of the two groups of children with total CARS scores. There were still significant differences between the two groups: the bilateral Sagittal stratum (include inferior longitudinal fasciculus and inferior fronto-occipital fasciculus), left anterior corona radiata and left posterior thalamic radiation (include optic radiation), and FA values increased in ASD-R group than in ASD-NR group. 2. There were 10 common hubs based on regional degree and regional efficiency (bilateral insula, hippocampus, caudate nucleus and putamen, left precuneus and right superior frontal gyrus-dorsolateral) in both groups. The hubness of the left superior frontal gyrus-dorsolateral, left middle occipital gyrus and right precuneus were enhanced (by regional degree) and that of the right thalamus was reduced (by regional efficiency) in the ASD-R relative to the ASD-NR group. After controlling for the course of regression, the CARS scores were significantly correlated with the regional efficiency of the right precuneus (r=-0.381, p=0.046) in the ASD-R group.

Conclusions: The FA value of the ASD-R group increased in the bilateral sagittal stratum (include inferior longitudinal fasciculus and inferior fronto-occipital fasciculus), left anterior corona radiata and left posterior thalamic radiation (include optic radiation) than the ASD-NR group.The ASD-R children were different from the ASD-NR children in the distribution of hub regions, although there were no global network property differences between them. In ASD-R children, the right precuneus (PCUN.R) might play an important role and relate to autism symptom severity.

406.030 *(Poster)* Markers of Risk for Autism in Early Infancy: Cry Acoustics and Neurobehavioral Responses at 1-Month of Age Predict Later Autism Diagnoses

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Background: Autism has prenatal etiology, but diagnostic signs of autism are not readily observable until the second year of life. Identifying precursor signs of autism in early infancy is a high priority for clinical research. Atypical cry characteristics have been reported for infants later diagnosed with autism, and may in part indicate differences in arousal and regulation in infants at risk for autism

Objectives: The goal of this study was to investigate cry acoustics and early neurobehavioral characteristics in relation to later autism diagnoses.

Methods: Participants were drawn from the Maternal Lifestyle Study (MLS), an investigation of 1288 infants with varying pre and postnatal risks followed into adolescence. Autism was identified and confirmed in 12 children (expert clinician judgment using DSM criteria, confirmed by ADOS). Comparison children were matched on the basis of sex, prenatal exposures, and availability of neonatal measures. At 1-month of age the NICU Network Neurobehavioral Scales (NNNS) was administered. The NNNS is a validated observational measure that yields neurobehavioral summary scores in the areas of attention, regulation, stress signs, motor quality, and basic reflexes. Also at 1-month of age, infant cry bouts were elicited, recorded and subjected to acoustic analysis. Acoustic analysis utilized a 2-phase, cepstral-based approach that quantified frequency and time domain characteristics of individual cry utterances grouped within a longer cry bout/episode. Data analyses included binomial logistic regression with presence/absence of autism diagnosis as the outcome. Receiver operating characteristic (ROC) curves were produced using bootstrap resampling in order to estimate the potential signal detection performance of the cry and neurobehavioral features identified from the logistic models.

Results: Using logistic regression with covariates, autism diagnoses were predicted by Cry and NNNS, separately and combined. There were 247 controls for this analysis. Cry acoustic features predicted autism outcomes, in a model with cry ($p = 0.03$) and cry+NNNS ($p = 0.04$). Significant cry features included utterance timing, voicing, frication, and signal amplitude/energy. Significant neurobehavioral features included poor movement quality, elevated stress signs, and disrupted arousal and regulation. Estimated ROC's support the potential for good accuracy of prediction of autism for both models ($AUC_{cry} = 0.95$; $AUC_{cry+NNNS} = 0.96$).

Conclusions: Infants with later diagnoses of autism may differ from non-autism controls on measures of neurobehavior and cry acoustics. These results are too preliminary to discuss in terms of accuracy metrics, but do indicate that signal detection characteristics of the Cry and NNNS variables have the potential of performing well as early predictors of autism. These results suggest that precursor signs of autism may include neurobehavioral measures of arousal and regulation.

406.031 *(Poster)* Measuring Neural Changes with Early Intervention through Electroencephalography

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Background: Early cognitive skills are widely recognized as predictors of long term outcomes for children with autism spectrum disorder (ASD) (Kim et al., 2018; Seltzer et al., 2004). Additionally, higher IQ predicts response to early intervention (Vivanti et al., 2014). Despite the importance of cognitive skills, little is known about the neural underpinnings of cognition among children with ASD, or whether these neural correlates are predictive of cognitive outcomes. A recent EEG study found that school-aged children with ASD exhibit decreased peak alpha frequency (PAF) in comparison to age-matched peers without ASD (Dickinson et al., 2018). PAF was strongly related to verbal cognition among those with ASD, suggesting that PAF may be an objective and quantifiable marker of cognitive function in this population. To the best of our knowledge, no one has examined PAF as a longitudinal marker of cognitive change in ASD. Identifying neural correlates of early cognition in ASD may facilitate the use of these neurobiological markers as measures of response to intervention.

Objectives: In the context of an early intervention clinical trial, (1) does cognitive ability (Mullen DQ) change over the 2-month intervention period, (2) does baseline PAF predict cognitive outcomes, and (3) do changes in peak alpha relate to changes in nonverbal (NVDQ) and verbal cognition (VDQ)?

Methods: Data reported here are from an intervention study of infants at-risk for ASD (ages 12-24 months, mean age at entry = 18 months) at UCLA. Infants were identified as ‘at-risk’ if they exhibited risk signs on the AOSI or ADOS. Parent-child dyads received early behavioral intervention (JASPER or standard-based classrooms) for 4 hours/week for 8 weeks. Cognitive developmental assessments (Mullen Scales of Early Learning) and EEG recording were collected across entry and exit. A planned intent-to-treat analysis by intervention condition is currently in progress. Results presented here include the full sample of infants enrolled in the study with usable EEG and behavioral data at both time points (n= 43).

Results: Linear mixed models were used to investigate change in DQ scores over 2 months. Mullen total DQ and all subdomain t-scores (except gross motor) improved significantly from entry to exit ($p < .05$). Regression analyses revealed that PAF prior to intervention did not predict change in VDQ ($P > .237$) or NVDQ ($P > .6$). However, the change in PAF between the 2 time points was closely associated with change in both VDQ ($R=0.32$; $P=0.03$) and NVDQ ($R=0.54$; $P<.001$). Further inspection revealed that change in PAF in frontal regions was a significant predictor of VDQ change ($R=0.32$; $P=0.03$), whereas frontal ($R=0.47$; $P=0.001$), central ($R=0.34$; $P=0.02$), and occipital ($R=0.43$; $P=0.004$) change in PAF predicted NVDQ change.

Conclusions: High risk infants receiving early intervention showed significant gains in both nonverbal and verbal cognition scores over the brief study period. Additionally, results suggest that change in neurobiological markers such as PAF are related to change in both nonverbal and verbal cognition within this sample, suggesting that PAF may be an objective neural marker of changes in cognition that occur in the context of early behavioral intervention.

406.032 *(Poster)* Parental Autism Traits and Advanced Parental Age at Conception (APA) in Autism Spectrum Disorders (ASD)

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Background: Existing literature has described a multifactorial etiology for Autism Spectrum Disorder (ASD), where genetic and environmental factors are likely combined. Amongst potential epidemiological factors, APA has been associated with an increased risk for autism in the offspring (Janecka et al., 2017). These studies have mainly reported that older fathers have an increased risk of having children diagnosed with ASD. Different explanatory models have been proposed, including the possibility of delayed fatherhood in subjects with autistic traits (Gratten et al., 2016).

Objectives: We aim to study whether autistic traits in parents of ASD individuals correlate with parental age (both in mothers and fathers) at time of conception, and to what extent this correlation differs according to the DSM-IV-TR autism subtypes.

Methods: 256 parents of 128 subjects with ASD (almost 90% male and Caucasian) were included in this study. 55% of the probands had received a DSM-IV diagnosis of Autistic Disorder (AUT), 15.6% Asperger Syndrome (AS), and 29% Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). Parental autism traits were evaluated with the Spanish version of the Autism spectrum Quotient for adults (AQ). Bivariate correlation analyses were assessed to investigate the potential association between APA and AQ, also by offspring's ASD subtype.

Results: We found a statistically significant positive relation between parental age at conception and AQ total scores ($\rho = 0.207$, $p = 8.39 \times 10^{-4}$, $n = 256$). Studied separately, this correlation remained significant for mothers ($\rho = 0.233$, $p = 8.23 \times 10^{-3}$, $n = 128$), but not for fathers ($\rho = 0.123$, $p = 0.166$, $n = 128$). Within the different subtypes of ASD, APA and AQ was only positively correlated in parents of participants with AS ($\rho = 0.319$, $p = 0.034$, $n = 44$) when both parents were considered together, but not when split by role (all ps > 0.13).

Conclusions: Contrary to previous literature, our results suggest that mothers – and not fathers - who delay their parenthood tend to present more autistic traits. Regardless of role (i.e. mother or father), parental age seems to relate to an AS profile of symptoms in their probands more so than other ASD subtypes.

406.033 *(Poster)* Preliminary Findings: Hand-Held Pupillometry to Detect an Atypical PLR Threshold

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Background: Behavioral tools and parent interview are the primary assessment measures to identify autism spectrum disorder (ASD). However, disparities are documented regarding socioeconomic status and underserved communities, suggesting challenges in current screening practices affecting timely access to treatment. These challenges were recently reported for the M-CHAT-R/F, which identified ASD with less than 40% accuracy based on a cohort of >20,000 children followed from time of screening through age 8. A feasible clinical tool is needed to support screening in the context of routine healthcare which incorporates objective physical measures monitored in relation to ASD risk. The pupillary light reflex (PLR) is a physical marker differentiating ASD from typical development and holds promise for screening within the context of medical exams. Previous studies examining PLR have used static binocular systems which are expensive and require extensive training to operate. Hand-held technology provides objective PLR output metrics and a standard pupillogram which can be monitored over time in relation to neurodevelopment. This exploratory study analyzed PLR parameters obtained using a validated hand-held pupillometry research tool.

Objectives: The purpose was to a) demonstrate sensitivity of the PLR to identify ASD from typical development using gold standard hand-held pupillometry technology and b) identify PLR output metrics to identify a sensitivity threshold to support further clinical studies examining hand-held pupillometry technology. We hypothesized output metrics for ASD obtained using hand-held technology would replicate similar findings documented with static binocular eye-tracking and would significantly differ from typical development based on PLR parameters of return to baseline (RTB T75) and constriction latency.

Methods: PLR measures were obtained from 60 children and adolescents (36 ASD; 24 TD) between ages 6-17 using a Neuroptics PLR-3000 hand-held pupillometer. Replicating prior protocol for PLR analysis, four pupillograms were captured per participant. 238 PLR pupillograms were analyzed for baseline pupil diameter, constriction latency, maximal constriction, and RTB T75. Logistic regression and receiver operating curve analyses (ROC) examined PLR parameters, documenting a latency threshold differentiating groups.

Results: Significant differences were found between groups for RTB (ASD, $M = 2.92$ s; TD, $M = 2.4$ s; $t(211) = -2.105$; $p < .05$ and constriction time (ASD, $M = 0.80$ s; TD, $M = 0.72$ s; $t(232) = -2.146$; $p < .05$. Results of the ROC analysis for RTB T75 identified cases of ASD (n= 240; AUC = 0.586, $p < .05$; 95% CI = 0.512-0.656; $z = 2.29$) with 44% sensitivity (95% CI = 36.2-52.9) and 72.34% specificity (95% CI = 62.2 - 81.1). Thresholds for RTB T75 reveal an ASD specificity criterion of >3.78 s. A threshold of > 5.0 s was identified for 45% of the ASD sample indicating a significant portion of the group did not return to baseline.

Conclusions: PLR parameters captured with hand-held technology replicated previous findings obtained using binocular systems. Increased constriction time and the RTB parameter were significantly different in ASD, representing reduced parasympathetic activity. Further research is needed to examine hand-held pupillometry output metrics, factoring age and sex effects in a younger sample beyond exploratory analysis.

406.034 *(Poster)* Short-Duration Transient Visual Evoked Potentials in Adults with Autism Spectrum Disorder

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Background: Visual Evoked Potentials (VEPs) offer an objective and non-invasive method to evaluate excitatory and inhibitory postsynaptic activity in the brain. Transient VEPs produce a characteristic waveform in which positive and negative peaks and troughs reflect different cellular events. Our group previously identified weaker VEP amplitudes at two of the earliest VEP components (P_{60}-N_{75}, N_{75}-P_{100}) and weaker gamma wave activity in children with autism spectrum disorder (ASD) relative to typically developing (TD) controls. A short-duration stimulus condition was also validated for use in severely affected pediatric populations.

Objectives: (1) To examine tVEPs in adults with ASD and (2) to assess the reliability of a short-duration tVEP stimulus in an adult sample.

Methods: tVEPs were obtained from 19 adults with ASD (m_{age} = 26.85) and 18 typically developing (TD) controls (m_{age} = 23.20) between the ages of 18-42. Participants viewed two contrast-reversing checkerboard conditions (~100% contrast) to elicit a tVEP response: (1) a traditional 60-s condition ("standard condition") and (2) a short-duration condition (10 2-s EEG epochs with 1-s of adaptation per run). A discrete Fourier transform was applied to the VEP data to extract harmonic frequency components of the response. Amplitudes were measured peak-to-trough and latencies were measured by time-to-peak. Frequency-domain analyses applied magnitude-squared coherence (MSC) statistics to quantify responses in four distinct frequency bands (Band 1, 6-10 Hz, alpha-wave; Band 2, 12-28 Hz, beta-wave; Band 3, 30-36 Hz, gamma-wave; and Band 4, 38-48 Hz, gamma wave). Intraclass correlation coefficients (ICCs) were used to examine the reliability between conditions.

Results: There were no significant differences in P_{60}-N_{75} amplitude for either condition. The ASD group displayed significantly smaller amplitudes compared to controls at N_{75}-P_{100} on both the standard condition (p = .041) and the short-duration condition (p = .045). There were no differences in latency for P_{60} or P_{100}. There was a significant difference in latency at N_{75} in the short-duration condition (p = .006), although this did not reach significance in the standard condition (p = .089). ASD group latencies were approximately 3-4 ms longer than TD latencies for both conditions. MSC multivariate group differences were identified in Band 2 for both the standard (p = .023) and short duration conditions (p = .033). A significant difference was also identified in Band 4 for the short-duration condition (p = .043), but not the standard condition (p = .172). The estimated agreement between conditions for P_{60}-N_{75} amplitude was .843 and for N_{75}-P_{100} amplitude was .923. ICC for latency at N_{75} was .877 and at P_{100} was .87. Agreement among frequency bands was poor for Band 1 (ICC = .456) and strong for Band 2 (ICC = .759), Band 3 (ICC = .783) and Band 4 (ICC = .869).

Conclusions: Results suggest adults with ASD display a pattern of weaker N_{75}-P_{100} amplitudes and weaker beta-wave activity. Standard and short-duration contrast-reversing checkerboard conditions were highly reliable for amplitude, latency, and frequency bands encompassing beta and gamma-wave activity.

406.035 *(Poster)* Signal or Noise? Investigating Discrepancies between Eye-Tracking- and Clinician-Based Assessments of Social Function

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Background: Eighty percent of parents of children with autism spectrum disorder (ASD) report suspecting developmental problems before their child's second birthday. Yet, despite the presence of early concerns, the median age for diagnosis using best practice behavioral measures remains between 4-5 years of age, and later for under-resourced and rural families, hindering crucial access to early intervention. In comparison with this current state, eye-tracking technologies show promise for objectively quantifying biomarkers of atypical social visual engagement–a core component of ASD–and have been shown to reliably detect differences between toddlers with and without ASD. However, better understanding of the discrepancies between eye-tracking and clinical behavioral assessments is needed. Do the differences offer meaningful metrics (clinically-useful signal) or are they merely measurement error (clinically-detrimental noise)?

Objectives: To examine, in a sample of clinically referred patients, cases that are discrepant between eye-tracking-based measures of social disability and clinical gold standard assessments of ASD in children between 16-42 months.

Methods: We focus here on 2 groups of participants in which eye-tracking measures and standardized assessments were at odds, with one set of measures indicating relatively intact social developmental functioning while the other indicated impairment. Participants were recruited through a community clinic and an academic medical center in urban and rural areas of a metropolitan US city. Social visual engagement data were collected via eye-tracking. Doctoral-level psychologists blind to eye-tracking results completed comprehensive developmental assessments, which included the *Mullen Scales of Early Learning*, and the *ADOS-2*. Standard of care was provided in terms of assessment and diagnosis of ASD, and differential diagnoses including other developmental disorders, mental or behavioral disorders, were given.

Results: Among participants whose eye-tracking measures indicated impaired social developmental functioning—but who did not receive an ASD diagnosis and did not have ADOS scores in the impaired range (i.e., false positives, n=30)—~77% instead received a clinical best estimate diagnosis of another diagnosis. Specifically, ~40% had a non-ASD developmental delay (e.g., language disorder, global developmental delay, subthreshold communication disorder) and ~37% were noted to have subthreshold symptoms of ASD. In contrast, participants who received an ASD diagnosis and had impaired or delayed scores—but did not have eye-tracking measures indicating impaired social functioning (i.e., false negatives, n=29)—fell into two sub-groups: one with seemingly-engaged eye-tracking data (that may show signs of relatively improved opportunities for future social engagement), and another in which eye-tracking measures were of poor quality. Additional analyses of individual participant metrics and demographics against standardized assessments and diagnoses given will be presented.

Conclusions: The goal of this ongoing work is to investigate the clinical utility of eye-tracking-based measures of social developmental functioning for identifying ASD in early childhood. Preliminary results indicate that, in cases when eye-tracking-based measures of social disability are discrepant from other clinical assessments, there is meaningful signal that may aid in early identification generally and in identification of complex cases in particular.

406.036 *(Poster)* Similar Respiratory Sinus Arrhythmia and Rsa Reactivity during Sleep in Children with ASD and Typically Developing Peers

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Background: Respiratory sinus arrhythmia (RSA) is a measure of activation of the parasympathetic nervous system (PNS). Higher tonic RSA and greater RSA reactivity (specifically, withdrawal: a decrease in RSA from resting levels after a change in state) is associated with positive behavioral outcomes, such as better self-regulation. For this reason, these measures are relevant in populations with deficits in these areas, such as children with autism spectrum disorder (ASD). Tonic wakeful RSA and RSA reactivity have been measured in individuals with ASD to examine group-level differences between them and typically developing (TD) children, however, results are mixed. One potential reason for this is methodological differences, specifically variations in resting state or state-dependent conditions. Sleep may provide more consistent conditions because specific criteria of sleep staging ensures participants are in a similar brain state. For this reason, slow wave sleep (SWS; N3) and rapid eye movement (REM) sleep have been suggested as potential conditions to examine RSA. Since it has been hypothesized that children with ASD have lower PNS activation during rest and decreased state-dependent withdrawal during wakefulness (Klusek, Roberts, & Losh, 2014), we explored whether children with ASD have lower RSA during both SWS and REM, and blunted RSA withdrawal from SWS to REM compared to TD children.

Objectives: To investigate RSA during sleep in children with ASD compared to TD peers.

Methods: Children with ASD (n=104), developmental delay (DD; n=25) and TD (n=30) underwent polysomnograhic (PSG) recording as well as a behavioral evaluation as part of a longitudinal study at NIMH. Sleep staging from the PSG was used to locate the first and last consecutive 5-minutes of SWS and REM. Electrocardiogram (ECG) data was then processed through Kubios HRV Premium software to derive the root mean square successive difference (RMSSD; an index of RSA) of each child's heartbeats during these four periods. The RMSSD values for each period were log transformed and averaged by stage to create RMSSD[SWS] and RMSSD[REM] composites.

Results: Preliminary analyses from the subset included so far (N=28; 14 ASD, 14 TD), using a 2 (diagnosis) x 2 (stage) mixed repeated measures ANOVA revealed no interaction between diagnosis and sleep stage on RMSSD, nor a main effect of diagnosis; however, there was a main effect of sleep stage ($F(26)=19.24$, $p=0.0002$, $\eta^2=0.094$), such that RMSSD was higher during SWS than REM.

Conclusions: There was no difference in RSA between groups or RSA reactivity in this small sample of children with ASD compared to their TD peers. Furthermore, both groups show similar patterns of PNS activation during sleep, specifically RSA withdrawal during REM. This is consistent with patterns seen in TD adults. However, given the relative REM deficiency seen in children with ASD, further work investigating state-dependent PNS activation patterns during these sleep stage transitions is warranted. In addition, we plan to investigate the relationship between RSA and symptom profiles.

406.037 *(Poster)* Social Attention Profiles Associated with ASD and the Broad Autism Phenotype

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Background: Atypical visual attention to social stimuli has been well documented in ASD. Evidence also suggests that similar, but more subtle, differences in visual attention may be present in first-degree relatives of individuals with ASD (Pierce et al., 2016; Lee et al., 2019), suggesting atypical attention to social stimuli as a candidate ASD endophenotype related to downstream ASD-related symptomatology. However, there is limited research examining social attention across multiple tasks, or examining the same tasks in ASD and in first-degree relatives, which may be important to elucidate social attention profiles indicative of ASD genetic risk.

Objectives: To investigate social attention (i.e., dwell time and eye movement) across multiple tasks in ASD and in parents to identify profiles indicative of ASD risk.

Methods: Participants included 97 individuals with ASD, 57 ASD controls, 162 ASD parents, and 65 parent controls. Three eye-tracking tasks were examined: 1) A structured narrative task requiring participants to narrate a wordless picture book, 2) An unstructured narrative task requiring participants to tell stories about emotionally ambiguous images, and 3) A passive viewing task of emotional facial expressions. Following Frazier et al. (2016), areas of interest (AOIs) across tasks were analyzed based on effect sizes from t-tests investigating differences in dwell time to produce the ASD and ASD Parent Gaze Profiles. ASD and ASD Parent Index scores were then derived from the profiles of AOIs that best distinguished groups for subsequent analyses. Receiver operator characteristic curves were employed to assess the sensitivity and specificity of the index scores to discriminate groups. Analyses were also conducted to explore group differences in eye movement (i.e., repeated fixations, transitions from one AOI to another) to complement the profiles investigating dwell time. Analyses are currently underway to create an ASD Eye-Movement Profile and an ASD Parent Eye-Movement Profile based on these group differences.

Results: The ASD Gaze Profile was comprised of dwell time towards 58 AOIs across the three tasks, and its index score discriminated the ASD group from the control group (Area Under the Curve (AUC)=.78) with 78% specificity and 63% sensitivity. The ASD Parent Gaze Profile was comprised of only 20 AOIs, and its index score best discriminated the ASD parent group who met criteria for the broad autism phenotype from the parent control group (AUC=.71) with 76% specificity and 57% sensitivity, with slightly lower specificity (75%) and sensitivity (52%; AUC = .67, *Fig. 1*) for the ASD parent group overall. Group differences also emerged in eye-movement data, such that the ASD group exhibited more *repeated fixations* ($p < .05$), whereas the ASD and ASD parent groups demonstrated increased *transitions* towards non-social (rather than social) stimuli (ps<.05).

Conclusions: Findings support and extend prior reports of differences in visual attention towards social stimuli in ASD and first-degree relatives by demonstrating profiles of gaze across multiple tasks that discriminate individuals with ASD and parents from controls. Such specific, data-driven profiles may serve as a marker of ASD genetic risk, and help to inform current understanding of underlying mechanisms contributing to ASD symptomatology.

406.038 *(Poster)* The Influence of Maternal Stress during Pregnancy on Autism Symptoms Severity

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Background: Autism Spectrum Disorders (ASD) involve impediments in social interaction and communication as well as the presence of restricted, repetitive patterns of behavior, interests, or activities (APA, 2013). Compelling evidence supports the effect of environmental factors that may contribute to increased risk of ASD (Emberti Gialloreti et al., 2019). Maternal mental health problems are amongst the most common comorbidities found in pregnancy and postpartum, with up to 25% of women experiencing stress, depression or anxiety during those periods (Cole-Lewis, et al., 2014). In particular, stress during pregnancy has repeatedly shown an increased risk for ASD in the offspring (Chengzhong Wang et al., 2017).

Objectives: Our objective is to study how maternal stress during pregnancy influences symptom severity in the autistic child and the associated symptom early onset sleep disturbances.

Methods: Ninety-nine individuals with a diagnosis of ASD, aged 3 to 39 years, underwent a clinical and sociodemographic evaluation to assess ASD symptom severity. ASD symptomatology was measured with the ADOS, ADI-R, SCQ and RBS. The BEARS questionnaire (Owens et al., 2005) captured retrospective information of sleep disturbances between ages 2 and 5. The total number of obstetrics complications during birth was compiled from the Lewis' scale for obstetric complications (Owen, Lewis, & Murray, 1988) and a shorter, adapted version of the Early Life Exposures Assessment Tool (ELEAT; Schmidt, 2013). Stress during pregnancy was measured with the SRRS questionnaire (Holmes y Rahe, 1967). Bivariate analyses and linear regression were performed to explore the relationship between maternal stress during pregnancy and the ASD severity in the offspring.

Results: Maternal stress during pregnancy related positively to prenatal obstetric complications ($r = 0.200$ $p = 0.048$). Both stress during pregnancy and prenatal obstetric complications were significantly related to stereotyped behaviors ($r = 0.244$ $p = 0.017$ and $r = 0.184$ $p = 0.046$ respectively) but not to other core ASD symptomatology. Higher stress during pregnancy was associated to the presence of sleep disturbance in the child in the early years ($U = 440.5$ $p = 0.012$).

Conclusions: Greater maternal stress during pregnancy seems to be related to a greater number of obstetric complications during birth, and a greater severity of repetitive and stereotyped behaviors in the offspring. Future studies should focus on the direction and mechanisms of the relationship between maternal stress and ASD symptomatology.

406.039 *(Poster)* The Role of the Autonomic Nervous System in Mental Health Disorders Among Mothers of Children with Autism Spectrum Disorder

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Background: The autonomic nervous system plays an important role in regulating emotional responses (Appelhans & Luecken, 2006). Respiratory sinus arrhythmia (RSA), an index of parasympathetic control, has been implicated as a potential marker of mental health disorders (Nardelli et al., 2015), such that reduced baseline RSA is associated with elevated depression and anxiety symptoms (Hughes & Stoney, 2000). Mothers of children with autism spectrum disorder (ASD) experience higher rates of anxiety and depression than mothers of neurotypical children (Montes & Halterman, 2007). However, the role of RSA in psychiatric vulnerability among mothers of children with ASD is unknown. Studies of individuals with ASD suggest that RSA may be reduced in this population (Klusek, Roberts, & Losh, 2015), yet, little is known about autonomic function in relatives of those with ASD, who are also at increased genetic liability to ASD.

Objectives: The present study aimed to understand the role of RSA in mental health disorders among mothers of children with ASD.

Methods: Participants included 27 mothers of children with ASD (*M* age= 45 years) and 27 control mothers (*M* age= 42 years). The groups did not significantly differ in age (p=.268). Baseline heart rate was collected during a 3-min resting condition. CardioEdit/Batch software (Brain-Body Center, University of Illinois at Chicago) were used to clean the heart rate signal and extract estimates for mean RSA. Mothers completed the Beck Depression Inventory-II (Beck, Steer, & Brown, 1996) and the Beck Anxiety Inventory (Beck & Steer, 1990), which served as indices of current depression and anxiety symptoms. Parenting stress was measured using the Parenting Stress Index-4 (Abidin, 2012) and medication use was indexed by the presence or absence of psychotropic medication use.

Results: A series of general linear models examined group, RSA, and their interactions as predictors of depression and anxiety, controlling for medication use and level of parenting stress. The overall model predicting depression symptoms was significant ($F(5,48)=6.24$ $p<.001$, $R^2=.39$). RSA accounted for significant variance in depression symptoms, with a large effect size (p=.007, η^2_p=.24). Group and its interaction did not account for variance in the model (p's>.809). Lastly, group, RSA, and their interaction were not significant predictors of anxiety symptoms (p's>.118).

Conclusions: Reduced RSA was associated with elevated depressive symptoms across mothers of children with ASD and control mothers. This finding supports reduced RSA as a possible biomarker for depression risk in mothers of children with ASD, mirroring patterns observed in the general population. This finding also has implications for identification and targeted treatment. In the general population, reduced RSA predicts depression severity and treatment response among individuals with mood disorders and is of interest as a biomarker to help stratify subgroups of patients who are most likely to respond to targeted interventions (Rottenberg, Wilhelm, Gross, & Gotlib, 2002; Chambers & Allen, 2002). This study suggests that RSA may play a similar mechanistic role in the presentation of mood disorders in mothers of children with ASD, informing the development of mental health supports for mothers of children with ASD.

406.040 *(Poster)* Use of Empirical Mode Decomposition in ERP Analysis to Classify Familial Risk and Diagnostic Outcomes for Autism Spectrum Disorder

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Background: Atypical brain activity in response to socially relevant stimuli, such as faces and eye gaze, is found in individuals with ASD in early stages of their development and may serve as putative biomarker to supplement behavioral diagnosis

Objectives: We present a novel approach to classification of visual ERPs collected in response to socially relevant stimuli using Intrinsic Mode functions (IMF) derived from Empirical Mode Decomposition (EMD).

Methods: Participants were 104 infants from the British Autism Study of Infant Siblings (BASIS). ERP in response to face and gaze stimuli were collected on 54 infants at risk for autism (HR), by virtue of having an older diagnosed sibling and 50 low risk (LR) when they were 6 to 10 months of age (mean = 7.8 months, SD = 37.2). Seventeen individuals in the HR group were subsequently diagnosed with ASD around three years of age (Three Outcome groups: n=17 HR-ASD, 33 HR-noASD and 44 LR-noASD). EMD was applied to single channels of ERP waveforms to decompose it into IMFs. Initial testing showed that the first three IMFs best characterized the ERP signals. Six features were then extracted for each IMF to give a characterization of the studied input: energy, Shannon entropy, moment, mean, standard deviation and skewness. The maximum values per feature across all channels were selected and used as inputs to two machine learning methods (support vector machines- SVM and k-nearest neighbors- k-NN) for training and testing to classify an unknown input into one of the risk or alternatively the outcome groups.

Results: Different runs were executed for modelling and classification of the participants in the LR and HR groups and classification of diagnosis outcome within the high-risk group: HR-ASD and HR-noASD. The highest accuracy in the classification of familial risk was 89.4%, achieved using an SVM classifier along with the proposed statistical features extracted from temporal IMFs. In contrast, maximum accuracy for classifying infants at risk who go on to develop ASD vs. those who do not was achieved through a k-NN classifier with an accuracy of 76.5% when all six features are used as input, including energy, entropy and statistical features.

Conclusions*:* IMF-based extracted features were highly effective in classifying infants by risk status but less so by diagnostic outcomes. Improvements in performance of machine learning methods are therefore still needed. Small sample size is a limitation to be addressed in future work. Further, analytic approaches that can combine more IMFs features would likely achieve improved performance over single IMF features.

406.041 *(Poster)* Which Perform Best to Identify ASD and TD: Upright Faces, Inverted Faces, or Their Mix?

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Background: Social communication deficit is a key symptom for Autism Spectrum Disorder. Much research has demonstrated that human face is a sensitive biomarker for early detection on Autism Spectrum Disorder (ASD), due to its comprising of rich emotional expressions for a successful social interaction. By applying eye-tracking technology, a variety of different paradigms on faces are proposed with focus on subject's gaze behavior and pupillary change.

However, most efforts of ASD related face studies are on upright faces, fewer of them are on inverted faces. There is the conception that the perception and recognition are better of faces presented upright than that of inverted. But no previous study tells which perform better if they are used to identify ASD and Typical Development(TD) children, upright faces or inverted faces. For future application of face paradigm in early detection on ASD, it's necessary to find out the answer.

Objectives: Comparing three experimental paradigms designed on upright faces, inverted faces, and a mix of above two, find out which paradigm is the best in identifying ASD and TD children.

Methods: 47 ASD and 35 TD children of 3-6 years old were recruited, 23 ASD children provided valid data in the experiments, and 22 TD children as control group are matched by age and gender.

The experiments used SMI desktop eye tracking system with sample frequency 120Hz. The basic paradigm was a series of 12 pictures of same size and luminance on human faces of young people with different gender. In Experiment I, 12 face pictures were all upright. In Experiment II, 12 face pictures were all inverted. In Experiment III, the 2nd,5th, 7th, 10th ,12th pictures were inverted faces, while others were upright.

Subject's Fixation time on Area of Interest (AOI) of eyes, mouth, and faces on each picture were collected, as well as pupillary data. Average Fixation time on above AOIs, plus average and maximum changes of pupil diameter on their amplitude, time, and velocity was extracted as features. Further statistical analysis was done by SPSS and Python.

Results: Three experiments all showed significant difference on features of valid slide numbers and average fixation time on face and eyes, while Experiment II and III showed more on fixation time of mouth and pupil response in maximum diameter change or its changing velocity, referring to attached table.

After correlation analysis and Principal Component Analysis, the predicted probability of the regression modes in three experiments are compared by their AUC (Area Under Curve) of ROC curve. Refer to attached Chart, Experiment II and III showed better result of 88.4% and 89% than that of 83.9% in Experiment I.

Conclusions: Although three face paradigms all showed efficiency in identifying ASD and TD, two experiments with inverted faces perform better than upright faces only. But there's no big difference in result for paradigms with inverted faces only or mixture of both faces. These facts support the finding that inverted face can be a better indicator in identifying ASD and TD.

Biomarkers / Early Development

ORAL SESSION — BIOMARKERS / EARLY DEVELOPMENT
305 - ADHD and Autism: Phenotypic Overlap and Distinction

305.001 *(Oral)* Phase Synchronization Network Study for Attention Deficit/Hyperactivity Disorder Co-Occurrence in Autism Spectrum Disorder Detection

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Background: Attention Deficit/Hyperactivity disorder (ADHD) is a common co-occurring condition in Autism Spectrum Disorder (ASD). ASD with ADHD (ASD+) generally have a higher severity of pathophysiology and reflected in higher rates of hospitalization, medication treatment, and behavioral therapy than ASD alone. The physiological differences between these two groups remains poorly understood, but urgently needed to develop novel diagnostic and therapeutic tools.

Objectives: We hypothesize that phase-based functional connectivity measures may differentiate ASD+, ASD, and typically developing controls (TDC). Specifically, we predict resting EEG phase synchrony would be “over” connected in ASD populations, with ASD+ demonstrating additional phase synchrony than either ASD or TDC groups.

Methods: We recruited children with ASD, ASD+ and TDC. Five minutes of spontaneous scalp EEG recordings were collected with 32-channel electrode nets. After preprocessing and artifact rejection, the remaining dataset contains 39 subjects in the ASD+ group (14.7±3.6 years old), 23 subjects in the ASD group (15.4±3.7 years old), and 26 subjects in the TDC group (16.3±3.5 years old). A phase synchrony measure Debiased Weighted Phase Lag Index (DWPLI) was estimated for each possible pair of electrodes to construct a connectivity network. Local and global significant differences are examined by Network-Based Statistics (NBS) and a network centrality measure (Hubness) with cluster-based permutation tests.

Results: Several functional connectivity networks were detected between groups of interest. DWPLI identified increased gamma frontal-to-occipital interconnectivity of ASD+ over TDC. Hubness measures demonstrate greater gamma network connectivity in ASD+ of left posterior electrodes, whereas gamma connectivity was higher in ASD in the right central electrodes. Greater hubness clusters in the right hemisphere also observed in ASD compared to ASD+ in the theta and beta bands. In addition, ASD+ demonstrated greater variability in connectivity across multiple frequency bands compared to TDC.

Conclusions: As sophistication of rapid brain-based measures such as EEG are readily available, analysis methods such as functional connectivity can quantify dynamic brain states. Currently, in addition to identified networks, we are evaluating what clinical relationships these variables may pose. Such measures could assist in diagnostics as well as play a crucial role in identifying novel physiology-based subgroups for treatment trials and prognosis. This advance analysis methodology serves the discrimination of groups and further will be utilized to track treatment effects. These measures can help quickly and in a cost-effective manner differentiation ADHD features in ASD.

305.002 *(Oral)* Shared and Specific Alterations of Tactile Sensitivity in ASD and ADHD

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Background: Recent work has seen an increase in the reporting of tactile abnormalities in ASD and ADHD. Abnormal tactile function may exacerbate social and communicative difficulties, common in ASD and ADHD. Currently, it is unclear the degree to which these reported tactile alterations are disorder-shared and disorder-specific, and how these alterations related social, sensory and disorder-specific clinical symptoms.

Objectives: To investigate whether alterations in tactile sensitivity in ASD, ADHD and ASD + ADHD are disorder-shared and disorder-specific, and whether and how these alterations are related to social and disorder-specific clinical outcomes.

Methods: 103 children with ASD, 108 children with ADHD, 52 children with ASD+ADHD and 210 typically developing children (TDC) between 8-12 years old were included. Vibrotactile detection, discrimination and order judgement were assessed from the left index and middle fingers using a Cortical Metrics stimulator. Diagnosis of ASD was confirmed with the Autism Diagnostic Outcome Scale (ADOS) and Autism Diagnostic Interview – Revised (ADI-R). Diagnosis of ADHD was confirmed with the Conners or Conners-3 when available. Additional information was also acquired with the DuPaul’s ADHD parent-rating scale, the Sensory Processing Measure (SPM) and the Sensory Experience Questionnaire (SEQ).

Results: *Group comparisons:* Static detection thresholds (sDT) were higher (i.e., worse) in children with ASD, ADHD and ASD+ADHD than controls (all $p < .001$). Amplitude discrimination thresholds (aDT), were worse for the ASD and ASD+ADHD groups ($p = .02$ and $p = .01$ respectively), but not ADHD ($p = .16$), when compared to TDC. Temporal order judgement (TOJ) was worse than TDC for ADHD ($p = .05$; TOJ accuracy) and ASD+ADHD ($p = .01$; TOJ thresholds), but not ASD group ($p = .67$; thresholds and p = .37; TOJ accuracy). *Correlational analyses:* sDTs were related to SPM social participation (r(238) = .25, $p < .001$), body awareness ($r(238) = .28$, $p < .001$), SEQ hypo ($r(96) = .34$, $p = .001$) and hypersensitivity ($r(96) = .27$, $p = .006$) across the entire sample. sDT was not related to any ASD-specific clinical outcome in ASD, but was related to hyperactivity on the Conners ($r(31) = .65$, $p < .001$) and DuPaul's ($r(87) = .31$, $p = .011$) parent-rating scales in ADHD. aDT was predictive of ADOS communication problems in ASD ($r(95) = .27$, $p = .008$). TOJ thresholds were related to inattention on both Conners ($r(32) = .44$, $p = .009$) and DuPaul's ($r(86) = .27$, $p = ..032$) parent-rating scales in ADHD.

Conclusions: We show disorder-shared and disorder-specific alterations in tactile sensitivity in atypical neurodevelopment that were related to specific clinical features of the disorder. While elevated sDTs appear to be disorder-shared, elevated aDTs and difficulties with TOJ appear to be specific to ASD and ADHD respectively. Despite being disorder-shared, sDTs differentially related symptoms of ASD and ADHD. Alternatively, aDT and TOJ were disorder-specific and related to disorder-specific impairments.

These findings highlight the clinical relevance of disorder-shared and disorder-specific alterations in tactile sensitivity. The neurophysiological basis (e.g., atypical cortical inhibition) of these alterations might inform future patient-specific interventions.

305.003 *(Oral)* Shared and Distinct Developmental Pathways to ASD and ADHD Phenotypes Among Infants at Familial Risk

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Background: Autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) are believed to share partially overlapping causal mechanisms suggesting that early risk markers during infancy may also overlap (Miller et al., 2019; Stergiakouli et al., 2017).

Objectives: (1) Using person-centered approaches in a sample of infants enriched for ASD and ADHD, how many distinct groups of 3-year-old children emerge based on ADHD and ASD symptomatology?

(2) What infant behaviors uniquely predict ASD- versus ADHD-like profiles, versus serve as shared early predictors?

Methods: Participants included 166 children with a familial risk of ASD (n=89), ADHD (n=38), or low-risk for both (n=39) who were evaluated at 12, 18, 24, and 36 months of age. Latent profile analysis (LPA) was conducted to examine the number of classes that best fit the data based on parent and examiner ratings of ASD (ADOS, SCQ) and ADHD (ADHD-Rating Scale, Behavior Rating Inventory for Children) symptoms. Generalized linear mixed-effects models were used to examine trajectories of infant predictors of latent class membership based on variables independent of those used to define the classes: nonverbal and verbal development; behaviorally-coded negative affect, inattention, activity level, and impulsivity; and examiner-rated social engagement.

Results: ***LPA.*** A three-profile solution was selected based on fit indices and interpretability reflecting a *Typically Developing* Class (low symptoms; n=108), an *ADHD* Class (high ADHD/low ASD symptoms; n=39), and an *ASD* Class (high ASD and ADHD symptoms; n=19).

Predictors of LPA membership. Results are summarized in Tables 1-2 and were generally suggestive of a gradient pattern of differences over the first three years of life among children with ASD- and ADHD-like symptomatology by age 3, with the greatest impairment within the *ASD* Class, followed by the *ADHD* Class.

Conclusions: We did not find a distinct group of children with high ASD symptomatology who did not also have high ADHD symptom ratings, consistent with work conducted in older children/adolescents (Van Der Meer et al., 2012). Elevated ASD symptoms in the preschool period may frequently co-exist with inattention and hyperactivity. Alternatively, high ADHD symptom scores in the *ASD* Class may reflect measurement challenges, since these instruments have not been validated for use in young children with ASD and may measure different constructs than in children at risk for ADHD. Larger samples and measurements of attention/activity level beyond informant reports are required to address this. In this study, we did not focus on categorical diagnostic distinctions but this will be done when our sample enters the age range during which ADHD is typically diagnosed; notably, examiners rarely ascribed secondary clinical outcomes of "ADHD Concerns" for children who had primary diagnoses of ASD despite the presence of elevated parent- and examiner-rated ADHD symptoms.

Findings related to infant predictors of latent class outcomes are mostly suggestive of a gradient pattern of differences over the first three years of life among children with ASD- and ADHD-like symptomatology across measures. These findings suggest a mixture of overlapping and distinct early indicators of 36-month latent class profiles which can be difficult to disentangle early in life.

305.004 *(Oral)* Sustained Visual Attention Is Reduced Among Infants with 36-Month Outcomes of ADHD Concerns but Not in Infants Developing ASD

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Background: Autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) are thought to partially share developmental pathways (Johnson et al., 2014). One potential shared feature may be difficulties with sustained attention (Wass et. al., 2015; Miller et. al., 2018), although no study has directly compared children with such outcomes on the same measure of sustained attention during infancy.

Objectives: The present study examined sustained visual attention to non-social stimuli in infants at risk for ASD, ADHD, or neither condition. We hypothesized that infants with 36-month outcomes of ADHD Concerns or ASD would show impaired sustained visual attention relative to infants in a comparison group.

Methods: Participants were infants with a family history of ASD (i.e., older diagnosed sibling; *n*=80), family history of ADHD (i.e., older diagnosed sibling or parent; *n*=37), or low familial risk for both conditions (i.e., at least one typically developing older sibling and no family history of ASD or ADHD; *n*=35). At the 36-month visit, participants were categorized into one of three outcome groups: ASD (met DSM-5 criteria; *n*=24), ADHD Concerns (i.e., elevated ADHD symptoms; *n*=16), or a non-ASD, non-ADHD Concerns group (Comparison sample; *n*=112). At 12, 18, 24, and 36-monts of age all were administered a sustained visual attention task, the "Slides" episode from the Laboratory Temperament Assessment Battery (LabTAB; Goldsmith & Rothbart, 1996), adapted for use with an eye-tracker. This task involves the infant being oriented towards a screen where he/she views a series of 5 nature scene image, with no audio track, at increasing time increments (2, 4, 6, 8, 10s). This sequence is repeated three times, totaling 90s. Eye-tracking data was processed using gazepath algorithms (van Renswoude et. al., 2018) to calculate fixation and saccade durations. The primary variable was gaze time percentage. Outcome group differences were analyzed using generalized linear mixed-effects models.

Results: There were significant main effects for outcome ($F(2, 208) = 4.06$, $p = .02$) and visit ($F(1, 283) = 17.96$, $p < .001$), but the outcome by visit interaction was non-significant ($p > .05$). Results are presented in Table 1 and illustrated in Figure 1. Increase in slope of gaze time percentage from 12 to 36 months was not significantly different between outcome groups; however, across visits, the infants with ADHD Concerns outcomes had a lower gaze time percentage than the ASD ($p = .02$) and Comparison groups ($p < .001$). In contrast to our hypothesis, infants with ASD outcomes did not differ significantly from the Comparison group ($p > .05$).

Conclusions: Infants developing ADHD Concerns show impaired sustained visual attention, similar to older children (Corbett et al., 2009) and adults (Marchetta et al., 2008) with ADHD, while infants developing ASD were equivalent to the Comparison group. Disruptions in ability to maintain attention on non-social stimuli during infancy may mark a developmental cascade specific to ADHD rather than general to ADHD and ASD. Further research is needed to investigate early-life patterns of other aspects of attention (e.g., attention shifting, social attention) among infants developing ASD or risk for ADHD.

Cellular Models/Stem Cells

POSTER SESSION — CELLULAR MODELS/STEM CELLS
407 - Cellular models/stem cells Posters

407.001 *(Poster)* Deficiency of Tbck Leads to Deregulation of TBR1, a Gene Associated to Autism Spectrum Disorder .

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Background: Biallelic pathogenic variants in TBCK have been recently described as the genetic cause of the encephaloneuropathy, infantile hypotonia with psychomotor retardation and characteristic facies 3 (IHPRF3). Whole exome sequencing in 13 familial Brazilian cases of Autism spectrum disorder (ASD), revealed biallelic loss-of-function (LoF) variants in TBCK, a stopgain variant (p.Tyr710*) and a microdeletion (p.Glu687Valfs9*), in two affected sibs, born from healthy parents. Our family adds one additional family to this group of IHPRF3 individuals, for which there are less than 30 families so far reported. Even though not fully characterized, ASD seems to be part of the clinical spectrum of this syndrome, but with unknown penetrance. TBCK, a member of the TBC family of proteins, seems to be related to mTOR signaling and autophagy in non-neural cells.

Objectives: Understand the molecular mechanisms through which deficiency of TBCK underlies the neuronal phenotypes of IHPF3.

Methods: We are conducting cellular and molecular studies in neuroprogenitor cells (NPC) and neurons derived from induced pluripotent stem cells from 2 affected patients and 3 controls. A variety of studies, including imaging, cellular and molecular analysis have been conducted to evaluate cell migration, cell characterization in differentiation neuronal stages, cell cycle, mTOR and other pathways as well as neuron morphological analysis, among others. Statistical analysis to compare control and cases were conducted whenever adequate. The level of significance adopted was <0.05.

Results: Our studies in patients' NPC have shown that deficiency of TBCK leads to decreased mTOR signaling (pRPS6S240/244 protein level; p=0.024). We also observed that patients' NPC migration was dramatically compromised as compared to controls (p< 0.001) and also presented deregulation of cell cycle progression (p<0.01), two processes that are crucial for neurogenesis and cytoarchitecture organization of the brain. Regarding the morphology of patients' neuronal cells, we observed particularly larger cell bodies (about 17.5% larger in patients as compared to controls; p=0.003), and decreased neurite branching as compared to controls. Analysis of mRNA expression through quantitative real time PCR of cellular markers of neuronal development revealed significant dysregulation of TBR1 transcription factor (p<0.001) and important downstream targets implicated in neuronal differentiation and migration.

Conclusions: These preliminary data suggest defects in several neurodevelopmental processes, such as neurogenesis, neuronal differentiation and migration, as the pathophysiological mechanism that may contribute to the autism –like phenotype in patients with biallelic pathogenic variants in TBCK. FAPESP/CEPID, CNPq

407.002 *(Poster)* Human Induced Pluripotent Stem Cell-Derived 3D Organoids Combined with High-Content Screening Reveal Network-Level Phenotypes in Individuals with Idiopathic Autism

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Background: To date, hundreds of genetic loci have been implicated in ASD risk. Recent studies have shown that genes harboring ASD risk loci are highly enriched in sets of genes expressed during early neocortical development and genes encoding proteins that function in specific biological pathways involving regulation of transcription, chromatin remodeling, cell adhesion, signaling complexes, and synapse function. One of the hypothesized models for the pathogenesis of autism suggests that dysregulation of the balance between excitatory and inhibitory (E/I) neuronal inputs may underlie some phenotypic aspects of ASD. A precise E/I ratio is required to maintain the narrow range of optimal neuronal spiking required for the transfer of information within the brain. Neurodevelopmental deficits in γ-aminobutyric acid (GABA)ergic or glutamatergic neurons may contribute to an imbalance in this E/I ratio. Using human induced pluripotent stem cell (hiPSC)-derived neurons in a 3D model system, we can investigate these potential deficits in an in vitro model system that may more accurately recapitulate human cortical development.

Objectives: The objective of this study was to use 3D serum free embryoid body (SFEB) organoid model to assess for potential differences in the morphology and network-level function that are specific to cortical neurons derived from ASD-specific hiPSCs.

Methods: High throughput approaches were applied to compensate for heterogeneity and variability inherent in iPSC-derived 3D cultures. To model ASD neuronal phenotypes in our ASD cohort, SFEBs were generated from control and ASD individuals (n = 4 lines and 7 lines, respectively). High content screening using the ThermoFisher ArrayScan XTi platform was used to quantify GABA+ and VGLUT+ cells in SFEBs and VGLUT+ neuron morphology. Spontaneous network-level activity was recorded from SFEBs plated onto multi-electrode array (MEA) plates.

Results: High content analysis revealed that SFEBs derived from individuals with autism have fewer GABA+ neurons as compared to controls (N = 288 SFEBs/line, $p<0.001$; Mann-Whitney U). No significant difference in the number of VGLUT+ neurons was seen in individuals with autism compared to controls using the same analysis. A high content screen of the morphology of VGLUT+ neurons showed a decrease in the number of branch points and number of neurites in autism iPSC lines compared to controls (N = 288 SFEBs/line, $p<0.001$; Mann-Whitney). Although not completely uniform, MEA recordings reveal that SFEBs derived from individuals with ASD show increased spontaneous firing (N = 72 SFEBs/line, $p<0.001$; Mann-Whitney).

Conclusions: SFEBs derived from ASD-specific iPSC showed a reduction in the number of GABAergic interneurons compared to control iPSC. Additional alterations in electrophysiological activity were seen in the ASD compared to the control iPSC-derived SFEBs. These findings indicate that potential E/I deficits found in our ASD cohort can be detected using high-content approaches. The results of this study will aid in our understanding of the molecular mechanisms that underlie autism and identify new therapeutic targets.

407.003 *(Poster)* Modeling the Enteric Nervous System in Autism Spectrum Disorder Using iPSC-Derived Innervated Gastrointestinal Organoids

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Background: Children with autism spectrum disorder (ASD) are more likely to experience chronic gastrointestinal (GI) symptoms of uncertain etiology than their typically developing peers. Because chronic constiption is a common finding in this population, we hypothesized that in some ASD children an abnormally functioning enteric nervous system (ENS) may underlie colonic hypomotility. We chose to test this hypothesis using a model of Phelan McDermid Syndrome (PMDS) because: (1) ~80% of individuals with PMDS have an ASD diagnosis, (2) >50% of that subset are reported to have chronic GI symptoms and, (3) the hallmark of PMDS is haploinsufficiency of a key neuronal protein, SHANK3. In the central nervous system (CNS), SHANK3 contributes to the formation and maintenance of postsynaptic density of excitatory synapses. The goal of our study using PMDS patient-specific iPSC-derived GI organoids is to determine the role of SHANK3 in the *ENS* and to identify potential therapeutic targets to correct gut hypomotility.

Objectives: To create an *in vitro* model, using iPSCs from PMDS patients, to study ENS function in individuals with ASD and chronic GI symptoms.

Methods: PMDS iPSC lines (proband and non-affected parent) were obtained from the NIMH Repository and Genomics Resource Project. Patient-derived iPSCs were used to create an innervated gut organoid through the combination of individually cultured GI spheroids and neural crest cells (NCCs). After the GI spheroids had been passaged 9 times and NCCs had been cultured for 20 days, the two cell types were mechanically aggregated and co-cultured for 5 days. Immunocytofluorescence was used to characterize the individual components (GI spheroids and NCC) and then the innervated gut organoids following co-culture.

Results: Immunocytofluorescence staining confirmed the presence of Sox9 demonstrating that the patient-derived iPCSs were successfully reprogrammed to GI spheroids (Fig 1A). NCC identity was confirmed by neuronal communication via axonal extensions of nearby NCCs (Fig 1B) and further supported via immunocytofluorescence staining with HNK1 (Fig 1C). Co-culture of mechanically aggregated GI spheroids and NCC for 5 days resulted in evidence of spheroid innervation (Fig 1D).

Conclusions: This pilot study describes the early stages of development of a novel model system to evaluate the contribution of a malfunctioning enteric nervous system in ASD by using iPSCs from a PMDS patient with co-occurring diagnoses of ASD and chronic GI symptoms. Next steps will entail a longer period of co-culture, followed by functional assays.

407.004 *(Poster)* Modelling Early Brain Development in NF1 Autism Using Induced Pluripotent Stem Cells

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Background: Autism Spectrum Disorder (ASD) is a group of neurodevelopmental disorders thought to arise in early cortical development and have a complex genetic aetiology. However, the critical developmental stages and cell types affected have not been clearly defined. Neural differentiation studies using Human Induced Pluripotent Stem Cells (hiPSC) have suggested that there may be pathological priming during early development which may affect the cortical progenitor stage. Defects at the progenitor stage could affect the function of subsequent mature neurons. Neurofibromatosis 1 is a useful syndromic model of autism due to its monogenic nature and high prevalence of ASD amongst patients (24%). Loss of function mutations in the NF1 gene, results in RAS/MAPK pathway over activity, which causes abnormal cortical neuron development. $Nf1^{+/-}$ animal models suggest that the function of glutamatergic and GABAergic neurons may be affected differently, leading to an inhibition/excitation imbalance, but it is still unclear whether this is also the case in humans.

Objectives: To establish differences in the development of glutamatergic and GABAergic neurons between NF1-ASD and related parental control hiPSCs to determine the major aberrant pathways in early development which may contribute to disease.

Methods: We have generated four transgene-free hiPSC lines from peripheral blood mononuclear cells from two individuals with NF1-ASD and related parental controls, as well as unrelated controls. We are also currently developing isogenic cell lines using CRISPR-Cas9 to correct the NF1 mutations in NF1-ASD cell lines. The hiPSC lines have been differentiated into neuroepithelial, early glutamatergic and GABAergic progenitor cells and immature glutamatergic and GABAergic neurons using established protocols. Differences in their phenotypes throughout development were subsequently explored using qRT-PCR, immunofluorescence and flow cytometry.

Results: The hiPSC lines generated express key pluripotency markers and lack expression of early differentiation markers throughout several passages (p10-p20). We observed differences in the early development of cortical glutamatergic and GABAergic neurons. Furthermore, NF1-ASD hiPSCs appeared to have changes in the cell cycle throughout neuronal development.

Conclusions: Our results demonstrate that there are early differences between healthy and NF1 mutant lines in the development of excitatory and inhibitory neurons, suggesting that mutations in the NF1 gene may affect cortical neuronal development in ASD. As NF1 is a key protein in the RAS/MAPK pathway, which is also affected in other models of autism, these findings may prove useful more widely in understanding autism.

407.005 *(Poster)* Multiple RNA Sequencing Platforms Reveal Complex Impact of Air Pollution Exposure on Cerebral Organoid Development

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Background: Air pollution exposure has been established as a risk for development of autism spectrum disorders (ASD). Genetic variants in key genes can account for some cases of ASD, but cannot explain the majority cases. Environmental factors causing epigenetic changes may account for ASD not explained by genetic variants. While two-dimensional cellular models can be used for preliminary examination of the effect of environmental pollutants, it lacks the ability to model the three-dimensional development of the complex human brain and the symbiotic relationship between different cell populations during cortical development.

Objectives: To understand how diesel particulate matter (DPM), a key component of urban air pollution, exposure during cerebral cortex development affects different cell populations in the complex brain development using cerebral organoids and how it correlates to ASD.

Methods: Cerebral organoids were generated from commercially available human induced pluripotent stem cells (hIPSC). After 30 days of maturation, cerebral organoids were exposed to 30µg/mL of DPM for 7 days. Gene expression of the organoids was then evaluated with three distinct transcriptome-wide methods: Illumina paired end RNAseq, long read direct RNAseq using Nanopore, and single-cell RNA-seq (scRNA-seq) using the 10x Genomics platform.

Results: RNA-seq of the cerebral organoids shows that we have 117 upregulated genes and 24 downregulated genes with a log2FC greater than 1 or less than -1 with a q-val of <0.05. Analysis of scRNA-seq shows 18 distinct cell clusters in the cerebral organoids. We identified several cell types including intermediate progenitor cells, radial glia, choroid plexus, and neurons. DPM alters several of the cell populations resulting in decreased cell numbers. A closer analysis of ASD susceptibility genes and genes linked to intellectual disability shows certain cell populations enriched for genes, with multiple ASD-associated genes altered by DPM exposure.

Conclusions: Cerebral organoids are an ideal cellular model for examining the complexity of brain development. Our project shows that the combination of several RNAseq platforms and cerebral organoids can give unique insights into how different cell types in the developing brain can be affected by environmental factors.

407.006 *(Poster)* Utilizing Forebrain-like Organoids to Characterize the Impact of TBR1 De Novo Mutations on Regulation of Deep Layer Cortical Development at a Single-Cell Resolution

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Background: The *in vitro* differentiation of 3D cortical organoids from induced pluripotent stem cells (iPSCs) has been shown to recapitulate neurobiological processes that occur during *in vivo* midfetal cortical development. Prior studies have identified this midfetal period as a potential critical window when many autism risk genes begin to function as a network, especially in deep layer neurons. However, our understanding of how specific *de novo* mutations (DNMs) impact network characteristics during brain development is limited. Here, we perform an intensive genomic characterization of these cortical organoid models and utilize this system to understand the effects of DNMs in *TBR1,* a key transcriptional regulator of deep layer neuronal fate.

Objectives: To characterize molecularly distinct changes in cortical organoids at a single-cell resolution and alterations induced by *TBR1* DNMs.

Methods: Forebrain-like organoids were differentiated from two unedited control iPSC lines, in addition to, isogenic pairs of a control iPSC line edited to contain DNMs in the autism risk gene *TBR1*. Multiple individual organoids from two differentiation experiments were sampled at culture days 30, 60, and 90. Dynamic changes in epigenetic state during organoid differentiation were assessed using an optimized single-cell combinatorial indexing (sci) ATAC-seq (Mulqueen et al. 2019). Single-cell profiles were collapsed into groups using cisTopic then analyzed for enrichment of specific transcription factor binding motifs. Pseudotemporal analysis was performed to uncover the succession of putative transcription factor activity. In parallel, a subset of organoids were also evaluated using 10x Genomics single-cell RNA-seq.

Results: We previously reported chromatin accessibility profiles from a single control iPSC line and *in vitro* differentiation that we assessed for protocol optimization (three time points, over 12,076 single-cells). Here, we generated additional data on six organoids from this same differentiation experiment (~12,000 additional single cells) and ~2,500 single cell 3' RNA profiles for each of three organoids (paired at each time point). In addition, we generated data on a differentiation replicate as well as a second control line (two organoids per line per timepoint, ~25,500 single cells). Organoids generated from the original line used for optimization are morphologically the same across experiments showing similar numbers of cortical rosettes and patterning of markers recapitulating human corticogenesis *in vivo*. While organoids generated from the second control iPSC line are smaller than those produced from the first control, the regional patterning of cortical markers is similar. Using CRISPR-Cas9, we successfully generated isogenic pairs of our control line with and without an ASD-associated *TBR1* mutation for which we are currently generating additional organoids and genomic data.

Conclusions: Our data support cortical organoids as viable models of fetal brain development, which can be characterized at single cell resolution. Our initial assay of a control iPSC line revealed a progression of chromatin and development of cell types similar to the stereotyped progression in human cortical development. Characterization of organoids with *TBR1* DNMs will address important gaps in knowledge to better understand the role of *TBR1* and its regulated pathways in the development of ASD.

Cellular Neuroscience

POSTER SESSION — **CELLULAR NEUROSCIENCE**
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408.001 *(Poster)* Altered Expression of Cadherins Suggests Their Potential Roles in Dendrite Development and Autism

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Background: Multiple members of the cadherin superfamily have been strongly implicated in autism. The cadherin superfamily contains more than one hundred cell adhesion molecules. A genome wide association study identified the classical type II cadherins CDH8 and CDH11 and the protocadherin PCDH9 as candidate risk genes. We hypothesize that cadherin signaling pathways could be disrupted in autism and may exhibit increased vulnerability of altered neuronal structure and stability in neurons.

Objectives: We first determined the expression of autism risk cadherins CDH8, CDH11 and PCDH9 in iPSC-derived neural precursor cells (NPCs) from control and autism individuals to evaluate whether cadherin levels are commonly altered in autism. We then investigated the expression patterns of cadherins in developing mouse brains and in primary neurons at the subcellular level. Cdh11 knockout mice were used to examine functional effects on dendrite arborization and calcium signaling. This study provides novel insights into common and distinct functions of different cadherins in neural circuit formation and the implication in autism.

Methods: Western blot analyses were performed to evaluate the protein expression of CDH8, CDH11 and PCDH9 in iPSC-derived NPCs, the developing mouse tissues and primary neurons. Subcellular localization as well as enrichment of cadherins in synaptic plasma membrane and postsynaptic densities were further analyzed using a synaptic fractionation assay and immunocytochemical labeling with neuronal markers PSD95, synapsin1 and GAT1. By co-immunoprecipitation, binding partners of cadherins were identified. Morphometric analysis was performed to measure the effect of Cdh11 knockout on the complexity of dendritic arbors. Calcium activity was measured in Cdh11 knockout and wildtype cultures using calcium indicators in the IncuCyte S3 Live-Cell Analysis System.

Results: We found altered cadherin expression levels in iPSC-derived NPCs from autism individuals with an increase of CDH8 and a decrease of CDH11. Temporal expression analysis in the developing mouse brains revealed increased expression of cadherins in the time frame of dendritogenesis and synaptogenesis. Cdh8 was preferentially expressed in excitatory synapses and interacted with neuroligin-1. *Cdh11* knockout mice showed a similar increase of cadherin-8 protein as in iPSC-derived NPCs along with elevated expression of neuroligin-1 and PSD95. The Cdh11 knockout hippocampal neurons exhibited an increase in dendritic complexity and altered neuronal activity.

Conclusions: The present study suggests altered expression profiles of cadherins in autism brains, thus strengthening the hypothesis of a central role of cadherins in autism. The findings highlight that cadherins of different subfamilies are expressed in a developmental time window implicated in autism. The results of this study further provide evidence that Cdh8 and Cdh11 are involved in regulating the development of neuronal circuitry and indicate a potential mechanism by which they may be involved in the etiology of autism.

408.002 *(Poster)* Ankyrin-B Deficiencies Cause Defects in Axonal Development, Synapse Formation, and Cortical Connectivity.

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Background: Ankyrin-B (AnkB) is an integral component of the membrane-associated cytoskeleton, where it binds the spectrin meshwork to organize specialized membrane domains. AnkB also couples motor proteins to organelles to promotes axonal transport and growth. Two major AnkB isoforms are expressed in the brain, ubiquitously expressed 220kDa (AnkB220) and neuron-specific 440kDa (AnkB440) AnkB. *ANK2,* which encodes AnkB, is a high confidence autism spectrum disorder (ASD) gene. Loss of both AnkB isoforms in mouse brains results in absence of long cortical axonal projections and overall reduction in axonal length, confirming that AnkB serves important roles in neuronal development in both humans and mice. In contrast, specific AnkB440 loss increases axonal branching in cultured cortical neurons and *in vivo*. Here we examine the independently and combined molecular mechanisms driven by AnkB isoforms that underlie their effects on cortical neuronal connectivity and function.

Objectives: To dissect the AnkB isoform-specific molecular mechanisms underlying AnkB's role in neuronal cortical connectivity and synaptic function.

Methods: To determine the isoform-specific functions of AnkB during axonal development and synaptogenesis, and their role in ASD, we developed mice lacking either AnkB440 or AnkB220 in neural progenitors. We combined histology, high resolution microscopy, biochemistry, and rescue experiments in neuronal cultures and *in vivo* to define the potential pathogenic effects of ASD-linked mutations.

Results: We identified AnkB isoform-specific effects on axon growth, morphology, cue response during axonal guidance, and synaptogenesis. For example, AnkB440 is required for proper signal transduction downstream of guidance receptors to promote actin cytoskeleton remodeling during axon development. On the other hand, loss of AnkB220 leads to specific deficits in cortical lamination and corpus callosum formation. Additionally, combined loss of both isoforms results in dendritic morphology and spine defects. Selected ASD-linked AnkB mutations failed to rescue these cellular defects.

Conclusions: AnkB isoforms have critical and distinct cell-autonomous roles in the growth and guidance of long cortical axons, dendritic morphology, and synapse formation and function. We will describe the molecular mechanisms underlying these AnkB functions and how they are affected by AnkB-linked ASD variants. Our findings suggest that both AnkB isoforms contribute to neuronal development and function through independent mechanisms that may have a combined effect on cortical connectivity and give rise to functional deficits in ASD patients.

408.003 *(Poster)* Cytoplasmic-Predominant Pten Increases Microglial Activation and Synaptic Pruning in a Murine Model with Autism-like Phenotype

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Background: Germline mutations in the gene encoding Phosphatase and Tensin homolog deleted on chromosome TEN (*PTEN*) account for ~10% of all cases of autism spectrum disorder (ASD) with coincident macrocephaly. To explore the importance of nuclear PTEN in the development of ASD and macrocephaly, we generated a mouse model with predominantly cytoplasmic localization of Pten ($Pten^{m3m4/m3m4}$ model). Cytoplasmic predominant Pten expression leads to a phenotype of extreme macrocephaly and behavior reminiscent of high-functioning ASD.

Objectives: The primary objective of this study was to determine if constitutive Pten dysfunction predisposes microglia to aberrant activation, leading to increases in synaptic pruning during neurodevelopment.

Methods: Using IPA, we analyzed our $Pten^{m3m4/m3m4}$ neural transcriptome, and were able to bring our observed pathway-based predictions to *in vitro* and *in vivo* validation. Initially, we utilized a series of co-culture experiments with microglia and neurons from $Pten^{WT/WT}$ and $Pten^{m3m4/m3m4}$ genotypes to investigate Pten localization, synaptic pruning, phagocytosis, and C1q expression. To further validate our *in vitro* findings we used $Pten^{m3m4/m3m}$ mice to determine at what age microgliosis occurs in this model, as well as quantify cortical and hippocampal expression of Pten, Synaptophysin, Psd-95, C1q, and Iba1 thought the course of neurodevelopment.

Results: Transcriptomic analysis of the $Pten^{m3m4/m3m4}$ cortex revealed upregulated gene pathways related to myeloid cell activation, myeloid cell migration, and phagocytosis. Interestingly, a contrasting downregulation of gene pathways related to synaptic transmission was observed. Follow up of the transcriptomic data, *in vitro* revealed a 25-fold increase in C1q expression ($p = 0.0002$) in mutant microglia compared to wild-type a. In addition, we assessed phagocytic ability and efficiency of $Pten^{m3m4/m3m4}$ microglia. We found 20 % increase in the number of phagocytic $Pten^{m3m4/m3m4}$ microglia compared to $Pten^{WT/WT}$ ($p = .001$). We also found $Pten^{m3m4/m3m4}$ phagocytic microglia were ~2 times more efficient in their phagocytic ability compared to $Pten^{WT/WT}$ microglia ($p = 0.004$). To assess impact on synaptic pruning, we co-cultured combinations of wild-type and mutant microglia with neurons and found that $Pten^{m3m4/m3m4}$ microglia co-cultured with $Pten^{m3m4/m3m4}$ neurons resulted in a 2-fold increase in pruning compared to when no microglia were present ($p= 0.0001$). These *in vitro* findings on over pruning of neuronal synapses via a potential neuron-microglia cross talk in a $Pten^{m3m4/m3m4}$ system, were consistent with *in vivo* observations in our murine model. At 3 weeks of age significant increase in microglial cell area was observed in the cortex of mice with $Pten^{m3m4/m3m4}$ mutations compared to that of the $Pten^{WT/WT}$ cortex ($p = <0.0001$). This microgliosis was concurrent with drop in *Pten* expression levels to below 50% of wild-type levels in the cortex ($p = <0.001$). The decline in Pten expression and concurrent increase in microgliosis was strongly associated with decreased expression of synaptic markers in the cortices of $Pten^{m3m4/m3m4}$ mice.

Conclusions: These findings provide direct causal evidence that dysregulated Pten in microglia has an etiological role in microglial activation, phagocytosis, and synaptic pruning. Collectively, our data suggest altered PTEN activity in microglia could serve as a key regulator of synaptopathy phenotypes in PTEN-ASD patients.

408.004 *(Poster)* Interneuron-Specific Knockout of Semaphorin 3F Induces Neuroinflammation and Endothelial Injury with Disruption of the Blood Brain Barrier

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Background: Semaphorin is a well-known neurovascular molecule which impacts both neurogenesis and vasculogenesis. Both cell and neurite motility of the neurons and endothelial cells are regulated by semaphorin 3F-Neuropilin 2 (Sema 3F-NRP2) signaling. The immune system and glia also express neuropilins and semaphorins but their function in these cell types is much less clear. Recent evidence suggests that Neuropilin 2 signaling regulates inflammation and the loss of Sema 3F-NRP2 signaling has also been shown to increase vascular permeability and inflammation. Autism spectrum disorder (ASD) is a disorder with some evidence for neuroinflammation but little is known about vascular involvement and blood brain barrier function. We aimed to determine whether neuroinflammation we previously described in knockouts for Sema 3F-NRP2 signaling, a murine model of autism and epilepsy, also involved platelet-endothelial activation and injury.

Objectives: In the present study, we aim to examine neuroinflammatory markers in our GABAergic neurons-specific Sema3F KO mouse model of ASD that may parallel human neuroinflammation characteristics identified in ASD patients. We will examine whether these neuroinflammation processes lead to platelet activation and endothelial injury and to possible disruption of blood brain barrier (BBB) integrity.

Methods: Using a genetic model of ASD and epilepsy, Semaphorin 3F knockout mice (CRE+FF) and control mice (Cre−FF, Cre+WT, Cre−WT) expressing Semaphorin 3F, we examined physical (brain weight) and electrophysiological (EEG) changes and the expression and distribution of markers of inflammation (iba1 and iNOS) and of oxidative stress (3-nitrotyrosine) in the hippocampus, cortex and amygdala brain regions. In addition, we stained these brain regions for platelets (CD61) and platelet activation (p-selectin and serotonin) markers and for albumin leakage as an indicator of blood brain barrier integrity.

Results: Sema 3F deletion in interneurons results in brain weight loss and EEG changes and induces signs of neuroinflammation including activation of microglia, iNOS induction, and increased 3-nitrotyrosine. Signs of platelet deposition, activation, and release of serotonin occur in multiple brain regions important in ASD. Finally, along with platelet products, albumin leakage and uptake and outlining of neurons in these regions suggest possible BBB deficits mediated by inflammation.

Conclusions: In summary, disruption of neurovascular signaling molecules, such as Sema3F-NRP2, may mediate causative pathophysiology in some subgroups with ASD via neuroinflammation, oxidative stress, and compromised BBB integrity.

408.005 *(Poster)* Preliminary Cellular Evidence of Demyelination in Temporal Lobe White Matter As People with ASD Age into Adulthood

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Background: Extensive literature links autism spectrum disorder (ASD) symptomatology to impairments in neuronal connectivity and communication. Postmortem human brain tissue provides an invaluable opportunity to evaluate the cellular underpinnings of altered neuronal connectivity in ASD. Utilizing electron microscopy techniques, we and others have identified alterations in axon density in ASD brains. In addition, our own studies indicate a significant decrease of myelin thickness in multiple white matter regions of the temporal lobe in adults with ASD. This difference is not present in younger cases, suggesting possible demyelination as people with ASD age into adulthood. However, the underlying trajectory and potential pathology of oligodendrocytes, the cells that form myelin in the brain, across age remains unknown. We hypothesize that, in white matter regions of the temporal lobe where thinning of myelin was identified, there will be an age-related decrease in oligodendrocyte density in people with ASD.

Objectives: To measure oligodendrocyte density in superficial white matter dorsal to the superior temporal gyrus (STG) of postmortem human brain tissue from a wide age range of neurotypical and ASD individuals.

Methods: We collected postmortem human brain samples from 24 male cases (11 ASD, 13 neurotypical controls) ranging from 2-44 years of age. Tissue blocks containing the temporal lobe were cut with a sliding microtome at 100µm thickness and Nissl stained for cell bodies using our standard histological protocols. A total of eight sections were selected per case (1000µm apart) spanning the STG rostral to caudal. White matter regions were identified by the cytoarchitecture of the surrounding cortex and hand traced at 2.5x magnification. A 500µm x 500µm grid was superimposed over the tissue to ensure a maximum counting field depth of 500µm. Stereological measures (utilizing StereoInvestigator optical fractionator software from MBF Bioscience) were applied to count oligodendrocyte populations specifically in the superficial white matter (SWM) dorsal to the superior temporal gyrus (STG) at 100x under brightfield microscopy. All stereological quantification was performed with a 5µm guard zone and 15µm optical dissector height. Oligodendrocytes were identified based on their unique cellular morphology: 2.5µm -6µm diameter, dark nuclear boundary and spherical shape.

Results: The density of oligodendrocytes decreases with age in ASD superficial white matter dorsal to STG (correlation = 0.42). This age-related decrease in oligodendrocyte density seen in ASD does not occur in neurotypical individuals, and in fact density increases with age. There is no significant difference in oligodendrocyte density in younger cases (2-14 years) ($p<0.23$). In contrast, oligodendrocyte density is significantly decreased in adolescents and adults (15-44 years) ($p<0.02$). These age dependent trends align with previously found changes in the trajectory of myelin thickness with age in both groups.

Conclusions: The significant decrease in oligodendrocyte density with age in ASD is consistent with previous findings of decreased myelin thickness in white matter regions of the temporal lobe. A decrease in myelin thickness, axon density, and oligodendrocyte density with age suggests an overall degenerative pattern and disrupted neuronal connectivity in ASD that does not occur in neurotypical individuals.

408.006 *(Poster)* Testing the Link between Cell Cycle Disruption and ASD: Impacts of Chd8 Mutation on Cell Proliferation Dynamics in Embryonic and Postnatal Brain.

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Background: *De novo* mutations in the chromatin-remodeling factor *CHD8* (Chromodomain-Helicase DNA-binding protein 8) are strongly associated with autism spectrum disorder (ASD) and more generally with neurodevelopmental disorders (NDDs). Most *CHD8* mutations are expected to lead to a loss of functions and carrier patients display, among other manifestations, ASD-like behavior, intellectual disability, and macrocephaly. We previously reported that *Chd8* regulates the transcription of cell cycle genes and via paired transcriptomic and neuroanatomy analyses that *Chd8* plays a crucial role during early neurodevelopment. However, proliferation in the brain occurs throughout the lifespan at specific times and in specific brain regions. Thus, modeling the proliferative changes pathological mechanisms linking cellular proliferation and *Chd8* haploinsufficiency from the molecular to system level at different developmental and post-natal stages is critical.

Objectives: : Here, we hypothesized that *Chd8*-associated neuropathology is not limited to early neurodevelopment and/or to aberrations in a single cell type or region of the brain. Therefore, we aim to address major questions regarding the disrupted genomic control of neuronal proliferation dynamics in cortex, hippocampus and cerebellum, all three brain regions that exhibit anatomical size differences identified by MRI analysis in the *Chd8* haploinsufficient mice.

Methods: Using mice that harbor a heterozygous *Chd8* mutations and present behavioral deficits relevant to ASD and Intellectual Disability (ID), we performed 1) unbiased stereology to further characterize and investigate the causal roots of the cortical expansion previously described, 2) paired transcriptomic profiling (RNA-Seq) with neuroanatomical and functional studies (Immunohistochemistry and Edu pulse and chase assays) to investigate perturbations in cell cycle and neuronal progenitors dynamics during development and postnatally in cortex, hippocampus and cerebellum.

Results: Our unbiased stereological analysis validated the previously reported macrocephaly phenotype associated with *Chd8* haploinsufficiency with increased cortical volume but found no change in neuronal cell counts or cell body volume. Transcriptional signatures reflect observed changes in neuroanatomy and synaptic transmission and postnatal studies in hippocampus and cerebellum proliferative dynamics provide functional evidence of the impact of *Chd8* haploinsufficiency on proliferative and neurogenic processes.

Conclusions: Our current data, combined with our previous reported findings provide mechanistic insights into the proliferative and neuroanatomical pathology of ASD. These findings contribute to the critical knowledge on how chromatin remodeling factor haploinsufficiency contribute to ASD-relevant brain overgrowth, postnatal processes and adult neurogenesis, aspects that are often overlooked in ASD and NDDs.

408.007 *(Poster)* The Relationship between Parvalbumin Expression and Neuronal Function May Provide a Mechanistic Explanation for Autism

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Background: Differences in Excitation/Inhibition (E/I) balance in the brain have been linked to a variety of neurological conditions. In particular, mouse models and individuals with autism spectrum disorder (ASD) have exhibited differences in E/I balance through downregulation of parvalbumin (PV)-positive interneurons (PVIs), a class of neurons characterized through the presence of PV protein, as well as their fast-spiking capabilities. These neurons are found throughout the brain, and form local inhibitory synapses on either excitatory cell bodies or axon initial segments. PV itself is a calcium chelating protein that is thought to buffer the excess cytoplasmic calcium that occurs during neuronal spiking, and downregulation of this protein is associated with excess cytoplasmic calcium, and resulting disruptions in synaptic activity.

Objectives: While PVIs' involvement in ASD has been well-characterized in mice, the nature of how downregulation of PV affects PVIs, and whether this would result in excitotoxicity, is still not understood. Further, there is controversy concerning the fate of PVIs when PV is downregulated; whether the PVIs can survive without PV, or whether actual PVI numbers are reduced, is not fully understood. In this study, we examined the role of PV in PVIs. We hypothesize that the expression of PV correlates with neuronal morphology and synaptic activity, and knockdown of this protein will lead to abnormal dendritic arborization and disrupted synaptic activity.

Methods: We employed a mouse model that expresses the fluorescent protein tdTomato under the PV expression regulatory elements (PV-tdTomato), independent of the endogenous PV transcript. Using a primary cell culture approach, we examined PV levels in PVIs transcriptionally by Fluorescent *in-situ* Hybridization (FISH) analysis and translationally by immunocytochemistry. We further performed morphometric analysis and calcium imaging to determine the neuronal morphology and spontaneous calcium activity in PVIs. We have also used both a lentiviral and AAV approach to reduce the levels of PV using shRNA.

Results: Using our PV-tdTomato cultures, we have found that protein levels of PV show a broad variation in protein expression levels, and do not follow a normal distribution. PV also does not correlate with tdTomato expression, although some PV is typically found in tdTomato labeled PVIs. FISH analysis revealed that while PV protein and mRNA levels correlate, they do not show an association with tdTomato signal. PV levels correlate with the expression of CaMKIV, calcium/calmodulin-dependent protein kinase type IV, and inversely correlate with dendritic arborization. Additionally, the mean amplitude of spontaneous Ca^{2+} signaling peaks, as measured by the calcium indicator G-CaMP6, was increased in PVIs with low PV expression. Moreover, L-glutamate-mediated excitation of PVIs elicits, in parallel with a transient activation of ERK1/2, a fast upregulation of PV protein levels.

Conclusions: We show that variability of PV levels in PVIs have direct consequences on cellular morphology and neuronal activity. With the reduced levels of PV seen in ASD, our results suggest a putative mechanism for the cellular differences observed in this condition.

Clinical Genetics

POSTER SESSION — CLINICAL GENETICS
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409.001 *(Poster)* AutDB2020: A Resource for Autism Research

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Background: Since its public launch in 2007, the autism genetic database AutDB (http://autism.mindspec.org/autdb/Welcome.do) has evolved into a multi-modular platform consisting of curated ASD-related genetic and functional evidence that has become a widely cited resource by the ASD research community. Ongoing curation of ASD-associated genetic and functional evidence has resulted in enormous growth across the modules of AutDB. In particular, the Human Gene Module has seen a significant increase in the number of ASD candidate genes following the application of next generation sequencing (NGS) technologies in large ASD cohorts.

Objectives: The objective of AutDB is to continue to provide a publicly available web-portal for the ongoing collection, manual annotation, assessment and visualization of genes linked to ASD.

Methods: The current modules of AutDB include the original Human Gene Module, which annotates all ASD-linked genes and their associated variants; the Animal Model module, which catalogs behavioral, anatomical and physiological data from rodent models of ASD; the Protein Interaction (PIN) module, which builds interactomes from direct relationships of protein products of ASD genes; and the Copy Number Variant (CNV) Module, which catalogs deletions and duplications of chromosomal loci identified in ASD. All data in AutDB is manually curated from peer-reviewed, published scientific literature.

Results: The number of ASD candidate genes in AutDB has increased from 328 to 1117 since 2012. Many of the newly added genes were curated based on their identification in genome-wide studies of large ASD cohorts. The latest release of AutDB (September 2019) includes 14,258 rare variants in ASD-linked genes extracted from 1448 publications. Based on multiple lines of variant evidence, we have identified over 100 important ASD genes in which rare, likely pathogenic variants have been identified in ASD cases across published studies. Furthermore, many of these genes have subsequently been shown to be responsible for ASD-associated neurodevelopmental syndromes in which affected individuals frequently present with developmental delay/intellectual disability, seizures, dysmorphic features, and/or other congenital anomalies, in addition to ASD. Included in this resource are animal models derived from many high confidence genes that recapitulate a number of core and other ASD-related phenotypes observed in human patients, lending further evidence to the importance of these genes in ASD pathogenesis. Together, we provide a curated catalog of ASD genes encompassing coding and non-coding variants, as well as ASD-associated copy number variants.

Conclusions: AutDB is the most comprehensive resource for exploring genetic variation in ASD. The modular architecture of AutDB allows us to integrate genetic and functional evidence in order to better access the potential importance of a given candidate gene in ASD pathogenesis, while our quarterly release schedule of newly annotated data ensures that AutDB is an up-to-date resource highlighting the most recent advances in ASD research for usage by the scientific community.

409.002 *(Poster)* Autism High-Risk Genes and New Genetic Subtypes

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Background: Autism spectrum disorder (ASD) is a group of neurodevelopmental disorders with considerable genetic and clinical heterogeneity. Genetic studies have implicated hundreds of susceptibility genes and *de novo* variants in more than 100 genes confer increased risk for ASD. Even so, these genes account for only a small fraction of patients, suggesting that a large number of genes with extremely rare variants await discovery as study sample sizes increase.

Objectives: In an effort to better understand the genetic architecture, identify new risk genes, and define new genetic subtypes of autism spectrum disorders.

Methods: We targeted ~200 autism candidate genes originally implicated in cohorts of European descent for sequencing in 5256 families from the Autism Clinical and Genetic Resources in China cohort over the last five years using a modified single-molecule molecular inversion probes method.

Results: We validated recurrent *de novo* likely gene-disruptive mutations in 26 genes and identified multiple novel ASD high-risk genes. During this analysis, we identified transmission of private gene-disruptive mutations in genes predominantly associated with *de novo* mutations (DNMs) and showed that clinical revaluation of carrier parents revealed mild neurodevelopmental or related endophenotypes. We also identified families with DNMs in two or more candidate genes. Combining available exome sequencing data, we show that such oligogenic cases occur more frequently in probands associated with more severe phenotypes, including social impairments and seizure burden. By followed large-scale international collaboration, we and our collaborators defined new genetic subtypes (including *CSDE1*, *TANC2*, *GRIA2*, *ZNF292* and *TNRC6B*) of autism and related neurodevelopmental disorders by genotype-phenotype correlation studies.

Conclusions: We identify new risk genes and transmission of deleterious mutations in genes primarily associated with DNMs. Genotype-phenotype correlation analysis by large-scale international collaboration will not only lead to a causal diagnosis for patients but also be important for a better understanding of genotype–phenotype associations, definition of new ASD subtypes and in guiding precision medicine.

409.003 *(Poster)* Bringing Whole Genome Sequencing to the Clinic: The Itarget Autism Initiative (Individualized Treatments for Autism Recovery using Genetic-Environment Targets)

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Background: Genetic testing for autism spectrum disorder (ASD) routinely includes chromosome microarray (CMA) to detect genome copy number variants (CNVs); whereas whole exome/genome sequencing (WES/WGS) is rapidly emerging to identify single nucleotide variants (SNVs) and insertions/deletions (indels). In Canada, WES may be covered by provincial health insurance (PHI) if the patient qualifies; otherwise families are left untested, or pay privately.

iTARGET-Autism (www.itargetautism.ca) joined together with Illumina Canada and MSSNG (www.mss.ng) to increase access to community, clinic-based WGS for individuals with confirmed ASD to identify causes informative to personalized counselling and care.

Objectives: 1. Translate gold standard WGS and genetic counselling to the clinic. 2. Identify phenome/genome autism subtypes (VarSeq; Golden Helix). 3. Negate complementary CMA/CNV analysis, while optimizing accurate and informative diagnoses.

Methods: We tested 100 autistic patients referred to the Autism Integrated Medical Services (AIMS) clinic who did not meet PHI criteria for funded WES. WGS performed at TCAG (SickKids, Toronto) via MSSNG and hospital-based CMA identified SNVs, Indels, and CNVs in families with idiopathic ASD.

Results: The first 48/100 genomes already show results impacting autism management and personalized counselling by identifying gene variants closely fitting "whole-person phenotypes" using a Clinical Geneticist lens (see Table 1). 100% of clinically reported CNVs identified by CMA were also identified by WGS, including novel CNVs and SNVs pertinent to each individual's specific autism and co-morbidities. Key results thusfar are:

1. WGS data from 48/100 individuals include 18 ASD affected children and 30 parents from 15 families (12 trio/3 quad families).
2. ~40% of families showed pathogenic and/or likely pathogenic autism-related SNVs/indels and/or CNVs across multiplex and simplex families +/- positive family history respectively (42% of trio/33% of quad families). Among 18 affecteds, 6 (33%) were found to have pathogenic and/or likely pathogenic SNVs/Indels and/or CNVs .
3. One child showed both a pathogenic SNV related to autism and secondary compound-heterozygous SNVs for Alport Syndrome.
4. 17/18 affecteds had hospital-based diagnostic CMA. 6/17 of these affecteds had pathogenic, likely pathogenic, and/or CNV variants of unknown significance (VUS; 8 non-redundant unique CNVs total). All 8 CNVs (from 260 Kb-1.56 Mb in size, including 2 de novo pathogenic CNVs) were detected by WGS using VarSeq software. This suggests that the WGS-VarSeq algorithm can reliably replace CMA for CNV detection, despite our small cohort

The WGS-VarSeq algorithm detected one VUS CNV not reported by CMA; a 100Kb, maternally-inherited duplication involving a single gene, *TSPAN7,* associated with speech delay/seizures. The patient has mild speech delay without seizures, with a maternal family history of idiopathic epilepsy and learning difficulties/ADHD.

Conclusions: We are confident that analysis of the remaining 52 genomes will further validate the translational potential of this small pilot study and the larger iTARGET project objectives to optimize early autism diagnosis to stratify more precise and personalized "best-fit" treatments.

409.004 *(Poster)* Determining the Pathogenicity of a Variant in MEF2C in an Individual with Autism Spectrum Disorder Identified through a Targeted Childhood Epilepsy Panel

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Background: Many genes have been found to cause a pathogenic effect on Autism Spectrum Disorder (ASD), with most genetic etiologies of ASD to include chromosomal copy number variants (CNVs), highly penetrant single nucleotide variants (SNVs) and insertion/deletions (indels). The gene for Myocyte-Specific Enhancer Factor 2C (*MEF2C*) has been rarely associated with ASD and is essential for myogenesis and the development of the anterior heart, neural crest, and plays a role in craniofacial development. MEF2C haploinsufficiency syndrome, via mutation of the gene, typically involves a genomic micro-deletion at chromosome 5q14.3. Individuals with this mutation show a variety of symptoms, with the common features being intellectual disability (ID), global developmental delay (GDD), epilepsy, stereotypic movements, hypotonia, and cerebral malformation.

As part of the iTARGET Autism project (http://www.itargetautism.ca/), we investigated the functionality and pathogenicity of a novel SNV in the MEF2C gene identified in a young girl with ASD and the following features:

- Generalized neuromotor delay due to hypotonia, just starting to walk at age 3 years
- Atypical febrile seizures requiring anticonvulsant prophylaxis
- Completely nonverbal, and only started to use simple nonverbal tools to show her wants and feelings
- Limited eye contact, stereotypic arm and hand movements
- Moderate to severe ID
- Minor craniofacial dysmorphism
- A small muscular cardiac ventriculoseptal defect (VSD) which spontaneously closed, without any family history of cardiac structural defects
- Negative relevant family history

Objectives: To neuro-functionally analyze the pathogenicity of a novel variant in MEF2C identified in a patient with ASD.

Methods: As a clinical CNV microarray was negative, a targeted clinical sequencing panel available through GeneDx Inc, including 50 targeted epilepsy-related genes was used to evaluate a genetic association with the proband's condition. Variant functionality testing was performed with use of rat hippocampal cells transfected with GFP. Three different types of neurons were used to visualize changes in length, density, and excitatory/inhibitory synapses: control, wild-type, N231k variant.

Results: *Childhood Epilepsy Panel:* Proband was found to have a de novo heterozygous point mutation in the C-terminal transactivation region (c.693 C>G, p.Asn231Lys). This point mutation results in a missense mutation, in exon 7 of MEF2C gene]. This mutation occurs in a position that is conserved in mammals andis predicted to have damaging effect by multiple computational pathogenicity predicting tools including. Furthermore, it is absent from the normal control population databases of GnomAD exomes and genomes.

Variant Characterization: A loss of function of excitatory synapses in N231k variant neurons was identified, suggesting the variant alters a change in normal function and is thus likely pathogenic. A decrease in % mushroom spines of the N231k variant suggest a decrease in excitatory synapses, which is further proved by the decrease in PSD-95 density in N231k variant neurons (see Figures 1 and 2).

Conclusions: Variant functionalization is essential for understanding the genetic etiology of an individual's ASD. This novel variant in MEF2C has been shown to affect one of the two known functions of this essential gene, suggesting that this is a pathogenic variant that may be contributing to the etiology of this individual's ASD.

409.005 *(Poster)* Differential Effects of Deletions and Duplications on Autism Risk across the Genome

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Background: Deleterious deletions and duplications (copy number variations, CNVs) are identified in up to 11% of individuals with autism. However, only 12 CNVs have been formally associated with autism because the majority are too rare to perform individual association studies.

Objectives: We recently developed models to estimate the effect-size of undocumented CNVs on IQ and sought to extend this approach to autism susceptibility and multiple cognitive domains.

Methods: We identified CNVs in an autism sample from the Simons Simplex Collection and MSSNG, first degree relatives, and individuals from two unselected populations. Statistical models integrating scores of genes encompassed in CNVs were used to explain their effect on autism susceptibility and multiple cognitive domains.

Results: Deletions decrease IQ by 2.6 points per unit of "probability-of-being loss-of-function intolerant" (pLI). The effect of duplications on IQ is three-fold smaller. The autism susceptibility increases when deleting or duplicating any unit of pLI. Results are unchanged after removing de novo and neuropsychiatric CNVs. Once CNV effects on IQ are accounted for, autism susceptibility remains unchanged for duplications but is only borderline significant for deletions. Deletions and duplications differentially affect social communication, behavior, and phonology, whereas both equally affect motor skills. Model estimates for autism risk overlap with previously published observations.

Conclusions: Autism . Our model, trained on CNVs encompassing >4,500 genes, suggests highly polygenic properties of CNVs with respect to autism risk. These models will help interpreting CNVs identified in the clinic.

409.006 *(Poster)* Genetic Diagnostic Yield of Chromosome Microarray Analysis and Trio-Based Whole Exome Sequencing Among Chinese Children with Autism Spectrum Disorder

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Background: Chromosome microarray analysis (CMA) is recommended as the first-tier diagnostic test for patients with autism spectrum disorder (ASD) by the American College of Medical Genetics and Genomics (ACMG) in 2011. And it has been widely applied to the cohort of patients with ASD in Shanghai Jiao Tong University School of Medicine affiliated Xinhua Hospital in recent years. Furthermore, the advent of decreasing cost combined with superior efficiency of WES enables an additional 10%–15% identification of causes of ASD. Not until recently, the work by Tammimies *et al.* published in *JAMA* showed that the combined diagnostic yield of CMA and WES was higher among children with ASD co-occurring more complex morphological phenotypes. However, WES started relatively late in China.

Objectives: To determine the diagnostic yield of CMA and WES and the impact of the molecular diagnosis on clinical management in China

Methods: In Xinhua cohort of ASD, 968 Chinese children were diagnosed as ASD, more than 80% of whom were tested by CMA in recent years. And 431 unrelated children with ASD were tested by CMA from August 2016 to December 2017 as soon as whole exome sequencing (WES) was applied to patients with ASD in clinical practice in Xinhua Hospital. High resolution CMA was utilized to investigate rare CNVs among 401 patients (including 177 mildly/moderately and 224 severely affected individuals), together with an ancestry-matched control cohort (n = 197).

Results: Diagnostic yield was about 4.2%, with 17 clinically significant CNVs identified in ASD individuals, of which 12 CNVs overlapped with recurrent autism risk loci or genes. Autosomal rare CNV burden analysis showed an overrepresentation of rare loss events in ASD cohort, whereas the rate of rare gain events correlated with the phenotypic severity. Further analysis showed rare losses disrupting genes highly intolerant of loss-of-function variants were enriched in the ASD cohort. Among these highly constrained genes disrupted by rare losses, *RIMS2* is a promising candidate contributing to ASD risk. Given a high suspicion of genetic etiology and/or reproductive planning of the parents, 65 probands with negative findings of copy number variants (CNVs) were further analyzed by trio-based WES. A total of 23 children received a molecular diagnosis: 3.9% (17/431) from CMA and 9.2% (6/65) from WES, corresponding to a total diagnostic yield of 12.7%. Among patients with ASD analyzed by WES, 45 of 65 patients were co-occurring with developmental disability or intellectual delay (DD/ID), while the rest were without DD/ID. Data showed that all of the presumed causative genes (*CHD8*, *AFF2*, *ADNP*, *POGZ*, *SHANK3* and *IL1RAPL1*) highly related to ASD were identified in patients with ASD &DD/ID. Notwithstanding, no disease-related genes and variations were detected among patients without DD/ID

Conclusions: In spite of the negative findings of CMA, WES remains an efficient diagnostic tool for ASD. And children with negative findings of CNVs and co-occurring DD/ID are more likely benefit from the dual testing strategy (CMA combined with WES) in clinical practice, thus contributing to the corresponding change of clinical management and prenatal genetic counselling.

409.007 *(Poster)* Genetic Investigation in Autism Spectrum Disorder CASES

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Background: Autism Spectrum Disorder (ASD) is a complex and heterogeneous neurodevelopmental disorder where the etiological diagnosis and genetic counseling have been a challenge to the families, especially in underdeveloped countries. In the last years, with greater knowledge about the genetic and molecular mechanisms it is possible identify the etiological causes in up to 25% of autism cases in genetics centers.

Objectives: Thus, the aim of this study was to investigate genetic patterns in a sample of ASD patients who attended a public care outpatient clinic.

Methods: The study was performed in the neurogenetic research outpatient clinic of the University of Southern Santa Catarina, SC, Brazil, between 2010 and 2018. Data were obtained from data review of medical records. From a total of 417 patients diagnosed with ASD, 145 children were submitted to Polymerase chain reaction (PCR) karyotype for fragile X syndrome and 32 children were qualified for further investigation by for Chromosomal Genomic Hybridization - Array (CGH-Array).

Results: The average age of the patients was 6.8 ± 5.7 years old. PCR karyotype for fragile X syndrome was performed in 145 (34.8%) of the patients, of whom 22 (15%) had some change in karyotype and 3 (2%) in PCR for fragile X. Chromosomal Genomic Hybridization - Array (CGH-Array) were performed in 32 (7.7%) patients, of whom 22 (68.7%) showed some alteration.

Conclusions: The karyotype analysis allows the identification of numerical and structural chromosomal alterations and, even in the face of the development of complex genetic tests, is still considered the main genetic screening test. In our study, karyotype examination and investigation of the fragile X gene was able to generate a response at a rate higher than that found in the literature, which is around 10% and 1.6%, respectively. The CGH array offers greater sensitivity by allowing the identification of submicroscopic genetic variations. In our study, the method was able to detect changes at a rate higher than that found in the literature, which is 9 to 15%. Among the alterations found in the CGH- ray, microdeletion, microduplication and gain of genetic material were more frequent. Five patients presented 47 XY +21, four patients presented 46 XY - 9qh+, two patients presented 46 XY - 16qh+ and more two 46 XY 1qh+, the others presented individual alterations. Despite the small sample size, it can be concluded that genetic evaluation is an important etiological investigation method in ASD cases, being the CGH-Array so far the most effective tool. The search for a cause for autism is fundamental allowing the adequate family genetic counseling and the indication of more specific treatments.

409.008 *(Poster)* Genotype-Phenotype Correlation and Functional Analysis of ASD High-Risk Gene KMT5B

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Background: KMT5B is a histone methyltransferase that involves in the regulation of histone H4K20 methylation, gene transcription and DNA repair process. *KMT5B* is highly expressed in embryonic brain, while it gradually decreases and eventually tend to be stable after birth. *KMT5B* knockout mice are embryonic lethal. Recent studies has shown that *KMT5B* variants cause autism spectrum disorder (ASD) and related neurodevelpmental disorders.

Objectives: To determine the phenotype spectrum caused by *KMT5B* mutations and to explore whether and how *KMT5B* involves in neurodevelopment.

Methods: Single-molecule molecular inversion probes methods was used to targeted sequence ASD high-risk genes including KMT5B in a large Chinese ASD cohort. Immunostaining on in vitro cultured mouse neurons and mouse in utero electroporation was used to investigate the phenotypes resulted from disruption of KMT5B.

Results: We identified two transmitted likely gene-disrupting(LGD) mutations (c.978-1G>A and c.1205_1206insGCGTAAAA:p.K403Sfs*11) and one *de novo* missense mutation (c.788T>C:p.L263P) in three ASD patients. To explore genotype–phenotype correlations, we curated and analyzed the new identified and reported clinical information from 20 patients with KMT5B mutations (10 *de novo* LGD, 2 transmitted LGD, *8 de novo* missense). We observed that patients with *KMT5B* pathogenic mutations are mainly associated with ASD, intellectual disability (ID), languages development delay and developmental regression. Knockdown of *KMT5B* expression in cultured primary cortical neurons lead to a decrease in neuronal dendritic complexity and an increase in dendritic spine density. Knockdown of endogenous *KMT5B* expression in the mouse embryonic cerebral cortex by in utero electroporation resulted in decreased proliferation and accelerated migration of neural precursor cells which were rescued by overexpression of human *KMT5B*. While two *de novo* missense mutations (c.788T>C:p.L263P, c.791G>C:p.W264S) located in the SET domain failed rescue the phenotypes indicationg a loss-of-function effect.

Conclusions: These findings suggest that histone methyltransferase KMT5B plays important roles in neurodevelopment. Loss of function mutations in *KMT5B* cause a neurodevelopmental disorder with main features of ASD, ID and language developmental delay.

409.009 *(Poster)* Precision Medicine in Autism Spectrum Disorders: Insights from a Cross-Sectional Study of Clinical Chromosomal Microarray Testing, Outcomes & Medically Actionable Diagnoses

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Background: Chromosomal microarray (CMA) is recommended as a first-tier genetic test in the medical evaluation of autism spectrum disorders (ASD). However, there may be substantial variability in clinical genetic testing practices despite available guidelines. Understanding current genetic testing practices and its associated factors can facilitate the identification of care improvement targets and the utilization of genomic precision medicine.

Objectives: Characterize CMA ordering practices and outcomes among providers treating children with ASD in a regional pediatric healthcare organization (Rady Children's Hospital-San Diego (RCHSD)). Investigate the association of CMA ordering practices with phenotype, clinical services utilization, and demographic factors.

Methods: Data on 1832 children meeting the following criteria were extracted from the electronic medical record: (1) ASD listed on the child's "problem list," a clinician validated list of features and diagnoses; (2) had at least one encounter at RCHSD (including primary and specialty care) between January 2015 and August 2018; (3) born after January 1st 2012. Children were a mean age of 5.5 years (range 2.3-7.3 years), 79% male and 39.4% Latinx. Data on phenotypic features, clinical services, and demographic information were abstracted. Socioeconomic status was estimated by median household income by zip code. Descriptive statistics were used to characterize practice patterns and multi-variate regression analyses were used to examine factors associated with practice patterns.

Results: Follow-up data after ASD diagnosis was available for 77. 1% (median 0.5 years, range 0.1-3.6 years). At least 1 CMA was ordered by a RCHSD affiliated clinician for 387 children (21%); an additional 41 children had a CMA ordered by an outside provider. Higher clinical service use and sub-specialist evaluation was associated with the likelihood of CMA order ($p<0.001$). This included evaluation in multiple departments (OR 1.12, 95% CI 1.05-1.18), neurology consult (OR 13.75, 95% CI 9.93-19.18) or genetics consult (OR 6.75, 95% CI 4.31-10.64). While global developmental delay was also associated ($p=0.01$) with CMA order (OR 1.46, 95% CI 1.09-1.97), 655 of the 899 children with global developmental delay did not have a CMA order. Of the 234 CMA orders with available results, a pathogenic or likely pathogenic copy number variant was reported in 10 (4.3%) including 3 medically actionable findings (47, XXY, 17q11.2 deletion syndrome, 17p11.2 deletion syndrome). There was substantial variability in the use of other diagnostic studies including biochemical testing, other genetic testing, brain imaging and EEG.

Conclusions: The amount and type of clinical services a child received was associated with the likelihood of CMA order. These findings provide direction for care improvement targets. Specifically, implementation strategies aimed to improve access to genetic counseling and testing should include and explicitly target children not being evaluated in neurology or clinical genetics. As many genomic etiologies of ASD would not be detected by CMA, utilization of more comprehensive testing such as whole genome sequencing (WGS) would likely improve diagnostic yield, optimize potential for medically actionable results, and reduce variability of further testing practices.

409.010 *(Poster)* The Family History Interview of Neurodevelopmental and Neuropsychiatric Conditions: Comparing First and Second Degree Family Members of Autistic and Typically Developing Individuals

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Background: Clinical and genetic evidence suggests that Autism Spectrum Conditions (ASC) frequently co-occur with other neurodevelopmental and neuropsychiatric conditions (NDC/ NPC), both in individuals [1] and families [2, 3]. However, previous studies examining family history in autism either focused solely on autism symptoms, assessed NDC/ NPCs in first-degree relatives only, and/ or only included individuals with established clinical diagnoses. The latter may have resulted in underestimating clinical features in older generations (due to lack of access to diagnosis) or individuals with sub-clinical traits. Moreover, the relationship between familial neurodevelopmental/neuropsychiatric liability and clinical symptom profiles in autistic individuals remains relatively unexplored.

Objectives: We developed a new semi-structured Family History Interview to assess a range of NDC/ NPCs in first and second-degree relatives in the EU-AIMS Longitudinal European Autism Project. We compared 1) frequency of overall NDC/ NPCs, as well as individual disorders between family members of autistic vs TD/ ID probands, and 2) examined the relationship between the proband's and familial severity of NDC/NPC features.

Methods: The FHI was conducted with 349 informants (mother, father, both biological parents, or adult proband) reporting on family members of 219 probands with ASD, and 120 controls (113 with typical development, and 17 with Intellectual Disability without ASD.) Before the interview, informants were sent a short description of nineteen NDC/ NPCs, and were encouraged to discuss them with family members. To begin the interview, a family tree was created to obtain demographic information on family members. For each family member, four entry questions were asked about formal diagnosis, special support at school, referrals to psychiatrist/ psychologist, and treatments. Then, for each condition, 'screening' and, where applicable, 'symptom' questions were asked. Responses were scored as no/ unlikely, possible/ suspected, or probable/ definite. 'Don't know' responses were coded as 'no'. Informants gave confidence ratings about their knowledge of each family member (which was very high in the majority of 1st degree relatives, and moderate-to-very high in 2nd degree relatives).

Results: All first-degree relatives of the ASC group had a significantly higher number of autism and total NDC features than first-degree relatives of the TD/ ID group, and this remained significant once ASD itself was excluded (all $p< 1x\ 10^{-8)}$. First degree-relatives of the ASC group also had significantly more NPC features than those of the TD group, with the highest symptom load in mothers. Brothers had on average the overall highest number of NDC/ NPD features ($p= 2x\ 10^{-16}$). Both maternal grandparents of the ASC group had more NDC (and maternal grandmothers more NPC features) than TD grandparents (p<.001).

Further, in both ASD and control groups, probands' overall number of NDC/ NPC features was significantly related to the total familial NDC/ NPC feature load (ASD: r=.47, p<.001; TD r=.41 <.001) but in the ASD group, this association was higher in females (r=.62, p<.0001) than in males (r=.4, p<.001).

Conclusions: Findings indicate that NDC and NPC features were consistently more elevated in relatives of autistic than non-autistic probands, and familial liability was associated with probands' clinical symptom profile.

409.011 *(Poster)* The Paris Study: A Resource to Identify Subgroups of Individuals with Autism By Integrating Clinical, Brain Imaging and Genetics Data

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Background: Autism is characterized by deficits in social communication and restricted pattern of interest and stereotypies. But beyond this unifying classification, lies a very heterogeneous group of individuals with different clinical symptoms. This heterogeneity hampers the development of targeted clinical trials on homogeneous subgroups of patients sharing similar causes of autism.

Objectives: Our multidisciplinary team made of clinicians, psychologists, neuroscientists and geneticists has collected and analyzed a large dataset of clinical, brain and genetics data on a large group of patients with autism collected through the PARIS cohort. This resource can be used to identify new genetic pathways and mechanisms for autism, but also to develop new clinical classifications.

Methods: The PARIS study consists of a deep-phenotyped cohort of 4,503 individuals including 1,102 probands with autism, 2,745 relatives and 656 controls. For all the patients and most of the first-degree relatives, we have clinical data and DNA. We have SNP data for 2,815 participants (1,085 patients, 1,089 relatives and 641 controls), whole exome/genome sequencing (WES/WGS) data for 1,938 participants (481 patients, 1,018 relatives and 439 controls) and methylation data for 316 participants (72 patients, 148 relatives and 96 controls). At the brain level, we have collected Magnetic Resonance Imaging (MRI) and Electroencephalographic (EEG) data on more than 800 individuals. MRI data are acquired at 1-3T, and include structural T1W data, functional MRI data, and diffusion weighted MRI. Our EEG protocol includes resting states (eyes opened, eyes closed), classical tasks for induced (e.g. action execution and observation) and evoked (e.g. MisMatch Negativity) activity, but also a new paradigm of real-time social interaction with a virtual partner.

Results: Using the resource, we characterized the genotype-phenotype relationship of autism-associated genes such as *SHANK1*, *SHANK2*, *SHANK3*, *CNTN5*, *CNTN6* and others that will be presented. We also studied multiplex families with at least two members with autism and showed that patients can share risk factors, but also carry different risk variants suggesting a multiple hits inheritance in some families. Finally, the contribution of the common variants in the susceptibility is estimated by computing the polygenic scores of the patients, their relatives and controls.

Conclusions: There is a need for research on complex conditions such as autism to have access to large dataset with deep clinical, brain and genetic profiles. The effort of the PARIS study is also aligned with other initiatives such as the European EU-AIMS/AIMS2-trials project, the Simons Simplex Collection, the SPARK and the MSSNG projects. These collaborative initiatives must be extended to additional projects focused on epilepsy and intellectual disability in order to identify the shared and specific factors associated with these complex conditions.

409.012 *(Poster)* Whole Exome Sequencing Identifies Novel De Novo Variants Related with NF-Kb Signaling Pathway in Autism Spectrum Disorders

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Background: Autism spectrum disorder (ASD) is highly genetically heritable condition and it is considered to be caused by a combination of environmental and genetic factors such as *de novo* and inherited variants as well as rare or common variants in hundreds of related genes. Previous genome-wide association studies have identified some susceptibility genes, but many genes associated to ASD is still undiscovered.

Objectives: The objectives of this study is to examine rare *de novo* variants to identify risk genetic factors of ASD using whole exome sequencing (WES), functional characterization and genetic network analyses of identified variants in Korean family data .

Methods: Subjects with ASD, their biological parents and unaffected siblings were recruited. The clinical best estimate diagnosis of ASD was made for probands and siblings by board-certified child psychiatrists according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) by using comprehensive diagnostic instruments including Korean versions of Autism Diagnostic Interview-Revised and Autism Diagnostic Observation Schedule. For variants discovery and filtering, GATK best practice was used for bioinformatics analysis and was mapped and annotated to GRCh37 (hg19) reference genome assembly using dbSNP 137/138 build databases. For *in silico* prediction, we used dbSNP, 1000 genomes, ESP6500, ExAc, GME, HRCR, and Kaviar. The genetic network of the identified *de novo* variants were constructed by closely interacting gene neighbors using “Variant effect” core analysis in Ingenuity Pathway Analysis software (IPA, Qiagen).

Results: A total 151 individuals from 51 families were participated in this study (probands' mean age 70.16 [SD 27.35] months, 4 females, IQ mean 56.74 [SD 22.35). We identified *de novo* variants in 36 *de novo* variants (28 missense, 1 nonsense, 2 silent, 1 5’UTR, 1 exonic, 1 intronic, and 2 deletion) as potential significant contributors of ASD. In genetic network analyses, we identified 6 networks having functional relationship. Among the interactions between the *de novo* variants in this study, NF-κB signaling-related genes, which have strong relation to neurological functions, were commonly observed at 2 networks (ANKRD27, TMEM8A and TTC21A genes and ADCY7, ATXN1, IWS1, KCTD9, MT-ND2, NFKB1 and PPP1R16B genes) in IPA assay.

Conclusions: We identified novel variants that might underlie the genetic cause of ASD using WES and genetic network analyses on Korean families with ASD. The functional characterization of novel variants provides insight that might contribute to complex neurodevelopmental disorders, particularly related to functional genetic network including NF-κB signaling pathway.

Clinical Trial Design

POSTER SESSION — **CLINICAL TRIAL DESIGN**
410 - Clinical trial design Posters

410.001 *(Poster)* Multicentre, Randomized Controlled Trial of the Frankfurt Early Intervention Program for Toddlers and Preschool Children with Autism Spectrum Disorder – a-Ffip

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Background: Naturalistic developmental behavioral interventions (NDBI) have been shown to improve autism specific symptoms in toddlers and preschool aged children with ASD. Studies on early and longitudinal development in children with ASD point to many impaired core domains, which need to be targeted by complex, individualized NDBI approaches focusing on the child’s individual strengths and weaknesses. Cost-effective interventions which can easily be implemented in the local health care / social welfare system are necessary. A-FFIP is such a complex, low-intensity, manualized approach. It has shown medium effects in a small clinically controlled study on autism symptom improvement measured by the ADOS severity score after one year (Kitzerow, J., Teufel, K., Jensen, K., Wilker, C., & Freitag, C. M., 2019). Therefore, an adequately powered, randomized-controlled, multi-centre efficacy study is currently performed. Here, we present essentials of the study design of the multicentre, randomized-controlled A-FFIP trial.

Objectives: (1)To establish one-year efficacy of the low intensity, manualized early intervention program A-FFIP in toddlers and preschool children aged 2;0 to 5;6 years old with ASD compared to early intervention as usual (EIAU). It is hypothesized that A-FFIP will result in improved autism specific symptoms compared to EIAU; (2) To assess A-FFIP effects on the child’s cognition, language and behavior; on parent’s competences, anxiety, depression and stress, and family quality of life; (3) To study the child’s and parents’ characteristics as predictors and moderators of outcome; (4) To explore treatment mechanisms (mediators) related to parents’ and child’s competences.

Methods: The trial is designed as a confirmatory phase III, prospective, randomized, multi-centre, controlled, parallel-group study with two treatment groups (134 subjects, i.e. 67 subjects per treatment group) and six measurement time points. Study participants are recruited at four study centres in Germany. Experimental intervention is the manualized Frankfurt Early Intervention program for children with Autism Spectrum Disorder (A-FFIP; Teufel, K., Wilker, C., Valerian, J., & Freitag, C. M., 2017). Two hours of intervention/week with two therapists working with the child are provided. Control intervention is early intervention as usual (EIAU). For EIAU, individual or group therapy intensity of 1-10 hours/week as well as waiting time prior to intervention onset is allowed.

Results: The data collection is currently in process (descriptive data of the current sample will be presented at the conference). The primary endpoint is the absolute change in the total score of the Brief Observation of Social Communication Change (BOSCC-AT) between baseline and 12 months after the first intervention session. The secondary endpoints include measures on the child's and parent's characteristics and competences. See also figure 2.

Conclusions: If efficacy of A-FFIP is established, the current study will change clinical practice strongly towards implementation of evidence based methods in ASD early intervention in Germany. Additional positive effects by the trial will be: (1) Improvement of care including diagnosis as well as treatment in underserved areas in Germany; (2) Alerting many different professionals working in early intervention to effective methods; (3) Establishing an effective method and setting of training professionals to high treatment fidelity of evidence based early intervention.

410.002 *(Poster)* Preliminary Findings of the Pre-Pilot of the World Health Organization Caregivers Skills Training in Hong Kong

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Background: It was estimated that the incidence of autism spectrum disorders was 5.49 per 10,000 and the prevalence rate was 16.1 per 10,000 for children less than 15 years old in Hong Kong[1]. The figure is likely an underestimation because a rigorous epidemiological study on children and youth mental disorders is yet-to-be conducted in Hong Kong to detect the undiagnosed individuals[2]. The Jockey Club Autism Support Network (JC A-Connect) and The University of Hong Kong sought and collated the understandings and experiences of caregivers and experts. Consequently, the adaptation and localisation of the World Health Organization Caregivers Skills Training (WHO-CST) to the Hong Kong context took place in 2018.

Objectives: This study aimed to examine the perceived benefits, feasibility, and acceptability of the WHO-CST in Hong Kong adopting the implementation science approach[3].

Methods: A sequential mixed-methods design was used. Caregivers of children with ASD or developmental delays were invited to participate in the pre-pilot stage of the study. Their pre-post changes in mental health and confidence in caregiving were measured. They also joined the post-intervention focus group interviews. Repeated measure analyses and pattern coding analysis[4] were conducted.

Results: 19 female caregivers of 15 male and 4 female children completed the pre-post questionnaires (Table 1). The quantitative analyses showed a statistically significant positive trend in changes of mental health ($F(2, 22) = 3.92$, $p < .05$), but not confidence in caregiving ($F(2, 20) = .054$). Four patterns emerged from the qualitative data: 1) *Perceived benefits*. The participants stated that their parent-child relationship and emotional well-being improved and the caregivers' conflict within the families and challenging behaviours in children reduced; 2) *Useful elements*. Participants felt that four caregiving skills, i.e., 'offering choices', 'problem-solving and self-care', 'mood thermometer', and' engagement with children through play' were useful; 3) *Cultural barrier in implementation*. Some participants mentioned that although home-visitation was perceived as a hesitation for participation due to the cultural belief that "family shames must not be spread abroad" at the beginning, after being visited, they regarded home-visits as the uniqueness of the WHO-CST programme because it provides tailored-made support to them; and 4) *Major challenges and proposed solutions*. The participants mentioned that competing daily activities for both the employed and housewives was a major challenge for them although almost all of them appreciated very much of the programme. Another challenge was related to the influences of other caregivers in the families to fully implement the learned skills at homes. Fathers or grandparents of the children who did not understand nor appreciate the rationale of engaging and teaching children through play could negatively impact the efficacies of the strategies learned. Hence, some participants suggested that the arrangements for child-care and make-up classes may help to tackle the former challenge. Blended teaching and learning, i.e., including e-learning materials, can be used to educate caregivers in the families who cannot physically attend the WHO-CST.

Conclusions: The preliminary findings provide important implementation process evaluation data for our large pilot study of the locally adapted WHO-CST in Hong Kong.

410.003 *(Poster)* SPARK Research Match: A National Registry for Clinical Trial Recruitment

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Background:

The Simons Foundation Powering Autism Research for Knowledge (SPARK) is a collaborative, online study that enrolls individuals with a professional diagnosis of autism and their family members into an autism research cohort. All participants consent to be contacted about future autism research studies. To date over 200,000 participants, including over 85,000 with ASD, have enrolled. A core feature of SPARK, called research match (RM), facilitates study recruitment for researchers – a major challenge in clinical trials. RM services are available to researchers at no cost. In return, researchers agree to share their study data with SPARK to strengthen its core dataset.

Objectives: 1) Describe the research match process for clinical trials

2) Report recruitment metrics for research match-assisted studies

Methods: Access to the SPARK cohort is available to approved investigators. Applications are submitted online (https://base.sfari.org/) and reviewed by the SPARK participant access committee. Studies are approved to recruit for one year with the possibility of renewal. Eligible participants are identified based on study inclusion/exclusion criteria and geographic location. Participants are notified via email and actively indicate "interested" (or "not interested") in the study. Interested participants provide authorization for SPARK to share contact information with the study team. Investigators must agree to bi-directional data sharing and are required to track participant enrollment. Participant and researcher feedback are captured upon study completion.

Results: As of October 2019, SPARK approved 10 applications for interventional studies registered on ClinicalTrials.gov. For 8 recruiting studies (5 completed, 3 active), the number of potentially eligible SPARK participants ranged from 56 to 1,051 (median=214). Participants indicating initial interest in each study ranged from 17 to 104, with per study response rates between 8%-37%. Study enrollment ranged from 0 to 21 participants, with one study reaching 42% of their recruitment goal. Additionally, feedback data from researchers and participants will be shared.

Conclusions: SPARK research match is an effective platform for supporting clinical trial recruitment.

410.004 *(Poster)* Using Naturalistic Interactions in Clinical Trial Design for Minimally Verbal Autism: Lessons from a Motor Communication Skills Intervention

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Background: Assessment of candidate therapies for severe autism poses challenges including autism's heterogenous presentation, suitability and acceptability of outcome measures, and barriers to recruitment and retention. We are addressing these obstacles in a randomised controlled trial (ISRCTN 12808402) of Point OutWords (http://PointOutWords.online/), a caregiver-delivered, iPad-assisted intervention targeting motor and cognitive skills prerequisite to non-spoken communication in nonverbal and minimally verbal children with autism, a group largely excluded from research.

Objectives: Primary aims of this feasibility trial are to 1) establish recruitment/completion rates, 2) assess whether quantitative measures at baseline match clinicians' decisions on inclusion criteria, and 3) assay suitability of outcome measures.

Methods: Our parallel-groups randomised controlled design aims to recruit 46 children aged 3–15 years, diagnosed with autism and speaking fewer than 100 words functionally. Clinicians are asked to recruit children with motor impairment and greater receptive than expressive language. The intervention group uses Point OutWords half an hour 5 times a week over 8 weeks. Controls have equal caregiver/iPad contact time using other iPad apps. Communication, motor, and daily living skills are tested at baseline and post-intervention; assessments include the Mullen Scales of Early Learning (MSEL), Vineland Adaptive Behavior Scales (VABS-2), Verbal Motor Production Assessment for Children (VMPAC) British Picture Vocabulary Scale (BPVS), and measures of movement efficiency during interactions with the iPad itself. Parents keep diaries and take part in focus groups.

Results: Of 300 children with an autism diagnosis accessing the Peterborough Children's Neurodevelopmental Service, 55 (18%) were deemed by clinicians to meet inclusion criteria, 45 of whom were contactable, 22 of whom (49%) were recruited. 18/22 children completed the MSEL whereas only 13/22 completed the BPVS. 8/13 children fully tested thus far had significantly better VABS-2 Receptive than Expressive language, and these same children showed superior Gross to Fine motor skills ($r = 0.65$, $p < 0.016$, Figure 1). Age-equivalent MSEL scores showed an uneven profile, consistent at a group level with VABS-2, in which Fine Motor and Receptive Language exceeded Expressive Language age equivalents (Figure 2, $F(2, 24)=8.77$, $p =0.0013$, *post hoc* FM-EL p=0.0149, RL-EL p=0.0086). 11/13 children had severe deficits in VMPAC Global Motor Control, Focal Oromotor Control, and Sequencing. Consistent with these measures, baseline variance of speed and direction of finger movements across the iPad touchscreen was heightened in contrast to a typically developing reference sample.

Conclusions: This study has successfully recruited a somewhat more homogeneous, motor-impaired population in whom receptive outpaces expressive language. Initial findings demonstrate feasibility of recruiting and testing these severely affected autistic children using a combination of parent reports, observational assessments of parent and child play, play-based assessments (*e.g.,* MSEL), and motor interactions with the iPad itself, all of which glean information from naturalistic, ecologically valid interactions rather than real-time responses to instructions (*e.g.,* BPVS). Some parents expressed surprise at skills manifested, but also observed the high burden of so many tests. Insights from this trial will refine ecologically valid assessment procedures not only for the current motor skills intervention but also in autism clinical trials more broadly.

Clinical Trial Endpoints

ORAL SESSION — CLINICAL TRIAL ENDPOINTS
306 - Social and Non-Social Behaviours in Assessment and Treatment

306.001 *(Oral)* Performance of Clinical Scales Measuring Restricted and Repetitive Behaviors (RRBs) in a 12-Week Observational Study in Individuals with ASD

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Background: Restricted and repetitive behaviors (RRBs), including stereotyped or repetitive motor movements, insistence on sameness, and highly restricted interests, are one of the two core symptom domains in autism spectrum disorder (ASD). There is a high need for accurate and reliable assessments of RRBs for the use in clinical trials. Several clinical scales measure the frequency or severity of RRB symptoms including the Repetitive Behavior Scale–Revised (RBS-R), Repetitive Behavior Questionnaire (RBQ-2/2A) and Children/Adult Routine Inventories (CRI-R/ARI). However, there is no consensus in the field on which ones of these scales, if any, would be appropriate for the use in clinical trials, and they have not been compared head to head to date.

Objectives: To compare the psychometric properties, stability, and ability to separate individuals with and without ASD of different RRB scales over a 12-week period.

Methods: We conducted an observational multi-center study (ongoing). Individuals with ASD (n = 68, target: 90) stratified into three age groups (children: 5-12, adolescents: 13 – 17, adults: ≥18) and two levels of functioning (IQ ≥ 50 & < 70, IQ ≥ 70) completed a battery of assessments (including RRB scales RBS-R, RBQ-2/2A and CRI-R/ARI) at three clinic visits (baseline, week 2, week 12). The main inclusion criteria were a confirmed ADOS-2 diagnosis of ASD and a CYBOCS-ASD score of ≥12 assessed at the screening visit. We tested the stability of scales over the 12 weeks using ANOVA/ANCOVA. We compared RRB scores from the study sample (ASD) to historical scores from typically developing (TD) and individuals with ASD from different data sources (EU-AIMS, NDAR, SSC, Roche studies).

Results: Psychometric properties (internal consistency, test-retest reliability) and convergent/divergent validity were good across RRB scales. RRB severity in the study sample was higher compared to values for historical ASD samples likely reflecting the effectiveness of the enrolment criterion (CYBOCS-ASD score of ≥12). For instance, RBS-R score was 0.54 higher (standardized mean score) as compared to the score of reference data sets, and clearly separated from typical developing controls (1.43 standard deviations). Surprisingly, the caregiver- and self-reported forms of CRI-R/ARI and RBQ-2/RBQ-2A scales were not correlated raising important questions regarding the use of self-reported vs. caregiver-reported scales in clinical trials. The stability analyses revealed that over the whole study population mean scores were fairly stable over the 12-week observation period, but the variance of the score changes was larger over the entire 12-week period compared to the two weeks from baseline to week 2 (i.e. test-retest) suggesting that the score changes may reflect true changes in symptom severity.

Conclusions: Our results show comparable psychometrics across RRB scales and reveal their sensitivity to clinical factors. Scales are sensitive to enrolment criteria, differentiate between ASD and TD participants, and pick up spontaneous fluctuations in RRB symptoms over the course of a 3-month observational period.

306.002 *(Oral)* Increases in Parent Responsiveness Mediate the Relationship between Treatment Group and Improvements in Social Communication Symptoms.

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Background: Early interventions for children at elevated likelihood of developing Autism Spectrum Disorder (EL-ASD) are often delivered through parent-mediated models. An area of current exploration is whether changes in parent behaviors, e.g. parent responsiveness, are a mechanism through which to improve and track child behaviors in these interventions. In addition, research highlights the association between parent responsiveness and the development of toddler social-communicative skills (Watson et al., 2017; Yoder et al., 2015), highlighting that this relationship needs further exploration.

Objectives: This study examines the mediating effect of changes in parent verbal responsiveness (PVR) between treatment group and changes in social communication behaviors. We hypothesize that changes in PVR will significantly mediate the relationship between treatment group and changes in child social communication behaviors (SC) such that increases in PVR will be associated with larger improvements in child SC in the treatment group compared to the control group.

Methods: This study used extant data from toddlers at EL-ASD who participated in a randomized controlled trial of a parent-mediated early intervention (see Watson et al., 2017). Children were seen for assessments at age 14 months (Time 1; n=87; 60 males) and 22 months (Time 2; n=83). Children were randomly assigned to either a treatment group (Adapted Responsive Teaching; ART; n=45) or Referral to Early Intervention and Monitoring (REIM; n=42); referred to as Group in analyses. The Brief Observation of Social Communication Change (BOSCC; Grzadzinski et al., 2016), a treatment response measure that quantifies changes in ASD symptoms, was applied to parent-child free-play videos using standard coding procedures at Times 1 and 2 to examine changes in child SC behaviors. These videos were also coded using the Parent Verbal Responsiveness (PVR) coding scheme adapted from Yoder et al. (2015). Changes in BOSCC (BOSCC-SC) and PVR (PVR Change) from Time 1 to Time 2 were calculated. Mediation analyses were conducted, controlling for PVR at Time 1 and BOSCC SC at Time 1, using Process v3.1 (http://www.afhayes.com) in SPSS.

Results: To date, videos for 74 dyads have been coded using the BOSCC. Analyses revealed that the relationship between Group and changes in BOSCC-SC was significantly mediated by PVR Change, such that improvements in PVR (increases) were associated with improvements in BOSCC-SC (decreases) for the ART group but not the REIM group. See Figure 1. Coding on all available dyads will be completed and the analyses will be re-run prior to the conference.

Conclusions: These results provide evidence that parent responsiveness may be a mechanism through which to improve and monitor child behaviors during early intervention. Understanding whether there is an association between changes observed in the child and changes observed in the parent has implications for the identification of treatment mechanisms and may lead to novel intervention programs for young children at risk for ASD.

306.003 *(Oral)* Toward a Fully Automated Computer Vision Approach for Measuring Facial Affect in ASD

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Background: Atypical emotional expressiveness has long been associated with ASD, but there is increasing evidence that facial expression differences in ASD are nuanced and context-dependent. For example, people with ASD may express emotions more frequently and intensely in solitary (versus social) contexts. Automated facial analysis using computer vision has vast potential for elucidating individual and situational variability in facial affect by providing efficient, fine-grained, and objective measurement of naturally-occurring expressions.

Objectives: 1) Evaluate whether individuals with ASD produce context-appropriate positive affect, and 2) validate a fully automated computer vision approach for measuring facial affect in ASD and neurotypical samples.

Methods: 40 youth and young adults with ASD (mean age=13.2, 13 female) and 41 typically developing controls (TDC; mean age=12.2, 17 female) were recorded during a computerized battery designed to elicit language and facial expressions. ASD and TDC groups were matched on age, sex, and general intelligence (ASD/TDC FSIQ=104/107). The battery included two humorous videos lasting 23 and 28 seconds, respectively, to elicit spontaneous positive affect. Camera footage of participants' faces during each video was extracted and analyzed using the open-source program OpenFace and an in-house facial analysis software suite. Each segment was also manually coded for the presence or absence of smiling. Key dependent variables included frequency of smiling in each group (manually coded), and intensity of facial activity corresponding to smiling (measured through automated computer digitization of Action Units 6 and 12 of the Facial Action Coding System, based on machine learning algorithms). Summary statistics of smiling intensity included frame-by-frame averages of Action Units 6 and 12, and area under the curve (AOC) as a function of time.

Results: The majority of participants smiled at the videos, with no overall differences in smiling rates between ASD and TDC groups (74% of the ASD sample smiled, 77% TDC sample, χ^2=.18, p=.67). Across diagnostic groups, participants who were coded as having smiled showed significantly higher AOC values than those who did not (Mann-Whitney U=1479, p<.001) – a validation of our computer vision technique. See the Figure for time series plots of smiling magnitude in participants who smiled versus those who did not, separately by diagnostic group and video. No diagnostic group differences in AOC values (i.e., smiling intensity) were identified for either video, though one video approached trend level (U=361, p=.48 and U=389, p=.10 [ASD>TDC]; see Figure).

Conclusions: Participants with ASD and neurotypical peers demonstrated similar frequency and intensity of smiling in response to humorous videos. These results join other literature suggesting that emotional expression may be less atypical in ASD when the measurement context carries low social demands. This study expands on prior research by providing validation for an automated facial analysis system, capable of measuring spontaneous facial affect with higher spatial and temporal granularity than human annotation. Accordingly, further analyses using graph theory to study the *quality* of expressions are underway in this dataset, and will incorporate more detailed information about how affect unfolds across multiple components of the face (i.e., additional action units) and over time.

306.004 *(Oral)* What Lies Beyond the Autism Diagnosis? a Transdiagnostic Approach to Modeling Distinct Autism Symptom Dimensions in Relation to Comorbid Psychopathology

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Background: Autism spectrum disorder (ASD) is a heterogeneous disorder comprised of a range of social difficulties and restricted, repetitive behaviors (RRBs). Despite the diverse symptom content defining ASD, overall diagnostic classifications and composite total scores are most often used for evaluating how ASD relates to other types of psychopathology. Much less is known regarding how *distinct* ASD symptom dimensions relate to internalizing and externalizing behavioral problems, leaving a significant gap in our understanding of which aspects of ASD most strongly relate to comorbidity that impedes our ability to support the mental health of autistic individuals. Moreover, little research has considered whether patterns of comorbidity are similar in ASD relative to other disorders. Comparative cross-disorder research is necessary to advance comorbidity research by examining whether the same comorbidity patterns are observed in ASD and other related disorder contexts, such as Attention Deficit/Hyperactivity Disorder (ADHD).

Objectives: The first objective was to examine the structure of autism symptoms in a large, province-wide dataset (N = 1,359) of youth with ASD or ADHD, and to evaluate whether the emergent structure was similar across groups. The second objective was to examine relations among emergent autism symptom dimensions with a broad range of internalizing (e.g., depression, anxiety) and externalizing (e.g., attention problems, oppositionality) psychopathology factors. We were particularly interested in the extent to which autism symptom dimensions explained additional variance in comorbid psychopathology beyond diagnostic group status (ASD versus ADHD).

Methods: Participants included 1,359 youth ages 6-18 (ASD group n=758, 20% female; ADHD group n=601, 30% female) who participated in the Province of Ontario Neurodevelopmental Disorders (POND) Network. Caregivers reported on autism symptoms using the Social Communication Questionnaire (SCQ) and broader types of psychopathology using the Child Behavior Checklist (CBCL), including affective, anxiety, somatic, ADHD, ODD, and conduct problems.

Results: To model symptom dimensions, item-level factor analyses of the SCQ were conducted across groups. Results demonstrated that a three-factor solution comprising Social Problems, Repetitive Verbal and Motor Behavior, and Gesture domains provided the best fit to the data and was highly congruent across ASD and ADHD. Second, correlation analyses between primary study variables demonstrated differential patterns of associations between autism dimensions and psychopathology (see Table 1). Third, regression analyses were used to examine how these emergent symptom dimensions related to psychopathology (see Table 2). Across both disorders, Repetitive Behavior was transdiagnostically associated with all CBCL scales, whereas Socialization was uniquely associated with Affective Problems. Moreover, autism dimensions explained significantly (between two and eight times) more variance in psychopathology outcomes than diagnosis.

Conclusions: Overall, results demonstrate that autism symptoms can be broken down into discrete dimensions broadly tapping the social and RRB domains that differentially relate to comorbid psychopathology. These autism symptom dimensions showed robust incremental predictive power beyond diagnostic group status in predicting comorbidity, such that RRBs were transdiagnostically associated with all psychopathology outcomes. Implications for transdiagnostic ASD research and clinical work will be discussed.

POSTER SESSION — CLINICAL TRIAL ENDPOINTS
411 - Clinical trial endpoints Posters

411.001 *(Poster)* Orbiting - an Observational Study to Evaluate and Explore Scales for Restricted and Repetitive Behaviors and Digital Biomarkers in Children, Adolescents and Adults with Autism Spectrum Disorder (ASD)

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Background: Restricted and repetitive behaviors (RRBs) are core features of ASD according to DSM-5. RRBs constitute a broad range of behaviors, including simple motor stereotypies as well as more complex ritualized and rigid behaviors, compulsions, and restricted interests that vary in frequency, intensity, and duration. A number of clinical scales to measure RRBs exist, however, they have not been designed to measure change and their utility for use in clinical trials remains largely unknown (Scahill et al 2015). Furthermore, some scales are available only for pediatrics and others only for adults. Generally, availability of caregiver-reported scales is very limited for adults. There is a need for a systematic investigation using longitudinal data to compare different RRB scales across age and IQ in ASD.

Objectives: oRBiting (ClinicalTrials.gov Identifier: NCT03611075) is a non-drug observational study that seeks to characterize different scales to measure RRBs across age and IQ in ASD longitudinally and in addition to explore the use of digital biomarkers to complement traditional clinical assessment and scales. The results from this study will inform the planning and setup of future drug interventional studies in programs aimed at treating RRBs in ASD.

Methods: At screening consenting participants were assessed for the following key eligibility criteria: ASD diagnosis (DSM-5 criteria) confirmed by ADOS-2, ABIQ (SB5) ≥ 50, CGI-S ≥ 4, CYBOCS-ASD total score ≥ 12, 5 to 45 years, males and females. The study (ongoing) aims to enroll 90 participants with ASD and 45 typical developing controls (TD) grouped into nine cohorts with ~15 participants each based on age (children 5-12 years; adolescents 13-17 years, and adults 18-45 years), diagnosis (ASD, TD) and ABIQ for participants with ASD (SB5 ≥ 70 versus participants with 50 ≤ SB5 < 70). Eligible participants visit the clinic at baseline, week 2 and week 12 and complete a battery of clinical outcome assessments testing RRB symptoms: Children's Yale-Brown Obsessive Compulsive Scale for ASD (CYBOCS-ASD), Montefiori Einstein Rigidity Scale Revised (MERS-R), Repetitive Behavior Scale Revised (RBS-R), Repetitive Behavior Questionaire-2 (RBQ-2 and RBQ-2A, Routine inventories (CRI-R and ARI). Additional clinical scales include: Global Clinical Impressions, Vineland^{TM}-II (survey), Executive functioning (BRIEF/A), Short Sensory Profile (SSP), Sleep questionnaires (CSQI/PTQI), Anxiety questionnaires (PRAS-ASD/HAM-A/BAI), Quality of Life (PedsQL) and Reading the Mind in the Eyes Test (RMET). For adult and adolescent participants we collect both the self-reported and caregiver-reported scale versions if available (e.g. RBQ-2A and RBQ-2, ARI and CRI-R) to enable direct comparison of the respective scales versions in same individuals. Furthermore, digital biomarker data are collected from all participants in their homes using wearable devices.

Results: In early November 2019 enrollment into this study was ongoing (N=119/135 enrolled) and is planned to be completed end of December 2019.

Conclusions: This poster details the trial design and conduct. Initial study results are presented on companion posters.

411.002 *(Poster)* Preliminary Validation of the Behavioral Inflexibility Scale-Clinical Interview

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Background: Current outcome measures are not adept at detecting the incremental changes seen in individuals with autism spectrum and related disorders, have not been consistently validated with these populations, and often fail to measure functional or clinically-relevant outcomes. In addition, many of the existing outcome measures solely rely on parent or caregiver report, making them more prone to placebo effects and more difficult to include as blinded outcome measures in clinical trials. Repetitive and inflexible behaviors are among the most common forms of aberrant behavior that occur in the context of neurodevelopmental disorders; however, existing repetitive behavior measures also heavily rely on parent report. It then becomes essential to develop tools that use other measurement formats to move the field towards more objective assessment of the functional impact of these behaviors. Our team developed a clinical interview version of the Behavioral Inflexibility Scale (BIS-CI) to meet this objective.

Objectives: The primary objective is to examine the reliability and validity of the BIS-CI.

Methods: The BIS-CI is a structed clinical interview version of the parent reported BIS. The BIS-CI consists of two sections (a) a 25 item symptom checklist (scored as present / absent), and (2) a set of seven questions designed to provide a multidimensional assessment of the functional impact of the items endorsed on the symptom checklist portion. The interview questions are scored using a 5-point Likert severity rating scale based on the caregiver's response to the question. The BIS-CI derives a total score ranging from 0 (no impairment) to a maximum score of 28 (maximum impairment). To understand the psychometric properties of the BIS-CI, n=144 children with ASD, ages 3 – 17 years, and their families completed a number of clinic-based measures to assess validity and reliability. Trained clinicians conducted interviews with parents as part of the clinic-based assessment battery.

Results: Child demographic data: 80% of children were male, 71% were white, the mean age was 9 years old (SD= 7.0), and a substantial majority had at least one co-occurring condition. Validity data: Factor analysis suggested a 1 factor solution with factor loadings ranging from 0.50 to 0.74 and acceptable fit indices (RMSEA = 0.09, CLI = 0.961, TLI = 0.927). The BIS-CI was correlated with the parent BIS at 0.65. Correlations with the Repetitive Behavior Scales-Revised (RBS-R), as a form of convergent validity, ranged from 0.38 – 0.58. The correlation with the Social Communication Questionnaire (SCQ), as a form of discriminant validity, was 0.26. Additional measures further demonstrating convergent and discriminant validity will be presented. The BIS-CI was not significantly related to child IQ ($p > .90$). Reliability data: Test-retest reliability was 0.87 and Cronbach's alpha was 0.80.

Conclusions: The BIS-CI is a potentially valid and reliable measure that can be used to assess the functional impact of the repetitive and inflexible behaviors of children with ASD. The brevity of the measure also suggests it could be feasible to include in clinical trials. Future work will be needed to examine the measure's sensitivity to change over time.

411.003 *(Poster)* Symptom Improvement in Children with Autism Spectrum Disorder Following Bumetanide Administration Is Associated with Decreased GABA/Glutamate Ratios

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Background: Bumetanide has been reported to alter synaptic excitation–inhibition (E-I) balance by potentiating the action of γ-aminobutyric acid (GABA), thereby attenuating the severity of autism spectrum disorder (ASD) in animal models. However, clinical evidence of its efficacy in young patients with ASD is limited.

Objectives: The objective of this study was to evaluate the efficacy and safety of bumetanide treatment and examine the effect on neurotransmitter levels in the brain and the association between the latter and changes in ASD symptoms.

Methods: This was investigated in the present clinical trial of 83 patients, randomised to the bumetanide group (bumetanide treatment, 0.5mg twice daily) or the control group (no bumetanide treatment). Primary [Children Autism Rating Scale (CARS)], secondary [Clinical Global Impressions (CGI)], and exploratory [inhibitory (γ-aminobutyric acid, GABA) and excitatory (glutamate, Glx) neurotransmitter concentrations measured in the insular cortex (IC) and visual cortex (VC) by magnetic resonance spectroscopy (MRS)] outcome measures were evaluated at baseline and at the 3-month follow-up. Side effects were monitored throughout the treatment course.

Results: Compared with the control group, the bumetanide group showed significant reduction in symptom severity, as indicated by both total CARS score and number of items assigned a score ≥3. The improvement in clinical symptoms was confirmed by CGI. GABA/glutamate ratio in both the IC and VC decreased more rapidly over the 3-month period in the bumetanide group than that in the control group. This decrease in the IC was associated with the symptom improvement in the bumetanide group.

Conclusions: Our study confirmed the clinical efficacy of bumetanide on alleviating the core symptoms of ASD in young children and it is the first demonstration that the improvement is associated with reduction in GABA/glutamate ratios. This study suggests that the GABA/glutamate ratio measured by MRS may provide a neuroimaging biomarker for assessing treatment efficacy for bumetanide.

411.004 *(Poster)* The Effectiveness of the Dutch Version of PEERS® for Adolescents with Autism Spectrum Disorder; Results from a Randomised Controlled Trail with Active Control Condition

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Background: Limited social skills are a major challenge for adolescents with Autism Spectrum Disorder (ASD), as social skills become crucial for peer acceptance. Adolescents with ASD often have few friends, and experience increased peer rejection, resulting in greater functional impairment and poorer quality of life. Consequently, they are frequently referred to social skills training. Yet, evidence-based social skills interventions for adolescents with ASD are available in few cultures. The Program for the Education and Enrichment of Relational Skills (PEERS®) has shown to be effective for autistic adolescents in randomized control trials (RTCs) in several cultures. However, validation of PEERS® in other cultural settings is needed, given the sensitivity to cultural conventions of the particular content of social skills trainings.

Objectives: The current preliminary study examines the effectiveness of the Dutch version of PEERS®, utilizing an RCT with an active control condition, and observational, self-, parent- and teacher reported measures of social competence at pre- (T1), intermediate (T2), post (T3) intervention and follow-up (T4). Secondly, we examine client satisfaction.

Methods: Adolescents were randomly assigned to one of two conditions: the experimental condition (PEERS®) or an active control condition; ROAD (Regulation, Organization and Autonomy Didactics; psycho-education on adolescent socio-emotional developmental issues). The Dutch version of PEERS® consists of 14 weekly, 90 minute adolescent sessions and parallel parent sessions. ROAD also consists of 14 weekly, 90 minute adolescent sessions, with parent-involvement through e-mail. In the current study, social skills were assessed using parent-reports on the Social Responsiveness Scale-2 (SRS-2). Other relevant measures, such as behavioral observation utilizing the Contextual Assessment of Social Skills (CASS), were also obtained, but are not yet presented. Clients satisfaction was rated by providing grades from 1 (low satisfaction) - 10 (high satisfaction).

Results: We included 106 adolescents with ASD (73 males; n=54 PEERS, n=52 ROAD), ranging from 12-18 years old (M=14.57), with a mean total IQ of 102.66 (SD=17.18).

Preliminary analyses (T1: n=105, T3: n=82) show that at T1, mean total SRS-2 scores in the PEERS (88.90, SD 27.01) versus ROAD (86.20, SD 22.01) condition do not differ significantly $F(1,103) = .311$, $p = .578$. At T3, scores also do not differ between PEERS (69.09, SD 27.15) and ROAD (72.76, SD 26.18), $F(1,80) = .386$, $p = .536$.

Both conditions show significant improvement regarding SRS-2 mean scores from pre- to post assessment (PEERS $t(54)=-3.713$, $p < .01$, ROAD $t(53)=-4.035$, $p < .01$).

The difference amongst conditions regarding Δ SRS-2 scores from pre- to post assessment (PEERS: 19.81 vs. ROAD: 13.44) reached marginal significance $F(1,80) = .392$, $p = .051$, indicating a trend towards a superior effect in the PEERS condition. As for clients satisfaction (total n=81); in the PEERS condition, adolescents average satisfaction grade was 7.5, parents 8.2. In the ROAD condition, adolescents average satisfaction grade was 7.3, parents 7.5.

Conclusions: These preliminary findings suggest that the Dutch version of PEERS® treatment is effective in improving the social skills of autistic adolescents. Moreover, clients satisfaction is high. Results on other outcome measures will be presented at the conference.

411.005 *(Poster)* The Relationship between Core Symptoms and Associated Symptoms in ASD

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Background: Autism spectrum disorder (ASD) is characterized by the two core symptom domains of social communication deficits and restricted and repetitive behaviors. In addition, there are a number of associated symptoms including anxiety, executive control dysfuntioning, sensory hyper-/hyposensitivity, sleep impairment, and intellectual disability. The correlation between the two core symptom domains and specific associated symptoms is poorly understood.

Objectives: To investigate systematically the relationship between the two core (RRB, SCD) and associated symptoms (anxiety, executive control dysfunction, hyper/hyposensitivity, sleep) within a single cohort of individuals with ASD.

Methods: We conducted an observational multi-center study (ongoing). Individuals with ASD (n = 68, target: 90) stratified into three age groups (children: 5-12, adolescents: ≥12 – 18, adults: ≥18) and two levels of functioning (IQ >50 & ≤70; IQ > 70) completed a battery of assessments measuring (1) RRBs: Repetitive Behavior Scale–Revised (RBS-R), Repetitive Behavior Questionnaire (RBQ-2/2A), and Children/Adult Routine Inventories (CRI-R/ARI); (2) SCD: The Vineland Adaptive Behavior Scale (VABS-II); and (3) associated symptoms: anxiety: Parent-Rated Anxiety Scale (PRAS-ASD) in children and adolescent, Hamilton Anxiety Rating Scale (Ham-A) in adults; Cognitive abilities and executive control: Behavior Rating Inventory of Executive Functions (BRIEF/BRIEF-A), sensory abnormalities: Short Sensory Profile (SSP), IQ: Stanford-Binet Intelligence Scale-Fifth Edition (SB5). The main inclusion criteria were a confirmed diagnosis of ASD (ADOS-2) and a CYBOCS-ASD score of ≥12 assessed at the screening visit.

Results: In pediatrics (5-18 years), we found medium to high correlations between RRBs and anxiety (r = 0.58 to 0.75), and RRBs and executive control (working memory: r = 0.36 to 0.43, inhibition: r = 0.54 to 0.57, attentional shift: r = 0.57 to 0.70). Correlations of the same associated symptoms with SCDs were not significant. However, we found low to medium correlations between IQ and SCDs (communication and socialization domains: r = 0.39 to 0.41). Generally, in adults, correlations with associated symptoms were much weaker and only executive control was significantly correlated with RRB and SCD symptoms.

Conclusions: Our results suggest that associated symptoms have differentiated associations with the two core symptom domains of RRB and SCD, and that the strength of the associations generally decline with age. E.g., anxiety and executive function deficits seem to be linked to RRBs, while overall IQ is linked to SCDs. While more work is needed to understand the nature of the relation between core and associated symptoms this work sheds some light on the relational structure.

411.006 *(Poster)* Understanding Meaningful Changes in Autism Spectrum Disorder Clinical Trial Outcomes Using an Exit Interview Methodology

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Background: Recent FDA guidelines highlight the importance of patient-focused drug development. Reliable and valid measures of social communication challenges that reflect meaningful changes in a real-world setting are thus critical for assessing the efficacy of new behavioral and pharmaceutical interventions in autism spectrum disorder (ASD). The Vineland™-II Adaptive Behavior Scales – Second Edition (Vineland™-II) is one of six measures of social communication impairment recommended by an expert panel to assess measures for their utility in ASD clinical trials. Vineland™-II has been used in multiple clinical trials, including those evaluating balovaptan (VANILLA [NCT01793441], V1ADUCT [NCT03504917], and AV1ATION [NCT02901431]). It is therefore important to assess the impact of changes in Vineland™-II in a real world-setting.

Objectives: Exit interviews are being conducted as part of the AV1ATION and V1ADUCT trials to gain an understanding of the perception of meaningful change in elements of ASD captured by Vineland™-II (socialization, communication, and daily living skills) and health-related quality of life (HRQoL). Here, we describe the methodology of these exit interviews.

Methods: Exit interviews, each consisting of an in-depth, 60-minute, telephone-based conversation in the native language, are being conducted with study partners of trial subjects who have recently completed the Week 24 visit of the AV1ATION and V1ADUCT trials. Experienced interviewers ask open-ended questions to gain insights into the impact of ASD on the lives of individuals and their families followed by focused discussion on the meaning of any changes experienced over the course of the trial. Questions focus on the domains captured by Vineland-II™: socialization, communication, and daily living skills, with some discussion on changes in HRQoL. All interview data are audio-recorded, transcribed and analyzed using thematic analysis to understand meaning and real-world impact of any changes. Additionally, quantitative ratings of change from baseline, overall and per domain (based on 7-point scales), are provided by study partners during the interview. Experienced, independent clinician reviewers are also rating the changes, using the same rating scales, for a number of transcripts (n=20). Inter-rater reliability will be assessed for clinician reviewers if the sample size permits. These data, alongside blinded descriptive data from selected outcome variables in the clinical trials, will inform anchor-based analyses exploring the interpretation of meaningful change on Vineland-II™.

Results: This novel approach will provide improved understanding of meaningful change in individuals with ASD in a real-world setting, supported by quantitative estimates of meaningful change on the Vineland™-II scale. Studies are ongoing and initial data support this approach. The rich qualitative accounts of observed changes and their meaning provide impactful evidence to support the relevance of numerical changes observed on Vineland™-II.

Conclusions: Exit interviews conducted after clinical trials will provide a rich source of both qualitative and quantitative data that provide a detailed account of what constitutes a meaningful change in ASD outcomes. This methodology will also provide a valuable way to assess the clinical meaningfulness of additional outcome measures in future ASD trials.

Cognition: Attention, Learning, Memory

POSTER SESSION — COGNITION: ATTENTION, LEARNING, MEMORY
412 - Cognition: Attention, Learning, Memory Posters

412.001 *(Poster)* ASD, but Not ADHD, May Have Deficit in Visuospatial Working Memory

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Background: Both as neurodevelopmental disorders emerged from early childhood, Autism Spectrum Disorder (ASD) and Attention Deficit/Hyperactivity Disorder (ADHD) may have overlap but distinct neurocognitive basis, such as executive function (EF). Visuospatial working memory (VSWM), a core component of EF, was thought to be correlated with learning, behavior regulation, metacognition and the core symptoms of ASD and ADHD. However, it hasn't met agreement on whether ASD and ADHD children would have deficits on VSWM, especially on the different periods of encoding and retrieving.

Objectives: The study aimed to identify whether VSWM were impaired in children with ASD and those with ADHD, and further to explore the concrete characteristics of memory encoding and retrieving.

Methods: 21 boys with ASD, 16 boys with ADHD and 15 boys with typical development (TD) aged 6-12 years old were recruited in present study. The Chinese edition of Wechsler Intelligence Scale for Children (C-WISC), Child Autism Rating Scale (CARS), Social Response Scale (SRS) and Swanson, Nolan, Pelham-IV rating scales (SNAP-IV) were applied to assess participants' cognition ability and the core symptoms of ASD and ADHD respectively. Meanwhile, the paradigm of face encoding and retrieving were arranged to evaluate the specific aspect of VSWM. We conducted one-way analysis of (co)variance to compare the characteristic differences (age, IQ, VSWM) among the three groups, and additional post hoc Bonferroni procedures were used for multiple comparisons. Furthermore, Pearson correlation analysis was employed to explore the relationship between VSWM and core symptoms of ASD and ADHD.

Results: The three groups were matched on age and FIQ, while there existed differences on verbal comprehensive index (VCI) and process speed index (PSI). Children with ADHD showed severer inattention, hyperactivity and social dysfunction than TD, and participants with ASD manifested more social problems than ADHD and TD. The results of behavioral task implied the deficits of VSWM were obviously in ASD but not ADHD during both encoding and retrieving periods. After controlling for PSI, the results remained that ASD boys responded slower than TD in encoding task (RT_{-ASD}=1542±296ms, RT_{-ADHD}=1369±248ms, RT_{-TD}=1210±264ms, F=6.594, P=0.008), while made more errors in retrieving task (ACC_{-ASD}=0.60±0.16, ACC_{-ADHD}=0.79±0.14, ACC_{-TD}=0.80±0.17, F=10.024, P=0.001). What's more, the social deficits of ASD were correlated with performance on VSWM: the worse of social cognition they had, the more errors they made (r=-0.566, P=0.007).

Conclusions: Our findings suggest that children with ASD but not ADHD may possess deficits in VSWM, and they showed different abnormal formats during encoding and retrieving period. Meanwhile, it may be related with social difficulties. Our study has shed lights on the underlying behavioral mechanism to discriminate ASD and ADHD.

412.002 *(Poster)* An Examination of the Relationship between Fine Motor Ability and Executive Functions in Toddlers with and without ASD

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Background: Despite literature supporting a relationship between motor skills and executive functions (EF) as well as their impact on academic readiness and achievement in school-aged children, little research has investigated these abilities in young children with ASD compared to their neurotypical peers (Cameron et al., 2012, & Rigoli, Piek, Kane, & Oosterlaan, 2012). One recent study (St. John et al., 2016), noting a lack of clarity on the emergence of EF challenges in children with ASD under three years old, examined EF and motor skills in young children at high and low risk for ASD. Their work suggested that motor skill development might be a key factor in atypical EF development for high-risk children. A more nuanced understanding of these possible relations and how they differ between children with and without ASD will result in improved early detection of delays and more targeted intervention and support.

Objectives: To assess the degree to which fine motor ability (FM) is related to everyday executive functioning in young children with ASD and their typically developing peers (TD).

Methods: Toddlers with ASD (n = 13) and TD (n = 16) completed a battery of tasks as part of a larger study describing the trajectory of executive functioning abilities as related to diagnostic status. Toddlers completed the Mullen Scales of Early Learning (MSEL) to assess FM and the Behavior Rating Inventory of Executive Function (BRIEF) at 2 years of age. Fine Motor T-score, controlling for verbal ability (MSEL Verbal DQ), was entered as a predictor of BRIEF Shift, Executive Control, Working Memory, and composite scores. Differences by diagnostic group were explored. Data collection is ongoing.

Results: Toddlers with ASD had significantly lower fine motor ability, shifting, executive control, working memory, and overall BRIEF scores compared to TD toddlers. Across all toddlers, and controlling for their verbal ability, children with better FM were rated as having less difficulty with shifting between tasks (β= -.66, p=.01), working memory (β= -.45, p=.03), executive control (β=-.52, p=.04), and total executive functioning (β= -.48, p=.04). Preliminary analyses suggest that some relations may be different for TD vs. ASD children such that the relation between FM and shifting or working memory components of executive functioning might be stronger for TD children than for children with ASD.

Conclusions: This study indicates that FM and EF abilities are generally lower in children with ASD as compared to their TD peers. Furthermore, it supports the current literature suggesting that in general, FM is related to EF in children; possibly implying that interventions seeking to increase EF should emphasize FM development in tandem. However, preliminary results of this study suggest that the strength of the relationship between FM and EF might differ across diagnostic groups. These findings highlight the importance of examining and comparing developmental profiles of children with and without ASD in order to learn more about the emergence of skill deficits and relationships and to inform early and effective intervention. Data collection and analysis is ongoing.

412.003 *(Poster)* Attention Processes across Sensory Domains: Characterization from EEG and Eye Tracking

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Background: Attention is a cognitive process that plays a significant role in directing a person's purposeful and reflexive thoughts and actions. Attention in individuals with ASD is a particularly intriguing area of research with inconsistent findings (Travers, Klinger & Klinger, 2011). Given sensory sensitivities in ASD, it is important to understand attention processes across different domains (e.g., auditory, visual). Current research has implicated attention as an underlying process in modulating sensory sensitivities. For instance, individuals with ASD demonstrate early detection of sound frequency deviation, but habituate to novel sounds slowly (Hudac et al., 2018). Eye-tracking paradigms have indicated attention as a key player in social activity monitoring in ASD. For example, toddlers with ASD have shown decreased attention to the activities of others compared to typically developing peers (Shic et al., under review). However, the relationship of attention between each of these sensory domains has yet to be examined.

Objectives: We aimed to examine the relationship between auditory and visual attention by examining relationships across modes of measurement (EEG and ET) in a sample of typically developing participants and participants with ASD.

Methods: Preliminary data from children with ASD (n = 6) and typically developing children (n = 42) who completed an ongoing study were included in these analyses. An auditory odd-ball EEG task (Hudac et al., 2018) measured the N1 amplitude to infrequent and frequent tones and the P3a amplitude to frequent tones and novel sounds. An eye-tracking paradigm measured gaze patterns within areas of interest (AOIs: Background, Shared Activity, Head and Body) during a scene depicting two actors engaged in a shared social activity. Here, we focus on AOI percentages calculated for the head and shared activity across conditions in which the actors were looking at each other (i.e., mutual gaze) and looking at the shared activity (i.e., activity directed gaze). Pearson correlation analyses focused on examining relationships between ERP (N1/P3a) and the eye-tracking (%AOI) attention responses by condition.

Results: Results across all participants indicated that increased looking to the activity was associated with increased auditory attention responses, including P3a frequent amplitude (r = +0.374, p = 0.009), P3a novel amplitude (r = +0.361, p = 0.012), and N1 infrequent amplitude (r = -0.351, p = 0.014) in the mutual gaze condition. No significant correlations were found in the activity directed gaze condition. Children with ASD that had smaller auditory attention responses (N1/P3a to frequent) exhibited more visual attention to the head, but only in the activity directed gaze condition (See Table 1). However, TD participants with smaller auditory attention responses corresponded with more visual attention to the head and activity but only in the mutual gaze condition (See Table 1).

Conclusions: This preliminary analysis suggests that there are significant relationships between attention processes across these two domains.

412.004 *(Poster)* Atypical Perception in Autism: Characterizing Inference in Basic Perceptual Processing

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Background: Perceptual atypicalities are a widely acknowledged but poorly understood feature of autism.Prevailing models, formulized in Bayesian terms, suggest that reduced top-down influences underlie atypicalities in perception. Within this framework, changes in bottom-up factors, if they exist at all, are considered *quantitative*, mostly involving changes in noise levels. Consequently, testing has little consideration of potential underlying constraints of basic sensory-perceptual processing.

Objectives: We have recently demonstrated violation of Weber's law in autism, in the visual and tactic modalities, suggesting a modality-independent mechanism of abnormal stimulus encoding. Specifically, JNDs in individuals with ASD are not scaled with intensities, indicating deficits in the low-level calibration mechanism. Here, we examined whether this modulated mechanism of stimulus encoding is associated with the reduced effects of priors (e.g., anchoring, range effects). We hypothesized that the typical pattern of increased biases for noisier measurements may not be evident in autism, where scalar variability (Weber ratio) does not seem to hold.

Methods: A set of experiments was designed to examine the relationship between the precision of the sensory input and the utilization of perceptual priors. In Experiment 1, we extended our recent findings by demonstrating the violation of Weber's law in autism also in the auditory domain, while manipulating the effect of perceptual anchoring. We examined discrimination thresholds for empty tones intervals using three standards durations. JNDs were compared across the different durations and between two conditions: (1) blocked presentation in which strong anchoring is established for each standard (2) random presentation in which anchoring is weaker. Experiment 2 utilized the height-width illusion to manipulate perceptual bias (i.e., longer rectangles are perceived narrower than shorter ones), while blurring the vertical contours composing the rectangles by imposing a Gaussian filter varying in its standard deviations (i.e., precision of the measurement). Increased biases were expected in neurotypicals for noisier measurements.

Results: In Experiment 1, 17/17 of our TD showed the expected increase in JNDs with increasing durations, as well as the expected effect of anchoring, indicated by higher JNDs for the random presentation. Interestingly, 7/10 of our ASD did not show any scaling of JNDs with durations but a sub-group of 3/10 showed adherence to Weber's law. Perceptual anchoring was smaller in ASD and remained constant across intensities (presumably because Weber's law does not hold). Experiment 2 demonstrated substantial increase in the amount of the height-width illusion as a function of blurriness for TD, while for ASD, JNDs did not scaled with the increased blurriness to the same extent, and the bias magnitude remained fairly constant across the different noise levels.

Conclusions: The typical pattern of increased effects of biases for noisier measurements is *not* evident in autism, demonstrating modulations in the relative weights of perceptual biases and incoming sensory input. The results suggest that the qualitative changes (the violation of the constant Weber ratio) in the underlying constraints of basic sensory-perceptual processing may account, at least in part, for the often reported modulated perceptual inference in ASD.

412.005 *(Poster)* Auditory Attention Switching Difficulty in Young Adults with Autism Spectrum Disorder

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Background: Communication in everyday life depends crucially on the ability to dynamically switch attention between competing auditory streams. Many of us do so effortlessly, such as switching attention between different speakers at a party. Sensory processing difficulties, particularly in the auditory domain, are commonly reported by individuals with autism spectrum disorder (ASD). Past studies have shown various auditory processing deficits in ASD, including difficulty listening under noisy conditions and impaired cross-modal attention switching; however, few studies have looked specifically at auditory attention deployment in ASD.

Objectives: This study investigates individual differences in the ability to switch auditory attention in young adults with ASD and age- and sex-matched controls. We hypothesize that individuals with ASD will demonstrate difficulty switching auditory attention.

Methods: Twenty-two participants aged 21 to 22 years (ASD n=11; TD n=11) were recruited from a larger longitudinal study conducted at the University of Washington Autism Center. All participants passed an audiometric screen of <= 20 dB hearing level at octave frequencies between 250 and 8000 Hz for inclusion in the study. The study paradigm consisted of presenting participants with two simultaneous auditory streams, each consisting of two compound words. On Switch Attention trials, participants were instructed to attend to the first speaker for the first word, then switch attention to the second speaker for the second word. On Hold Attention trials, participants were instructed to attend to the first speaker for both the first and second words. In each trial, the speakers were either both male, both female, or a male/female pair. Speakers' sex was manipulated to make the task harder (male/male or female/female) or easier (male/female). Additionally, speakers were either co-located (both from the left or both from the right) or spatially separated (one from the left and one from the right). There were 8 blocks, each consisting of 24 trials, for a total of 192 trials per participant. The entire task lasted approximately 30 minutes and was performed while the participant was undergoing magnetoencephalography recording.

Results: A two-way mixed ANOVA was conducted to investigate the effect of group and condition on task performance. There was a significant main effect of group, $F(1,20) = 15.45$, $p = 0.001$, with the TD group performing better than the ASD group. One-way ANOVAs were conducted to investigate the effect of group on performance and showed a TD advantage across all conditions. The ASD group performed above chance on Maintain Attention trials, and on Switch Attention trials where speakers were a male/female pair and spatially separated. However, on Switch Attention trials where speakers were male/male or female/female or where their voices were co-located, the ASD group did not perform above chance.

Conclusions: These results suggest that young adults with ASD can switch attention from one auditory stream to the other when speakers' voices are a male/female pair and spatially separated, although less accurately than TD individuals. The ASD group showed greater difficulty switching attention from one stream to the other when speakers' voices were both male or both female or were co-located.

412.006 *(Poster)* Characterizing the Metrics and Timing of Saccadic Eye Movements in Children and Adolescents with ASD

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Background: Fast and accurate orienting movements, such as eye saccadic movements play an important role in obtaining information available in dynamic social environments. Individuals with autism spectrum disorder (ASD) have difficulty executing fast shifts of visual attention (Townsend, et al.,1996) and accurate saccades to targets (Miller, et al., 2014). ASD individuals frequently have trouble redirecting gaze behavior appropriately, which has been highlighted as one of the earliest signs of ASD (Zwaigenbaum, et al. 2005). Although others have studied saccadic movements in ASD individuals using a range of techniques and ages, here we quantify the metrics and timing of saccades using a high-accuracy video-based eye tracking system in a sample of children and adolescents.

Objectives: We measured gaze behavior during baseline, gap and overlap saccade paradigms to assess expected differences between individuals with ASD and typically developing (TD) individuals, particularly with respect to number of saccades, saccade accuracy, and saccade latency.

Methods: Thirty-six ASD and eighteen TD children and adolescents were calibrated and assessed using the Gap-Overlap paradigm on the EyeLink 1000 video-based eye tracking system. A central fixation target was surrounded by possible target locations arranged in two concentric circles located approximately 5° and 10° from the central fixation target for a total of 16 total peripheral target locations. The central fixation target either 1) extinguished as the target appeared (baseline condition) 2) extinguished 400 ms before the peripheral target appeared (gap condition), or 3) extinguished 400 ms after the peripheral target appeared (overlap condition). Each trial began with the participant focused on the central fixation target. And subjects were instructed to move their eyes to the peripheral target "as quickly as possible." Two trials of each condition were presented at each of the 16 peripheral target locations for a total of 96 trials. Data from each trial was manually inspected using a custom MATLAB script. All trials in which we observed blinks, unsteady fixation in the 200 ms prior to target onset, or indications of drowsiness were excluded from further analysis. This data cleaning step allowed us to gain better clarity over the saccade metrics and timing results which were quite variable in the ASD group.

Results: The most consistent finding was that individuals with ASD required more saccades to get on target in all three task conditions. There was a trend toward significant differences in accuracy of the first saccade in the baseline and overlap conditions. Standard deviation of latency (ie. variability in the time to launch a saccade) was itself very variable across ASD participants.

Conclusions: Our analysis suggests that a one should consider differences in basic orienting behaviors in attempting to understanding an individual's response in dynamic situations. The additional time needed to orient correctly can result in missed information and/or opportunities in dynamic scenarios.

412.007 *(Poster)* Child Temperament and Parental Responsivity during Play: A Window into Heterogeneity Among Children with ASD

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Background: Chetcuti, Uljarevic, and Hudry (2019; *JCPP*) named temperament as a critical construct for understanding individual differences among children with ASD. In particular, Chetcuti et al. suggested that the relationship between temperament and aspects of the environment relevant to developmental outcomes, such as parental behaviors, could illuminate mechanistic bases of ASD heterogeneity. Indeed, differences between children with ASD and typical development have been identified for both temperament–especially effortful control–and parental behaviors, including responsivity and directiveness (Konstantareas & Stewart, 2006; Ku, Stinson, & Macdonald, 2019). In typical development and other disabilities, individual differences in effortful control are related to parental responsivity and directiveness (Eisenberg et al., 2015; Song et al., 2018). The current study extends previous research to a heterogeneous sample of children with ASD using a context critical for development: parent-child play.

Objectives: In children with ASD, we investigate within-group individual differences in parent-rated temperament, with a focus on effortful-control (attention-focusing, inhibitory-control), in relation to parental behavior (responsivity and directiveness) during play.

Methods: Participants with ASD (*n*=22, 6 female) were ages 3-11 years (*M*=7.4 years; *SD*=2.5 years). See Table 1. Based on child's age, child temperament was assessed by parental report using the Children's Behavior Questionnaire (CBQ, 3-7 years; Rothbart et al. 2001), Temperament in Middle Childhood Questionnaire (7-10 years), or Early Adolescent Temperament Questionnaire (>10 years; Rothbart et al. 1992/2007). Two effortful control indices overlapped across questionnaires and were the focus of analysis: attention-focusing and inhibitory control. Parent-child dyads were video-recorded during an unstructured, 10-18 minute free-play session; parental behavior was coded using Behavioral Observation Research Interactive Software (http://www.boris.unito.it). Toys were constant across dyads and appropriate for object-focused and symbolic play (e.g., blocks, firetruck, marble-run, picnic basket, farm animals). Twelve behaviors were coded with an adaptation of the Maternal Behavior Rating Scale (Van Keer at al., 2017); those relating to responsivity and directiveness were the focus of analysis (sensitivity to child's interest, responsivity, effectiveness, directiveness, and pace). Each parental behavior was scored in two-minute intervals on a 1-5 Likert scale and averaged across the minimum of five time epochs. Calculated for 10% of videos, inter-rater agreement within one scale-point was 96% (Van keer et al., 2017). Pearson correlations were tested between parent-rated temperament and observer-rated parental behavior scores.

Results: Attention-focusing was negatively correlated with parental directiveness (i.e., higher attention-focusing was associated with lower directiveness), *r(19)*=0.47, *p*=0.030. Inhibitory-control was positively correlated with parental effectiveness, *r(20)*=0.44, *p*=.041, and negatively correlated with parental pace, *r(20)*=0.55, *p*=0.008. See Figure 1.

Conclusions: Parental responsivity and directiveness during parent-child play can be predicted by effortful control aspects of child temperament (attention-focusing, inhibitory-control) in children with ASD. Specifically, children with higher levels of parent-rated effortful control experienced lower levels of observer-rated parental directiveness and pace. These findings have implications for understanding heterogeneity in outcomes for children with ASD and for potential parental interventions. Further research is needed to determine how parental behaviors differ according to temperament over time and how those behaviors moderate effects of temperament on long-term developmental outcomes (Chetcuti et al., 2019).

412.008 *(Poster)* Cluster Analysis of Extremely High Ability Autism Reveals Heterogeneity in Cognitive Performance and Behavioral Phenotypes in a Gifted/Talented Clinical Cohort

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Background: Although the extreme heterogeneity of autism is well-appreciated, current research is dominated by findings that relate chiefly to autism at low to average IQ. Comparatively little is known about the clinical features of autism in a population with high IQ. Exploration of this phenotype can provide insight into the symptomatology autism without the confounds of intellectual disability, and may have implications for effective clinical diagnosis and intervention across the spectrum.

Objectives: Using a one-of-a-kind sample from a major gifted and talented assessment center in the midwestern United States, we aimed to use psychoeducational data to cluster individuals with autism into distinct subgroups. Clusters were then recapitulated in a supervised learning framework to determine if differences between groups were robust and interpretable.

Methods: In a sample of over 1,300 individuals seen at a gifted/talented assessment and counseling clinic, we filtered to those who received an ASD diagnosis and an IQ-matched control group (final sample size of 353: 68 autism cases, 285 controls) who had Wechsler IQ and Behavioral Assessment System for Children (BASC) scores. Mean age of the sample was 10, there were 236 males and 112 females. The analysis presented here is a first look at this data. Hierarchical clustering was done on individuals with an autism diagnosis using scaled IQ and BASC data. We then developed a classifier to predict cluster status to examine whether the differences between clusters was robust enough to accurately predict cluster membership. ANOVA was then conducted to assess the significance of feature-level differences between clusters, and Tukey's Honest Significant Difference tests to find where the differences were.

Results: Cluster analysis revealed 3 distinct clusters.There were no significant differences in full-scale IQ scores between the clusters. Cluster 1, had a significantly higher verbal comprehension index score than the other clusters ($F=9.1$, $p<0.001$) and a lower processing speed. This group had a very similar behavioral profile to Cluster 2, but Cluster 2 had a less extreme IQ profile. Cluster 3 had a unique behavioral profile, with significantly less problematic scores on BASC measures. Behavioral measure differences that survived Bonferroni multiple test correction were: **adaptability** ($F=42.8$, $p<0.0001$), **functional communication** ($F=41.2$, $p<0.0001$), **leadership** ($F=16.27$, $p<0.0001$), **conduct problems** ($F=13.6$, $p<0.0001$), **social skills** ($F=11.25$, $p<0.0001$), and **attention problems** ($F=8.9$, $p<0.01$).

We then developed a classifier using linear discriminant analysis predicting cluster membership. We were able to accurately classify 90% of unseen test cases into the correct cluster.

Conclusions: Our results show that extreme heterogeneity is found across all levels of intellectual ability in autism. Interventions and educational plans tailored towards high ability autism should be individualized and can likely be informed by what cluster these individuals fall into. Using cluster analysis, we can effectively distinguish profiles found in high ability autism and better understand their phenotype using IQ and behavioral measures. Further research is underway to define the genetic and neuroimaging correlates of these clusters.

412.009 *(Poster)* Cognitive Flexibility Moderates the Association between Life Events and Emerging Psychopathology in Youth with ASD

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Background: In typically developing individuals, experiencing stressful life events (SLE's) is related to mental health problems. Youth with ASD are more likely to experience SLE's (Green, McGinnity, Ford, & Goodman, 2004) and experience higher rates of mental health problems (Siminoff et al., 2008). In addition, aspects of cognitive functioning associated with ASD may increase the chance of developing mental health problems following SLE exposure (Kerns, Newschaffer, & Berkowitz, 2015). Specifically, cognitive inflexibility may moderate the association between SLE and psychopathology, such that individuals with ASD have difficulty disengaging from distressing memories or in flexibly adapting to unexpected events.

Objectives: The current study aimed to test whether cognitive flexibility moderates the association between SLE exposure and emerging psychopathology in youth with ASD.

Methods: Participants came from the "Pathways to Better Outcomes" longitudinal study of children with ASD (n = 260). Around 7 years of age, SLE's were assessed as the total number of events in the preceding 12 months from the parent-report Family Inventory of Life Events and Changes and cognitive flexibility was assessed using the teacher-report Cognitive Shifting subscale of the Behaviour Rating Inventory of Executive Functioning. Mental health outcomes were assessed at age 10 using the Total, Externalizing and Internalizing problems scales from the parent-report Child Behavior Checklist (CBCL). To test whether cognitive flexibility moderates the association between SLE exposure and emerging mental health outcomes, main effects and the interaction term of SLE's and Cognitive Shifting were included in the models as predictors of later CBCL scores.

Six-year parent-report CBCL (to account for mental health problems prior to SLE exposure, family income (to account for sociodemographic risk), and study site were included as covariates. As a secondary step, autism symptom severity (assessed using 6-year ADOS) and IQ (assessed using 6-year full-scale IQ from the WPPSI) were added to test whether the results were specific to executive function. Path analysis models were fitted using the sem command with maximum likelihood estimation in Stata v14.

Results: The models showed excellent fit to the data (CFI > .99). There was a significant interaction between Cognitive Shifting and SLEs in the prediction of CBCL Total Problems ($p < .05$). This was driven primarily by the Externalizing subscale (interaction term $p < .05$) - the association between SLE's and Externalizing problems was significant only for children with low levels of Cognitive Shifting ($p<0.05$ at 1 standard deviation (SD) below the mean) but no association was found for those with strong Cognitive Shifting abilities. The results were unchanged after the addition of ADOS severity and IQ.

Conclusions: Consistent with the hypothesis, analyses showed that cognitive flexibility moderated the impact of SLE's on mental health outcomes later in childhood, whilst adjusting for mental health problems prior to SLE exposure and relevant sociodemographic factors. Cognitive flexibility may increase resilience by allowing youth with ASD to compensate or adapt more easily to environmental risk for psychopathology. Results suggest that interventions targeting cognitive shifting ability may be important for reducing the negative impact of SLE's in children with ASD.

412.010 *(Poster)* Cognitive Flexibility and Behavioral Inflexibility Differentiate Autism Spectrum Disorder and Attention Deficit Hyperactivity Disorder in Children

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Background: Two neurodevelopmental disorders (NDDs) with a high degree of comorbidity and phenotypic overlap are attention deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD). Executive functioning (EF) and cognitive and behavioral inflexibility (BI) are constructs that both overlap and dissociate these disorders (Martel, Nikolas, & Nigg, 2007), and can contribute to our understanding of shared and distinct variance between ASD and ADHD.

Objectives: The aims of the study are: (1) identify profiles of EF across NDDs using the NIH Toolbox Cognition Battery (NIH-TCB), (2) test the hypothesis that executive function deficits (EFd) and BI differentiate our ASD, ADHD, ASD+ADHD, and typically developing (TD) groups, and (3) recognize areas of BI that are most problematic in the ADHD population.

Methods: 70 children, ages 3-17, participated in the study; 19 ADHD, 17 ASD, 17 ASD+ADHD and 17 TD. ASD and TD subjects were matched to the ADHD sample based on sex, age, and IQ from a previous study (total sample 76 ASD, 93 TD, 51 ASD+ADHD). A larger matched sample (~120) is anticipated by May 2020, with 40 ADHD participants. Subjects completed the Stanford-Binet (SB-5) abbreviated intelligence quotient (ABIQ) and four tasks from the NIH-TCB [Flanker Inhibitory Control and Attention (Flanker; inhibition), Dimensional Change Card Sort (DCCS; cognitive flexibility), Pattern Comparison Processing Speed (PCPS; processing speed), and Picture Sequence Memory Test (PSMT; episodic memory)]. Caregivers completed a basic demographic form, questionnaires regarding ASD symptomatology, and the Behavioral Inflexibility Scale (BIS; Boyd, Bodfish, Lecavalier, & Harrop, 2018); a 38-item parent report measure of behavioral inflexibility in children with ASD rated on a scale from 0 to 5. To test for differences between groups, we used a series of independent samples t-tests.

Results: Children with ASD demonstrated greater cognitive inflexibility, as measured through the DCCS, than TD children (approaching significance $p=0.07$). There were no significant differences on inhibitory control between ADHD, ASD and TD children ($p>0.05$), but ASD subjects performed significantly better than the ASD+ADHD group ($p=0.03$). No significant differences were found on episodic memory or processing speed tasks between groups ($p>0.05$). There were significant differences on ratings of BI between some of our groups(ASD > ADHD > TD, $p<0.01$), but not others (ASD = ASD+ADHD, $p>0.05$). To identify areas of BI that are problematic,

Conclusions: This modest-sized study confirmed our hypothesis that EFd, explicitly cognitive flexibility, and BI play a significant role in differentiating ASD and ADHD. This important finding suggests EFd remain a meaningful target for cross-diagnostic intervention approaches. These findings should be interpreted cautiously given this preliminary sample. However, we find it promising that BI differentiates three of the four groups, suggesting that while BI may be a common feature between ADHD and ASD, the magnitude of it is what differentiates these NDDs.

412.011 *(Poster)* Continued-Influence Effects in Autism Spectrum Disorder

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Background: Decades of research has provided compelling evidence that misinformation – false or inaccurate information – continues to influence judgement and decision making despite subsequent correction, a phenomenon known as the continued influence effect (CIE; Lewandowsky et al., 2012). However, no research has investigated the CIE in autism spectrum disorder (ASD). Relative to those with typical development (TD), individuals with ASD exhibit specific deficits in cognitive flexibility (Fujino et al., 2019) and episodic memory (Cooper et al. 2017), meaning that they may be more susceptible to the effects of misinformation either through inefficient memory-updating following a correction or deficient recall of correct information.

Objectives:

1. To investigate whether ASD individuals are more susceptible to the CIE than those with TD.
2. To examine whether the CIE is specifically related to poorer cognitive flexibility and episodic memory in ASD.

Methods: 79 IQ-matched participants (44 ASD; 35 TD) read a series of brief news reports that contained confirmations or corrections of prior information. Following each report, participants were presented with two pictorial memory probes and asked to choose the image that matched the reports' *correct* facts. Importantly, the *incorrect* image either matched the initial *misinformation* (interference condition) or did not match *any* prior information (no-interference condition), resulting in three conditions: confirmation (CON), correction/interference (CORR_INT), and correction/no-interference (CORR_N_INT). Our dependent variable was drift rate, a combination of accuracy and reaction time that quantifies the rate of information processing and accounts for a potential speed-accuracy trade-off.

Results: There was a significant effect of condition on participants' drift rates ($F(2,154)=4.449$, $p=.013$), highlighting that *all* participants had a slower drift rate when a correction was followed by an interfering probe (CORR_N_INT; demonstrating the presence of the CIE). There was also a significant effect of diagnosis ($F(1,77)=5.257$, $p=.025$), with ASD participants drift rate being less than for TD. However, there was no significant interaction between the factors suggesting that ASD participants did not display a uniquely greater CIE than those with TD ($F(2,154)=0.583$, $p=.559$; Fig. 1). Further analyses examined whether participants' drift rate was related to measures of cognitive flexibility (from the Dimensional Card Change Sort task; DCCS) or episodic memory (from the Picture Sequence Memory task; PSM) from the NIH toolbox (Gershon et al., 2013). These analyses revealed that drift rate in all conditions was positively associated with measures of cognitive flexibility uniquely for ASD participants (Fig. 2). However, scores did not relate to episodic memory for either diagnosis group.

Conclusions: Our data revealed that overall individuals with ASD performed more poorly on the task than those with TD, however, evidence for a specifically larger CIE in this group was not found. Instead, the data suggested that flexible cognition closer to the level observed in TD is key for ASD individuals to overcome the effects of previously learned misinformation more efficiently. These findings therefore provide preliminary evidence that strategies to improve cognitive flexibility may be critical to aid individuals with ASD to function in a world in which misinformation is an ever-increasing concern.

412.012 *(Poster)* Decision-Making Impairments in Adolescents and Young Adults with Autism Spectrum Disorder

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Background: Individuals with Autism Spectrum Disorder (ASD) may show impaired (Mussey et al., 2015; Zhang et al., 2015) or even enhanced (South et al., 2014) performance on the Iowa Gambling Task (IGT), which measures decision-making under ambiguity. A modified version of the IGT (mIGT), which eliminates the potential confound of differences in exploratory behavior and allows for separation of approach (choosing to "play" a good deck) and avoidance (choosing to "pass" on a bad deck) behavior, has been developed but has not yet been used in ASD (Cauffman et al., 2010). Decision-making under risk can be assessed using the Game of Dice Task (GDT), where outcomes are unambiguous and explicit. Zhang et al. (2015) found impaired performance and suboptimal use of trial feedback in ASD.

Objectives:

1. Investigate decision-making under risk in ASD using the GDT. 2. Examine decision-making under ambiguity in ASD using the new mIGT.
3. Characterize decision-making performance across both tasks using cluster analysis.

Methods: 84 participants with ASD (Age = 17.45[3.16]; FSIQ = 100.52[14.91]) and 88 participants with typical development (TD) (Age = 17.35[3.15]; FSIQ = 109.16[12.35]) performed the GDT and mIGT.

In the GDT a bet is placed on 1, 2, 3 or 4 sides of the die. A selection of 1 or 2 sides is considered "risky," while selection of 3 or 4 sides is considered "safe." For each mIGT trial one of four decks is pre-selected and can be "played" or "passed." Two decks are profitable (good decks) and two decks are not (bad decks).

Results: GDT:

Mean net score (#safe choices – #risky choices) was significantly higher for those with TD (11.58[9.00]) versus ASD (7.69[8.99]), U=2592.000, p=.001. TD was more likely to place a safe bet following a "safe" win trial (U=2517.000, p=.003) compared to ASD, indicating better use of positive feedback (Fig.1).

mIGT:

Participants with TD showed better avoidance of bad decks compared to ASD (U=3041.000, p=.043) and had a greater net score at the end of the task compared to ASD (U=3053.500, p=.046) (Fig.2).

Cluster Analysis:

K-means clustering analysis was performed on GDT Net Score, mIGT Net Score for bad decks and mIGT Net score for good decks for all participants (ASD and TD). Three clusters were produced: Cluster 1 was characterized by risky performance on GDT and no learning on mIGT; Cluster 2 was characterized by good performance on GDT and learning to avoid bad decks; Cluster 3 was characterized by good performance on GDT and learning to approach good decks. A Chi Square analysis indicated a significantly different distribution of individuals across the clusters by diagnosis (X^2=8.686, p=.014), with greater than expected individuals with ASD in Cluster 1 (p=.015) and fewer than expected in Cluster 2 (p=.017).

Conclusions: Participants with ASD show impairments in decision making under risk and under ambiguity, where they are specifically impaired at avoiding bad decks. Longitudinal data collection is ongoing, and future analyses will assess development of decision-making processes throughout adolescence and young adulthood as well as associations with comorbid psychopathology and adaptive functioning.

412.013 *(Poster)* Delayed Sleep Onset Is Associated with Emerging Behavioral Regulation Difficulties in Youth with Autism

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Background: Sleep is disturbed in up to 80% of children with autism spectrum disorder (ASD). Observational and experimental studies have found poor sleep impairs executive functioning (EF) performance, which includes skills like cognitive flexibility and inhibition, in typically developing youth and youth with other developmental disorders. EF is a well-documented lifelong difficulty in individuals with ASD. Accumulating biological evidence and developmental accounts suggest that EF deficits in ASD may be exacerbated by poor sleep affecting neural pathways responsible for EF development. To date, the impact of childhood sleep disturbances on EF development in ASD are unknown.

Objectives: To examine if sleep problems in school-age children with ASD are associated with emerging EF difficulties. Specifically, we hypothesized that frequent night awakenings, longer sleep onset and shorter sleep duration at 6 years of age would be associated with lower teacher-reported EF performance at 7 years.

Methods: Data were drawn from an ongoing Canadian longitudinal study *Pathways to better outcomes*. Items on the *Children's Sleep Habits Questionnaire* were used to capture sleep quantity and quality for 113 children (mean age = 6.6 years, SD = 3.7). A binary coding approach was used to categorize night awakenings and sleep onset (0 = never, 1= sometime or always), and average sleep duration per weeknight was in hours. Raw scores on the Metacognition (MCI) and Behavioral Regulation (BRI) indices on the teacher *Behavior Rating Inventory of Executive Functioning* were used to measure EF approximately one year later (mean age = 7.7 years, SD = 3.1).

Two separate linear regression models, for MCI and BRI, were used to examine associations between sleep and EF, controlling for study site, age, and household income. As a secondary step, additional regression models were run accounting for IQ and ASD symptom severity with the ADOS calibrated severity score, to test the specificity of associations between sleep and EF.

Results: Delayed sleep onset predicted higher BRI (i.e., poorer behavioral regulation), accounting for all covariates (ß = 0.23, p = 0.02). Night awakenings (ß = -0.14, p = 0.21) and sleep duration (ß = 0.17, p = 0.10), did not significantly predict BRI. In contrast, no sleep variable predicted MCI: sleep onset (ß = 0.14, p = 0.15), night awakenings (ß = 0.08, p = 0.50), nor sleep duration (ß = 0.15, p = 0.17).

Conclusions: Delayed sleep onset is a robust predictor of behavioral regulation problems in school-age children with ASD, controlling for covariates of IQ and ASD symptom severity. Delayed sleep onset often leads to daytime sleepiness and is a core symptom of insomnia, the most frequently reported sleep disturbance in ASD. Difficulties initiating sleep could indicate internal dysregulation due to circadian rhythm disturbances (that control sleep timing), which have been documented in ASD. Such disturbances are strongly linked to behavioral problems in youth, including impaired inhibition and cognitive shifting, functions included in the BRI. Follow-up investigations will include examining the relationship between sleep disturbance and specific EF behavioral subscales, controlling for daytime sleepiness, which can impair daily regulatory abilities.

412.014 *(Poster)* Distinguishing between Implicit and Explicit Measures of Metacognition in Autism

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Background: Metacognitive monitoring (awareness of one's own mental states/cognition) is a key component of self-awareness and plays an important role in learning. The few existing studies of metacognitive monitoring in autism have required participants to make explicit judgements about their knowledge. The closer the correspondence between *judgements* of one's knowledge and one's *actual, objectively measured* knowledge, the more accurate one's metacognitive monitoring is. Previous findings using such tasks have been mixed.

Objectives: We aimed to resolve discrepancies in previous findings by employing not only a standard, explicit test of metacognitive monitoring, but also a "gambling" paradigm adapted from comparative psychology to assess metacognitive monitoring non-verbally/implicitly.

Methods: Twenty-five children/adolescents with ASD and 25 age- and IQ-matched typically developing comparison children/adolescents took part. The implicit and explicit tasks are illustrated in Figures 2 and 3, respectively. Each involved a visual discrimination "object level" task; either choosing the most densely pixelated or lightest blue of two arrays. In the implicit task, after each discrimination trial, participants chose between a circle and a triangle, which appeared on screen. Points were awarded/taken away depending on whether discriminations were correct or incorrect, and whether the circle or triangle was selected, as follows:

- correct + triangle -> win 30 points;
- correct + circle -> win 10 points;
- incorrect + triangle -> lose 30 points;
- incorrect + circle -> lose 10 points.

Accurate implicit metacognitive monitoring was indicated by a greater tendency to choose the triangle (high risk) more on correct than incorrect discrimination trials, and to choose the circle (low risk) more on incorrect than correct trials.

In a second session, participants completed the explicit task (using different visual discrimination stimuli for the object level task). This time, after each discrimination trial, participants chose between the options, "confident" or "not confident", rather than triangle or circle. The points structure was equivalent to the one in the implicit task. Accurate explicit metacognitive monitoring was indicated by a greater tendency to choose "confident" on correct than incorrect discrimination trials and, to choose "not confident" more on incorrect than correct trials.

Results: On the implicit task, gamma scores (the measure of metacognitive accuracy) were slightly and non-significantly lower among participants with ASD than comparison participants in the implicit task (Bayes factor supported the null hypothesis; ASD: M = .37, SD = 32; comparison: M = .45, SD = .28), $t(49) = 0.95$, p = .25 d = 0.27, but on the explicit task, they were moderately and significantly lower (Bayes factor supported the alternative hypothesis; ASD: M = .35, SD = .28; comparison: M = .51 SD = .26), $t(49) = 1.98$, p = .02, d = 0.59. Correlations between metacognitive monitoring, theory of mind, and autism traits were also analysed.

Conclusions: These results provide further evidence for explicit metacognitive monitoring difficulties in autism. More importantly, as the first study of non-verbal/implicit metacognitive monitoring in autism, the results extend the field significantly; indicating a strength for autistic individuals in this domain. Implications for theory and clinical practice will be discussed.

412.015 *(Poster)* Episodic Memory Dysfunction in ASD – Is It Real?

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Background: Episodic memory (EM) is memory for past events in specific spatial-temporal contexts ('what-where-when' memory) (Tulving, 1972). In typical development, EM emerges around 4-5 years of age (Tulving, 2003, 2005). Existing research suggests that individuals with autism spectrum disorder (ASD) display significantly poorer memory when recalling episodic events, compared to neurotypical controls (NT) - which might derive from diminished autonoetic (self-knowing) consciousness and impaired binding processes. However, often tests of EM use verbal material to be recalled which can be problematic for young NT children and children with ASD. Moreover, it is still not well understood how EM develops. Language delays and language impairments are documented in ASD. Therefore, complying with the demands of traditional EM tasks which rely on the language capacity of the child may underestimate their EM ability. Here, we report the first experiments exploring EM in ASD using a behavioural and nonverbal measure of EM which allows us to identify the integration and binding of different associations within an episodic representation – enabling children to show us rather than tell us about the contents of their memories.

Objectives: The aim of this study was to provide the first insights into EM in ASD using a behavioural and non-verbal measure of memory that allows us to disambiguate events in spatiotemporal context, with information about What happened, Where and in Which occasion.

Methods: We developed a hide-and-seek task combining elements of the "What-Where-When" memory test by Holland and Smulders (2011) and the "What-Where-Which" memory test by Eacott & Norman (2004). At this stage 5 children with ASD (mean age = 7.8 years; SD = 1.58 [5 Male]) and 49 NT children (mean age = 5.2 years; SD = 0.9 [30 Male; 19 Female) participated. Children completed two sessions to hide six coloured pens (what) at specific locations (where) in two different contexts (which). At retrieval, children retrieved 6 pens across two sessions yielding two trials each of What-where, What-Which and What-Where-Which. Cognitive functioning was assessed using Wechsler Intelligence Scale (WPPSI-IV and WAIS-IV) and will be used to match the groups (ASD and NT) on mental age.

Results: A GZLM was performed on binary data using group as the dependent variable, and trial type as the predictor to see if there was an effect of group on performance in the episodic task. Results showed no effect of group on accuracy in the WWWhich episodic task: Main effects of Group: Wald $X^2 = 5.229$, p=. 0.265. Comparisons to chance revealed that NT children are performing well over chance (p<0.05) and a similar pattern is observed in a slightly older group of ASD children (p=0.08, d=1.04).

Conclusions: Initial findings suggest that contrary to existing research reporting poorer episodic skills among children with ASD, children with ASD demonstrate a pattern of performance similar to TD children. The study provides a preliminary suggestion that when language is removed from a WWWhich task autistic children show a relatively typical pattern of performance, certainly no clear evidence of atypicality.

412.016 *(Poster)* Examination of Behavior Problems in Children with Autism Spectrum Disorder: Influence of Executive Functions

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Background: the literature has established the interconnections between autism spectrum disorder (ASD) and individual weak executive functions (EFs), as well as the relationship between ASD symptoms and problem behaviors. However, only a few studies have investigated how EFs affect children with ASD on their behavior problems, and if the influence of EFs work the same way among typically development (TD) children.

Objectives: the goal of the current study is to investigate if EFs produce different degrees of influence on behavior problems between the TD and the ASD group.

Methods: the present ASD sample includes 29 children who was formally diagnosed with ASD by a team including psychiatrists and clinical psychologists and met the ASD cut-off by Autism Diagnostic Observation Schedule (ADOS) and the Autism Diagnostic Interview-Revised (ADI-R). All 25 children of the TD sample did not demonstrate ASD characteristics while using social communication questionnaire. The ASD and the TD group were comparable in age (grand M = 105.79 months, SD = 1.95), sex (88.89% male), and the intelligence quotient (IQ). We assessed all participants' EFs and problem behaviors, using the behavior rating inventory of executive function (BRIEF) and the child behavior checklist (CBCL) respectively.

Results: trending in the expected direction, the results showed that the ASD group demonstrated significantly more problem behaviors than did the TD group ($p < .001$). Critically, the difference was fully mediated by the weaker EFs of the ASD group (EFs $p < .001$; after controlling for EFs, ASD status $p = .103$) and a marginally significant interaction between EFs and ASD status that buffered the detrimental effect of EFs on PB for the ASD group ($p = .063$). Because of the small sample size and that BRIEF consists of a behavior regulation index (BRI) and metacognition index (MI) aspect of EFs, we further explored the effects of these two types of EFs on problem behaviors separately. The results replicated and strengthened the former findings on composite EFs for BRI, in that now ASD status significantly buffered the negative effect of weak BRI on problem behaviors for the ASD group (interaction $p = .009$). The same moderation, however, disappeared for MI: weaker MI predicted more problem behaviors regardless of ASD status (interaction $p = .259$).

Conclusions: the current research indicates that even though weak EFs may contribute to children's problem behaviors in the ASD group, change in EFs might actually impact their problem behaviors less than for children in the TD group. This finding is especially pronounced when one focuses on BRI, and it disappears for MI. Overall, the results imply that more basic components of EFs such as MI compared to BRI should be treated first to reduce problem behaviors.

412.017 *(Poster)* Executive Functions in High School Students Graduating with a Regular Diploma: Associations with the Ability to Self-Manage Daily Life Tasks and Internalizing and Externalizing Behaviors

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Background: Executive functions (EF) may play a prominent role in the transition to adulthood as youth assume new responsibilities, especially for high school students on the autism spectrum who plan to continue to college or competitive employment. We examined EF profiles in high school students on the autism spectrum who were in their last year of school and preparing to graduate with a regular high school diploma. We then examined whether EF predicted key outcomes (the ability to self-manage daily life tasks; internalizing and externalizing behaviors).

Objectives: The objectives were to: (1) describe the EF profiles of diploma-track high school students on the autism spectrum; and (2) examine the associations among executive functions, the ability to self-manage daily life tasks, and internalizing and externalizing behaviors.

Methods: Participants were 33 parents and 32 youth on the autism spectrum who were in their last year of high school and expecting to graduate with a regular high school diploma. Youth ranged in age from 17 – 20 years old and 25 were male (78%). All youth had a parent-report diagnosis of autism spectrum disorder (ASD), received special education services or accommodations for ASD, and had a score of 15 or higher on the Social Communication Questionnaire (SCQ-L; Rutter et al., 2003). Parents and youth separately completed the Behavior Rating Inventory of Executive Function – Adult Version (BRIEF-A; Roth et al., 2005). Parents completed the Adult Behavior Checklist (ABCL; Achenbach & Rescorla, 2003) and a measure of the youth's ability to self-manage daily life tasks (PEDI-CAT-ASD Responsibility domain; Haley et al., 2012). The BRIEF-A includes an overall Composite score (GEC), Behavioral Regulation Index (BRI; subscales Inhibit, Shift, Emotional Control, and Self-Monitor) and Metacognition Index (MCI; subscales Initiate, Working Memory, Plan/Organize, Task Monitor, and Organization of Materials).

Results: Repeated measures MANOVA indicated that parents reported that the youth had more EF challenges than the youth reported themselves (BRIEF-A GEC, BRI, MCI, and all subscales). Parents reported that youth had clinically significant levels of EF difficulties on the Shift, Initiate, Working Memory, Plan/Organize, Task Monitor and Organization of Materials subscales. Youth did not report clinically significant difficulties on any of the subscales. Regression analyses using parent-report data showed that MCI significantly predicted greater difficulty in self-managing daily life tasks ($B = -.361$, $p < .001$), whereas BRI significantly predicted greater internalizing ($B = .391$, $p < .05$) and externalizing behaviors ($B = .673$, $p < .000$).

Conclusions: Diploma-track high school students on the autism spectrum showed variable EF profiles with elevated impairments in shifting attention, initiation, working memory, planning and organizing, and monitoring tasks. Parents consistently reported that the youth had more EF impairments than did the youth, a pattern observed in other self- versus proxy-reports of behaviors and skills of youth on the autism spectrum. Metacognitive impairments were associated with difficulty self-managing daily life tasks while behavioral regulation impairments were associated with internalizing and externalizing behaviors. The findings suggest important directions for services, supports, and interventions for diploma-track high school students on the autism spectrum.

412.018 *(Poster)* Exploring Mediating Effects of Executive Functions to Explain Relationships between Psychopathology and Social Adaptive Functioning in a Mixed Clinical Sample, Including Autism Spectrum Disorder

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Background: It has long been established that the presence and extent of psychopathology predicts adaptive functioning, with higher internalizing and externalizing symptoms leading to poorer adaptive outcomes. Executive function (EF) is related to both psychopathology and adaptive functioning and is disrupted across several clinical disorders, leading to the idea that EF may be a shared mechanism to explain links between psychopathology and adaptive functioning. Specifically, EF is an important precursor to social skills, and executive dysfunction predicts poorer social outcomes in individuals with ASD.

Objectives: To explore components of EF as possible mediating mechanisms in the relationship between psychopathology and social adaptive functioning.

Methods: Within the Research Domain Criteria (RDoC) framework, 133 children (ages 8-13) participated in an ongoing study examining profiles of EF and their underlying functional neural circuitry across clinical disorders, including ASD, attention-deficit/hyperactivity disorder, and generalized anxiety disorder. Internalizing and externalizing psychopathology was rated by parents on the Child Behavior Checklist (CBCL) and social adaptive functioning was assessed with the Social Domain of the Vineland Adaptive Behavior Scales, Third Edition. Three dimensions of EF -- shift/flexibility, inhibition, and working memory -- were assessed using both the Behavior Rating Inventory of Executive Function (BRIEF-2; parent report) and tasks tapping these specific EF dimensions that were completed during an fMRI scan. Correlations between measures of psychopathology, social adaptive behavior, and EF were explored, and mediation models were further tested to establish which components of EF mediate the relationship between psychopathology and social adaptive behavior.

Results: Increased psychopathology was associated with decreased social adaptive functioning (internalizing: $r(131) = -.35$, $p < .001$); externalizing: $r(131) = .38$, $p < .001$). All parent-report measures of EF were significantly positively correlated with measures of psychopathology (r's: .23 to .65) and significantly negatively correlated with social adaptive functioning (r's: -.18 to -.43). Task-based measures were not significantly correlated with their corresponding parent-report index of EF, nor with measures of psychopathology or social adaptive functioning. Mediation analyses revealed that the relationship between psychopathology (internalizing and externalizing symptoms) and social adaptive functioning is mediated by parent-reported executive functions of shifting (Internalizing: CI = -.41 to -.11; Externalizing: CI = -.35 to -.09) and inhibition (Internalizing: CI = -.27 to -.04; Externalizing: CI = -.52 to -.07), but not working memory (Internalizing: CI = -.14 to .04; Externalizing: CI = -.13 to .03).

Conclusions: The relationship between psychopathology and social adaptive functioning is mediated by parent-reported executive functions of shifting and inhibition, but not working memory. This suggests that one's ability to flexibly respond and inhibit impulses may explain how the presence of psychopathology manifests into real-world adaptive difficulties, at least in the social domain. Future directions include investigating other domains of adaptive functioning and more specific aspects of psychopathology (e.g., anxiety, aggression). Additionally, it will be important to understand how task-based behavioral measures of EF and functional neural networks relate to parent-reported EF and to measures of psychopathology and adaptive functioning. Finally, establishing shared and unique mechanisms across disorders will support targeted treatment and intervention.

412.019 *(Poster)* Inefficient Information Sampling Under Explicit Costs in Children with ASD

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Background: Information from the environment is generally beneficial but can also be costly to gather. Balancing the costs and benefits of information sampling and sampling optimally is thus central to human survival. One of the core symptoms of autism spectrum disorders (ASD), repetitive behaviors, may be interpreted as a failure to take into account the cost of information sampling; that is, spending too much time and energy to gather information that is redundant and helps little to reduce uncertainty (Palmer, Lawson, & Hohwy, 2017). How people with ASD trade-off the costs and benefits of information sampling, however, has received little research yet. By introducing explicit monetary costs into an information-sampling game, one recent study (Lu, Yi, & Zhang, 2019) found that adults with high autistic traits have a lower efficiency of winning rewards when the cost is high and the evidence is ambiguous.

Objectives: The present study aims to understand whether ASD influences the optimality of information sampling in children, specifically when additional information is beneficial for future decisions but incurs explicit costs.

Methods: Fourteen children with ASD and 21 typically developing (TD) children played a computer-based information-sampling game adopted from Lu et al. (2019). In each trial, children were faced with two islands: one island had a dog-to-cat ratio of 80%:20% or 60%:40%, and the other had the opposite ratio. They were told one island was secretly selected and could sample up to 20 animals sequentially with replacement from the selected island to infer which had been selected. However, each sample would cost 0, 0.1, or 0.4 points from 10 points that children could gain at most for each correct inference. The experiment consisted of 96 trials, with 3 cost blocks counterbalanced between children and two ratio blocks in a random order nested in each cost block.

Results: In all analyses, we regressed out the effects of age and IQ to control the group differences. To quantify the optimality of sampling, we used sampling efficiency – the expected gain for children's sampling numbers divided by the maximum expected gain. We found that the efficiency of the ASD group was lower than the TD group (Fig. 1a), specifically in the high-cost condition (i.e., 0.4 points). Further analyses showed that the absolute deviation from the ideal sampling numbers of children with ASD was significantly larger than TD in the high-cost condition (Fig. 1b). However, both groups showed a similar bias towards oversampling overall in the high-cost conditions (Fig. 1c). Results showed that children with ASD had a higher variation of sampling numbers across trials overall, particularly in the low-cost condition (i.e. 0.1 points) and also an evident trend in the high-cost condition (Fig. 1d).

Conclusions: In sum, we found that sampling choices of children with ASD were less optimal compared to TD children particularly when information gathering was highly costly, even after statistically controlling age and IQ differences. Together with Lu et al. (2019), ASD or high autistic traits suggest lower efficiency in sampling behaviors, but only under high sampling costs.

412.020 *(Poster)* Judgements of Auditory Visual Synchrony and Their Association with Reported Anxiety.

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Background: Auditory and visual information is often processed as one seamless experience even when there are slight temporal differences in the perception of this information. The degree of acceptance of asynchrony, for example in auditory-visual information, is what defines the temporal binding window (TBW). People with ASD have larger TBWs, which, in principle, means that other unrelated stimuli have a greater probability of interference with information that should be bound. While there is an emerging body of evidence on the TBW in ASD, the practical consequences of a difficulty binding information that should be related needs further clarification.

Objectives: We examined whether less accuracy of temporal binding could be associated with increased difficulties in other areas, such as anxiety in social situations where visual and auditory information must be processed quickly, or more generalized anxiety. We also examined potential links among IQ, autism symptoms, anxiety and the size of the TBW.

Methods: Samples were: Twenty children with ASD, ages 7-17 years (Mean=12.58, SD=2.88), 74% males, mean IQ=105.53 (SD=11.92); and thirty typically developing children, ages 7-18 years (Mean=11.90, SD=3.05), 32% males, mean IQ=103.34 (SD=9.67).

Synchrony Judgement Task: Participants decided whether the auditory and visual information in a brief stimulus was synchronous or not, the timing varying randomly across trials. The dependent variable was the number of errors in synchrony judgement. The stimuli consisted of a woman who expressed emotions (crying or laughing), social linguistic stimuli (SL; sharing a brief story), social non-linguistic stimuli (SNL; making non-word oral sounds) or stimuli that were non-social and non-linguistic (NSNL; a finger playing notes on a piano). Participants were also given a brief measure of IQ (Weschler Abbreviated Scale of Intelligence (WASI-2)), and parents completed measures looking at anxiety (Spence Children's Anxiety Scale) and autism symptoms (Sensory Profile 2 and the Social Responsiveness Scale).

Results: There were no significant correlations among measures of autism symptoms and the behavioural task. However, in the ASD sample, children who made more errors in synchrony judgements on the SL and SNL stimuli had lower scores on the WASI (verbal, non-verbal, as well as total; all r ranging from -0.52 to -0.63, $p < 0.05$). In addition, for children with ASD, there were significant correlations between reports of anxiety and their performance on synchrony judgement tasks. For example, children whose parents reported lower social anxiety made fewer synchrony judgement errors in the social conditions (i.e. SL and SNL; r = - 0.47, -0.65, respectively), while children with higher reported levels of social anxiety made more synchrony judgement errors in the NSNL condition.

Conclusions: Social interactions involve the rapid integration of auditory and visual information in interpersonal situations. Errors in identifying which components of an interaction should be bound together would make understanding social events chaotic, leading to increased anxiety, as components may be serendipitously or associatively bound that are quite unrelated. The current findings indicate that in ASD, the inability to make accurate synchrony judgements is related both to intelligence and reported social and general anxiety.

412.021 *(Poster)* Lack of Agreement between Self, Parent, and Clinician Reports of ADHD Symptoms in Adolescents with ASD

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Background: It can be difficult to diagnose attention deficit hyperactivity disorder (ADHD) in individuals with autism spectrum disorder (ASD) due to the atypical and idiosyncratic attention patterns they often display (Dawson & Lewy, 1989). Reports about rates of ADHD in ASD vary from 29% to 73% (Ovsanna T. Leyfer & Susan E. Folstein, 2006). Two potential causes of this discrepancy include diagnostic overshadowing (Miodovnik, Harstad, Sideridis, & Huntington, 2015) and differences in sensitivity, and or validity of the measures used to assess ADHD symptoms. While the Achenbach System of Empirically Based Assessment (ASEBA) (Achenbach & Rescorla, 2001; 2003),The Conners' Rating Scale (Conners, 1973; Fee, Matson, & Benavidez, 1994), and the Kiddie Schedule for Affective Disorders (K-SADS) (Masi, Favilla, & Mucci, 2000; Masi, Mucci, Favilla, & Poli, 1999) have been used in ASD they have not yet been tested for reliability and validity in autism in a single comprehensive study (Leyfer, 2006).

Objectives: Investigate inter-rater agreement between clinicians (K-SADS (adolescents); The Structured Clinical Interview for DSM V (SCID) (American Psychiatric Association, 2015) and self and parent report for adolescent and young adult participants (CONNERS 3 (Conners, 2008); Conners Adult ADHD Rating Scales (CAARS) (Christiansen, Hirsch, Abdel-Hamid, & Kis, 2014); ASEBA) when rating ADHD symptoms.

Methods: 47 adolescents (Mean Age= 14.9; Mean FSIQ = 101.4) and 41 young adults with ASD (Mean Age = 20.3; FSIQ = 99.4) participated. Each participant met criteria for ASD on The Autism Diagnostic Observation Schedule (ADOS) (Lord et al., 2000) and Social Communication Questionnaire (SCQ) (Rutter, Bailey, & Lord, 2003). The SCID and K-SADS were administered to both adolescent and adult participants separately by trained raters. ADHD symptoms were assessed with the ASEBA parent and self-report questionnaires. The CONNERS 3 self and parent report were completed for adolescent participants and the self and parent report CAARS questionnaires were completed for adult participants.

Results: 40.4% of the ASD sample met diagnostic criteria for ADHD on the K-SADS (Table 1) and 17% met diagnostic criteria on the SCID (Table 2). The Inattention domain on the CONNERS 3 and CAARS parent reports best matched the ADHD rates found in the clinical interviews (χ^2 = .090, p=.764 and χ^2 =.00, p=1.0 respectively). ASEBA parent and self-report underrepresented the ADHD rates found in the clinical interviews for adolescents, but the ASEBA Attention Problems scale fell close to the clinical interview rate in adult participants (χ^2 =.57, p=.450 for parent report and χ^2 =.91, p=.34 for self-report).

Conclusions: The CONNERS 3 and CAARS best coincide with ADHD rates found in the clinical interview (SCID/K-SADS). The ASEBA does not capture ADHD rates in the ASD population as well when looking at individuals under 18. With age, both parent and self-report on the ASEBA are more in alignment with clinical interview rates. It is essential in clinical practice to understand which measures most accurately assess ADHD in ASD for optimal treatment outcomes.

412.022 *(Poster)* Long-Term Melodic Memory Among Children with Autism Spectrum Disorder.

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Background: Short and long-term memory for individual tones and melody are enhanced among some musically untrained persons with autism spectrum disorder (ASD) (Bonnel et al., 2003; Stanutz, Wapnick, & Burack, 2014). Particularly, absolute pitch (AP), the ability to identify pitch of a tone without a reference pitch, is enhanced among musical savants with autism (Hermelin, 2001). As the abilities to identify and distinguish pitches are not as outstanding in typically developing (TD) children (Cooper, 1995; Fancourt, Dick & Stewart, 2013), AP may offer a potential framework for understanding the musical memory strengths of persons with ASD.

As visual-spatial skills have been linked to musical learning among both TD persons (Rauscher & Zupanee, 2000) and musical savants with ASD (Heaton 2012), they may be a potential mechanism for the enhanced musical memory among persons with ASD.

Objectives: Investigate the potential roles of pitch memory and visual-spatial skills in performance on a melodic memory task among high functioning children with ASD.

Methods: High functioning children with ASD aged 8-12 years and TD children matched on chronological (and mental) age learned 4 melodies and completed a melodic memory task one week later. In the first session, the participants learned melodies in a specific key that were each matched to a specific animal. One week later, the participants were presented each of the four melodies in the original key and two other transposed keys. They were then asked to identify 1) the key in which they originally learned each melody; and 2) the animal with which each melody was paired. The Wechsler Abbreviated Scale of Intelligence, 2nd edition (WASI-II), Digit Span of the Wechsler Intelligence Scale for Children, 5th edition (WISC-V, DS), Salk and McGill Music Inventory (SAMMI, Levitin et al. 2004), and Music Training and Experience Questionnaire (MTEQ, Quintin et al., 2011) were administered to account for intelligence and musical experience. The children with ASD were assessed with the Autism Diagnostic Observation Schedule, 2nd edition (ADOS-2) to confirm their diagnosis. One parent of each child completed the Social Responsiveness Scale, 2nd edition (SRS-2) and the Social Communications Questionnaire Lifetime version (SCQ-L) to ascertain autism symptomatology among the participants with ASD and to ensure that the TD children did not present with signs of ASD.

Results: In preliminary analyses, 7 children with ASD showed more accurate long-term melodic memory ($p < .05$) than 16 TD children after accounting for intelligence and auditory working memory (measured with WISC-V, DS), but no group difference were found in distinguishing the target melody from the transposed version of the melody ($p > .05$) (Figure 1). Correlational analyses revealed a positive relationship between accuracy in pitch memory task and all of the cognitive measures among the participants with ASD, but not among the TD participants (Table 1).

Conclusions: These tentative findings suggest that previously documented strengths in musical memory among children with ASD are attributable to melodic memory rather than pitch memory. They also suggest the potential cognitive overlap between visuo-spatial skills and pitch memory within children with ASD.

412.023 *(Poster)* Motor Ability As a Predictor of Language Ability in Older Children in Autism Spectrum Disorder

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Background: Procedural memory, a system involved with sequence-specific learning across motor and cognitive skills, has been argued to underlie language learning. Recent literature has suggested that deficits in procedural learning may, therefore, contribute to language and motor deficits across children with neurodevelopmental disorders including Autism Spectrum Disorder (ASD), a proportion of whom experience both motor and language impairment. Previous studies have reported that fine motor abilities, but not gross motor abilities, predict receptive and expressive language abilities in infants with ASD. Given that language and motor skills are still developing during infancy and early childhood, we may find differences in these associations in older children with and without ASD. Understanding these relationships at different ages can inform service development and ensure that services are tailored to meet the needs of children with ASD across age groups.

Objectives: This study is currently evaluating the language and motor abilities of school-aged children with and without ASD to determine which areas (fine motor, gross motor and balance) of motor ability predict receptive and expressive language abilities.

Methods: Eighteen children have participated in the study thus far. Five children with ASD were age (9-13 years) and IQ-matched with thirteen typically developing (TD) children. Participants completed (1) the Perceptual Reasoning subscale of the Wechsler Abbreviated Scale of Intelligence – Second Edition (WASI-2) as a standardized measure of non-verbal intelligence; (2) the Bruininks-Oseretsky Test of Motor Proficiency – Second Edition (BOT-2) as a standardized measure of fine and gross motor ability and balance; and (3) The Oral and Written Language Scales – Second Edition (OWLS-2) as a standardized measure of receptive and expressive language abilities. We conducted two hierarchical regressions: one with listening comprehension standard scores (receptive language) as the dependent variable and the other with oral expression standard scores (expressive language) as the dependent variable. We entered nonverbal IQ and diagnosis to control for confounding effects and six subscale standard scores of the BOT-2: Fine Motor Precision, Fine Motor integration, Manual Dexterity, Upper-limb Coordination, Bilateral Coordination and Balance.

Results: Our preliminary results are promising. The Fine Motor Precision standard scores were a significant predictor of receptive language scores, accounting for 24.8% of variance in scores across ASD and TD groups beyond non-verbal IQ and diagnosis, $F(1,14) = 6.320$, $p = 0.025$. Additionally, the Balance subscale appears to be trending towards significance, accounting for 16.1% of variance in scores beyond non-verbal IQ and diagnosis, $F(1,14) = 3.552$, $p = 0.058$. For expressive language scores, none of the BOT-2 subscales were significant predictors.

Conclusions: The initial results of this ongoing study indicate that in addition to fine motor abilities, balance may potentially be associated with language abilities in older children with and without ASD. These findings suggest that the relationship between motor and learning abilities may not be limited to sequencing.

412.024 *(Poster)* Print Vs. Pictures: Are Eye-Gaze Differences in Children with and without ASD during Shared Book Reading Associated with Emergent Literacy Skill Performance?

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Background: Significant challenges in becoming proficient readers are found in 30-50% of school-age children with autism spectrum disorder (ASD; Arciuli et al., 2013). Shared book reading during the preschool years facilitates language and emergent literacy learning in typically developing children, including important predictor skills of later reading ability (e.g., alphabet and vocabulary knowledge; NELP, 2008). Yet despite experiencing similar exposure to shared book reading as their peers without ASD, children with ASD often show differences in emergent literacy development. These consistently include relative strengths in print skills (e.g., alphabet knowledge) and challenges in meaning-related skills (e.g., vocabulary, comprehension; Westerveld et al., 2016). Such differences may reflect the detail-focused style observed in ASD which may lead to a greater focus on print versus pictures during shared book reading. Visual attention to print and pictures during shared book reading has been shown to differentially facilitate alphabet knowledge and vocabulary learning in preschoolers without ASD (Evans and Saint-Aubin., 2009; Justice et al., 2008), yet research investigating visual attention during shared book reading and association with emergent literacy performance for preschoolers with ASD is limited.

Objectives: We aimed to investigate differences between preschoolers with and without ASD in attention to print versus pictures during experimental shared book reading tasks. We used eye tracking technology to explore between-group differences in eye gaze to areas of interest (print vs. picture) and links to alphabet and vocabulary knowledge performance.

Methods: Participants included 60 3-5 year-old children (ASD: n = 37; M age = 54.27; SD = 8.88; without ASD: n = 23; M age = 47.43; SD = 8.12) recruited via autism-specific early intervention centres and mainstream childcare centres, local allied health professionals, and social media platforms. Experimental versions of two storybooks were created for viewing on a screen with narration. Children's eye movements were measured using a Tobii X2-30 binocular eye-tracker while each storybook was viewed on a computer screen. To assess children's emergent literacy skills, alphabet knowledge tasks and a vocabulary task (Peabody Picture Vocabulary Test; PPVT-4) were administered.

Results: Linear mixed-effect modelling (LMM) will be used to analyze the eye movement data collected. Models will be fit using the *lme4* package in *R*. The fit of each model will then be evaluated with R^2 using the MuMIn package in *R*. Between group differences in proportions of fixations, latency to first fixation and gaze fixation duration on each area of interest (print vs. pictures) will be analyzed. Fixed effects in the full model will include group (ASD vs. without ASD) and area of interest (print vs. picture); random effects will include subject and item (page of the book).

Conclusions: Findings will contribute to an enhanced understanding of the links between visual attention during shared book reading for preschoolers with ASD and their emergent literacy skills. Results will inform future shared book reading intervention research aimed at providing individualised support to promote emergent literacy and facilitate later reading success for children with ASD.

412.025 *(Poster)* Puzzling It out: Using a Novel Measure to Explore Metacognitive Abilities in Autism

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Background: Metacognition, or the understanding of one's own thought processes, is known to improve academic achievement, serves as the basis of therapeutic treatment for mental health conditions, and has been positively linked to social skills in autism. Current metacognitive research in autism has garnered equivocal results. To date there are no tasks which measure multiple metacognitive skills, the ones currently available only evaluate a small subset of skills and often involve language.

Objectives: With the guidance of an autistic mentor, this study looked to develop, explore, and validate a novel task measuring multiple metacognitive skills in order to better understand metacognitive differences in autism.

Methods: Basing the task on the concept of the block design test, a known strength for autistic individuals that lacks the need for language, we aimed to remove confounding effects of task demands on metacognitive processes. Skills evaluated were chosen by their ability to cover the entire metacognitive process that happens before, during and after completing a task. Therefore, the task evaluates planning (study time allocation, planning time), monitoring and control (increased accuracy of study time allocation as task progresses) and reflection (confidence judgments).

Study1

The task was built in PsychoPy and given to participants on a desktop computer. A third of the participants completed the task on their own computers via a link. Seventy-seven participants aged 18-25 took part in the study.

Study 2

Both autistic and neurotypical participants ages 10 to 18 are currently completing the Puzzle Task as part of a battery of assessments. Research is taking place within school-based computer suites.

Results: Study 1

After 39 participants, results indicated ceiling effects in that 15 of the puzzles had 81% or better accuracy rates. Puzzles were made more challenging and 38 additional participants recruited. Due to skew caused by ceiling effects, spearman's correlations were run. All three areas of metacognition (planning, r = 0.26, p = 0.02; monitoring and control r = -0.36, p = 0.002; evaluating r = 0.25, p = 0.03) significantly correlate with achievement as measured by puzzle accuracy. Components of metacognition also significantly correlate with each other (r's from -0.58 to 0.24).

Study 2

Results will be available for the conference.

Conclusions: Study 1

The Puzzle Task is a good task for measuring all aspects of metacognition, allowing the relationship between specific metacognitive skills and behavior to be evaluated in future research. Additionally, the data suggests a strong link between metacognitive abilities and puzzle accuracy, in that participants with longer planning times and better prediction and judgment accuracy complete more puzzles correctly.

Study 2

We expect to find patterns of strengths and weaknesses in autistic metacognitive abilities. This information will inform interventions aimed at improving academic achievement, access to mental health therapy, and/or social interactions in autism.

Note: I can show video of myself demonstrating each part of the task. No participants or sound are included. It is a screen shot capture only.

412.026 *(Poster)* Rhythm Perception: A Preserved Musical Ability of Children with Autism Spectrum Disorder

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Background: There is growing evidence showing musical ability as a strength of people with autism spectrum disorder (ASD). Many studies demonstrate intact or superior musical pitch, melody, and memory perception in ASD (Heaton, 2009), but only a few studies explore musical rhythm perception abilities. The preliminary research on rhythm perception suggests that people with ASD can process and produce simple and complex rhythms and that these musical skills are positively linked to cognitive visual-spatial skills in adolescence (DePape et al., 2012). Therefore, it is possible that rhythmic patterns in music can be used as temporal cues for synchronizing social interactions and facilitating impulse control in children and adolescents with ASD (Pellitteri, 2000). However, more research on the developmental trajectory of rhythm perception and its association with cognitive skills is necessary for future intervention planning.

Objectives: The purpose of this research is to 1) compare rhythm perception in typically developing (TD) children and children with ASD, as well as 2) compare rhythm perception and 3) its association with cognitive skills in younger and older children with ASD.

Methods: Eighteen TD children and 29 children with ASD (6-12 years of age) were recruited to examine objective #1. Nineteen older children with ASD (13-17 years of age) were also recruited to examine objective #2-3. All the participants completed a cognitive test (WISC-V/ WASI) and a rhythm perception task, which was an adapted version of the Beat Alignment Test (Iverson & Patel, 2008). The participants listened to short musical excerpts with overlaid beeps (on or off the musical beat) and identified whether the beeps matched the musical beat.

Results: One-sample t-tests revealed that TD children and children with ASD performed above chance level (two choices: 50%) on the rhythm perception task ($p < .05$); however, further inspection revealed that children with ASD with cognitive difficulties (full scale IQ < 70) could not complete the task above chance level, ($p > .05$) and thus, were removed from the sample ($n = 8$). An independent t-test revealed no group differences in task performance ($p > .05$). #2: There was also no difference in task performance between younger and older children with ASD ($p < .05$). Pearson correlations was used to confirm that there was no significant relationship between task performance and the age of participants ($p > .05$). #3: There was a strong positive correlation between visual-spatial abilities and rhythmic perception in older children with ASD ($r = .52$, $p < .05$) but not in younger children with ASD ($p > .05$).

Conclusions: Findings are consistent with previous research showing preserved rhythm perception for children with ASD across development, though this may not extend to children with ASD with cognitive difficulties. In harmony with the literature, we also found that rhythmic perception abilities are associated with visual-spatial abilities in adolescence. Findings could help guide the development of musical training programs that leverage preserved rhythm perception in ASD by using rhythmic patterns in music to facilitate behavioural (social skills, impulse control) and cognitive (visual-spatial abilities) functioning.

412.027 *(Poster)* Self-Regulation in Preschoolers with Autism Spectrum Disorder: Links to Autism Symptoms, School Performance, and Behavioral Regulation Strategies

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Background: Self-regulation development in early childhood has a long-lasting impact on children's school success and psychosocial wellbeing. Delays in self-regulation development are often reported in children with autism spectrum disorder (ASD). There is a need for research investigating how self-regulation of children with ASD is linked to their school performance and the factors that are related to children's self-regulation development.

Objectives: This study examined two essential self-regulatory skills, executive function (EF) and effortful control (EC), and their relations to the symptom severity and school performance of preschoolers with ASD.

Methods: A total of 32 preschoolers with ASD (M=52.64 months, SD= 6.70) from two private schools in the greater New York City area participated in this study. All participants had a clinical diagnosis of autism that was confirmed with an Autism Diagnostic Observation Schedule-Second Edition (Lord et al., 2012). Participants' EF skills were assessed directly through the NIH Toolbox Early Childhood Cognition Battery (Gershon et al., 2013), and their levels of EC were measured through a parental report, the Child Behavior Questionnaire-Short Form (Putnam & Rothbart, 2006). Participants' school performance was assessed using two teachers' measures, the Teacher Rating Scale of School Adjustment (Birch & Ladd, 1997) and the School Liking and Avoidance Questionnaire (Ladd & Price, 1987). Three behavioral measures were designed to assess participants' behavioral regulation strategies under frustrating situations: delayed delivery of tokens, edibles, and delayed turn-taking with an adult.

Results: Children with more severe ASD symptoms demonstrated significantly lower EF skills (see Table1 for all correlations) and lower behavioral school engagement as reported by teachers of children with ASD. Thus, children with more ASD symptoms demonstrated more difficulties in cooperating with others in school. In contrast, participants with higher levels of EC demonstrated greater school liking and better behavioral participation in school activities.

Participants' EF skills and levels of EC were positively associated with their maximum wait time during a delayed turn-taking task, such that children with better EF skills and higher levels of EC waited significantly longer for the teacher to finish her turn in playing without any disruptions or aggressions in an interactive turn-taking task.

Participants who used language to help regulate behaviors during tasks of delayed delivery of tokens and edibles were able to wait significantly longer than those who did not use language. Similarly, participants who used language more frequently during a turn-taking task with an adult were able to wait significantly longer than those who used less language.

Further analysis showed that participants with better joint attention skills on the ADOS-2 tended to use more language to help regulate their behaviors under frustrating situations. Female participants also tended to use more language than males during an interactive turn-taking task with an adult to facilitate their regulation.

Conclusions: Self-regulation plays a crucial role in the school performance of children with ASD. The severity of ASD adversely impacts the development of self-regulation in this atypical population. Language appeared to be the only behavioral regulation strategy that was related to children's longer waiting in all three delayed tasks.

412.028 *(Poster)* Sticky or Slippery Attention: How Do Symptoms of ASD and ADHD Affect Children's Attention Disengagement?

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Background: Some studies reported that people with autism spectrum disorder (ASD) had "sticky attention", for example, they could display longer disengaging latency (Elsabbagh et al., 2009, 2013). However, some evidences demonstrated comparable disengaging latency in people with ASD and typically-developing (TD) people (Fischer et al., 2014, 2015). On the other hand, Attention Deficit Hyperactivity Disorder (ADHD) was embodied with general distractibility that they distract their focused attention to the on-going task unrelated stimuli (Aboitiz, Ossandon, Zamorano, Palma & Carrasco, 2014; Cheung et al., 2015). Considering that ADHD is one of the most common co-occurring mental disorder in ASD, it is intriguing to examine the attentional disengagement in children with ASD and ADHD, compared with children with these disorders alone.

Objectives: In current study, we examined (a) the impact of comorbidity with ADHD on attentional disengagement of ASD. and (b) how symptoms of ASD and ADHD influence children's attentional disengagement. We hypothesized that different effect of ASD and ADHD symptoms on children's attentional disengagement: specifically, the autistic trait would lengthen the disengaging latency while hyperactivity trait would shorten the disengaging latency.

Methods: A group of children with ASD ($N = 33$, $M_{age} = 8$, $M_{IQ} = 104$), a group of children with ASD with comorbid ADHD ([ASD-ADHD], $N = 18$, $M_{age} = 6.17$, $M_{IQ} = 82.78$), a group of children with ADHD ($N = 31$, $M_{age} = 7.16$, $M_{IQ} = 109$) and a group of TD children ($N = 28$, $M_{age} = 7.68$, $M_{IQ} = 110$) completed the attentional disengagement task. Participants' disengaging latency from central stimuli to simultaneous or subsequent onset of peripheral stimuli was measured by eye- tracking technology. The setting of two condition enables us to prob both ability of disengaging attention from a fixed target (Disengage Condition) and shifting attention to another location with the hint of prior cue (Shift Condition). We compared disengaging latency of four groups in both Disengage Condition and Shift Condition.

ASD group, ADHD group and ASD-ADHD group were categorized into atypical development (AT) group; typical development (TD) group and AT group were combined into an independent factor of Group to predict the disengaging latency along with autistic traits and hyperactivity traits. Children's autistic traits and hyperactivity traits were measured by Autism Spectrum Screening Questionnaire (ASSQ) and ADHD Rating Scale.

Results: We found that (a) disengaging latency in condition of Disengage was longer than that in Shift condition for all groups; (b) disengaging latency in condition of Disengage for the ASD-ADHD group was significantly longer than ASD, and ADHD groups. Disengaging latency of the ADHD group was significantly shorter than the TD group in Disengage condition; (c) more severe repetitive behavior and less severe hyperactivity were correlated with longer disengaging latency; (d) symptom of repetitive behavior had larger effect on disengaging latency in the TD group than AT group.

Conclusions: Our findings suggested that the comorbidity of ASD and ADHD would deteriorate the attentional disengagement of ASD group, and autistic trait prolonged disengaging latency while hyperactivity trait acts on it adversely.

412.029 *(Poster)* The Impact of Activities and Speech on Scene Scanning Patterns in School-Age Children with ASD

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Background: Previous work has shown that toddlers with ASD look less at activities and heads than typically-developing (TD) toddlers when presented with dyadic interactive play scenes (Shic et al., 2011). Less is known about how school-age children with ASD visually process scenes with dyadic interactive play, and even less is known about how components, such as the presence or absence of activities or speech, underlie this process.

Objectives: To examine how speech and activities modulate differences in face scanning and activity monitoring between school-age children with and without ASD.

Methods: Participants were 30 children with ASD (Mean Age=7.84 years, SD=2.77) and 22 TD children (Mean Age=7.93 years, SD=2.40). Stimuli were presented as three 20-second activity monitoring video clips depicting two actresses interacting naturalistically over a shared activity. Clips were broken into sections by the presence of Speech (no speaker/one speaker) and Activity (no activity/activity). For each possible combination of conditions, dependent variables were based on the proportions of time spent examining the regions-of-interest (ROIs): (a)%Activity and (b)%Head. When Speech was present, we also examined looking at (c)%Speaker Head and (d)%Non-Speaker Head. Statistical analyses used linear mixed model approach to examine group and condition effects; associations with ADOS autism severity in ASD group were measured using Pearson's correlation.

Results: For %Activity, ANOVA revealed a group main effect (F(1,48.6)=5.91, p=.019) and no group interaction, with ASD looking more at activities than TD children (ASD M=45.2%; TD M=33.4%; d=.74). For %Heads, a group main effect (F(1,48.9)=6.65, p=.013) and a 3-way-interaction (group x activities x speakers, F(1,138.1)=6.94, p=.009) were observed. ASD group generally looked less at heads (ASD M=25.9%; TD M=38.1%; d=-.76); this was driven primarily by the condition with no activities and one speaker (ASD M=35.2%; TD M=56.2%; d=-1.32, p<.001) and, to a lesser extent, activities with no speaker (ASD M=9.8%; TD M=21.5%; d=-.73, p=.035). When a speaker was present, between-group differences did not exist in %Speaker Head(p's>.270); however for %Non-Speaker Head a group main effect (F(1,43.9)=12.6, p<.001) and a group x activities (F(1,44.9)=12.4, p<.001) interaction were observed. This interaction indicated between-group differences only when no activity was present (no Activities: d=-1.75, p<.001; with Activities: d=-.70, p=.070). Interestingly, correlations between looking patterns and severity of autism symptoms were correlated to %Speaker Head (r(28)=-.42-.60, p<.05).

Conclusions: As expected, children with ASD looked less at heads than TD children. Contrary to expectations, they looked more at activities. Between-group differences in face scanning were heightened when no activities and one speaker were present. This effect was driven by diminished looking at non-speaking, compared to speaking heads, suggesting children with ASD are making fewer predictions regarding the interactive nature of dialogue. This may be due to diminished ability to use scene cues (e.g. people talking or engaging in activities) to infer the importance of agents or to split their attention accordingly as TD children do. Interestingly while between-group differences in looking at heads seemed driven by attention to non-speaker's head, relationships with phenotype within ASD strongly associated with looking at the speaker's head, suggesting a potential separation between discriminative and stratification markers.

412.030 *(Poster)* The Impact of Auditory Distractors on Visual Search and Classroom Performance in College Students with ASD

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Background: Individuals with autism spectrum disorder (ASD) are enrolling in post-secondary education in increasing numbers; however, students with ASD are less likely to complete a degree than students with other disabilities. Successful classroom performance relies on the ability to focus selectively on relevant course-related information, while filtering out irrelevant distractions. These attentional functions – selecting and filtering - are associated with academic achievement. However, individuals with ASD exhibit pervasive impairments in filtering irrelevant visual and auditory information. Yet, it is unclear how this may affect in-class performance. The present study used visual search (VS), a task in which individuals with ASD excel, to investigate filtering of irrelevant auditory information and its association with off-task classroom behaviors in college students with ASD.

Objectives: To investigate the impact of filtering of irrelevant social and non-social noise on VS performance in college students with ASD, and to examine the association between filtering abilities and classroom behavior in students with ASD.

Methods: To date, participants are 5 college-aged students with ASD and 14 age- and IQ-matched typically developing (TD) students (projected n = 20 ASD, 20 TD). Participants completed a VS paradigm and three classroom observations. Participants' task was to indicate the presence or absence of a target "T" embedded within arrays of distractor "Ls," which were rotated in 1 of 4 cardinal orientations in set sizes of 18, 27, and 36. The task was divided into 3 conditions: quiet (no auditory stimuli), social (a stereo-monotract of two continuous overlapping voices of equal amplitude reading stories) and non-social (speech-shaped pink noise matching the amplitude and intensity of the social condition). The conditions were counterbalanced across participants. For the classroom observations, each participant was observed for 3, 30-minute sessions. The instructor, participant, and peer behavior (e.g., engagement/off-task, attentional shifts on/off-task, response to instructor/peer) were coded online.

Results: In the VS task, groups did not differ for overall response time (RT) or accuracy. As expected, participants were faster with smaller set sizes and when the target was present ($p< 0.05$); RT did not vary across noise conditions. To examine the cost of filtering, difference scores were calculated by subtracting noise conditions from the quiet condition (quiet – social; quiet - non-social). Students with ASD showed a greater filtering costs to social (M = -131ms) and non-social (M = -156ms) conditions, whereas TD students exhibited an RT benefit to social (TD = 97ms) and non-social (M = 91ms) noise conditions; however, group differences were not statistically significant ($ps = 0.19$). For both groups combined, there was a significant correlation between social difference score and off-task attentional shifts ($p< 0.05$), indicating that poorer filtering during VS was associated with more frequent off-task attentional shifts in the classroom.

Conclusions: Although preliminary, our results suggest that college students with ASD may have difficulty filtering irrelevant social and non-social auditory information. Further, the association between difficulties filtering in the VS task and increased off-task attentional shifts in the classroom data suggest that problems filtering may contribute to more off-task classroom behaviors.

412.031 *(Poster)* The Impact of Bilingualism on the Executive Function Skills of Arabic-English Children with Autism and Their Typically Developing Peers

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Background: there is evidence to suggest that certain executive function (EF) skills are impaired in children with autism, underlying several of autism's key characteristics. There is also evidence to suggest that the regular use of two languages has the potential to extend EF capacities. Most of the findings to date have focused on non-clinical populations, and are characterized by a substantial amount of conflicting evidence. Much remains unknown about the impact of bilingualism on the EF abilities of children with autism, with less than five studies published to date.

Objectives: to investigate the impact of bilingualism on the EF performance of Arabic-English children with autism and their typically developing (TD) peers, thus contributing to the evidence-base surrounding bilingual children with autism.

Methods: a battery of EF tests tapping into flexible switching (dimensional change card sorting task), sustained attention (psychomotor vigilant task), working memory (self-ordered pointing task) and interference control (simon task) was administered to 132 child participants from 10+ nationalities (mainly from the Middle East and North Africa region) based in the United Arab Emirates. The participants' ages ranged 5-12 years (mean age of 8.75 and SD of 1.73) and made up 4 groups; 33 TD Arabic-English bilinguals, 33 Autistic Arabic-English bilinguals, 33 TD Arabic/English monolinguals, and 33 Arabic/English Autistic monolinguals. Participants were matched on age, non-verbal IQ, and socioeconomic status. The distribution of gender groups was more balanced in the TD group (approximately 45% male and 55% female) versus the autistic group (approximately 60% male and 40% female). We hypothesize that bilingual groups (both TD and autistic) will outperform monolingual groups on interference control, flexible switching, sustained attention, and working memory.

Results: findings indicate a bilingual advantage for children with autism in sustained attention, a monolingual advantage for children with autism and their TD peers in interference control, and equivalent performances between bilingual and monolingual participants for children with autism and their TD peers in working memory and flexible switching. Findings suggest that bilingualism in autism can have differential influences in executive function depending on the task and outcome variables.

Conclusions: the reality is, parents, therapists, and educators around the world lack sufficient evidence to support their language decisions and choices for children with autism. These choices hold consequences for the treatment, education and formation of ethnic identities for children with autism. We can infer from the results that bilingualism does not negatively impact EF skills in children with autism, and can actually show an advantage in specific outcome variables of EF tests. We will also report on data from ratings-based measures of EF (using the Comprehensive Executive Function Inventory – CEFI) which assess the EF abilities of the same participants but across a wider time span, in school and home environments, from the perspective of teachers and parents respectively. Finally, we will report on the relationship between EF performance on direct tasks and autism symptoms (as measured by the Social Responsiveness Scale – 2 and rated by teachers), highlighting individual differences in EF performance in children with autism. **Background:** there is evidence to suggest that certain executive function (EF) skills are impaired in children with autism, underlying several of autism's key characteristics. There is also evidence to suggest that the regular use of two languages has the potential to extend EF capacities. Most of the findings to date have focused on non-clinical populations, and are characterized by a substantial amount of conflicting evidence. Much remains unknown about the impact of bilingualism on the EF abilities of children with autism, with less than five studies published to date.

Objectives: to investigate the impact of bilingualism on the EF performance of Arabic-English children with autism and their typically developing (TD) peers, thus contributing to the evidence-base surrounding bilingual children with autism.

Methods: a battery of EF tests tapping into flexible switching (dimensional change card sorting task), sustained attention (psychomotor vigilant task), working memory (self-ordered pointing task) and interference control (simon task) was administered to 132 child participants from 10+ nationalities (mainly from the Middle East and North Africa region) based in the United Arab Emirates. The participants' ages ranged 5-12 years (mean age of 8.75 and SD of 1.73) and made up 4 groups; 33 TD Arabic-English bilinguals, 33 Autistic Arabic-English bilinguals, 33 TD Arabic/English monolinguals, and 33 Arabic/English Autistic monolinguals. Participants were matched on age, non-verbal IQ, and socioeconomic status. The distribution of gender groups was more balanced in the TD group (approximately 45% male and 55% female) versus the autistic group (approximately 60% male and 40% female). We hypothesize that bilingual groups (both TD and autistic) will outperform monolingual groups on interference control, flexible switching, sustained attention, and working memory.

Results: findings indicate a bilingual advantage for children with autism in sustained attention, a monolingual advantage for children with autism and their TD peers in interference control, and equivalent performances between bilingual and monolingual participants for children with autism and their TD peers in working memory and flexible switching. Findings suggest that bilingualism in autism can have differential influences in executive function depending on the task and outcome variables.

Conclusions: the reality is, parents, therapists, and educators around the world lack sufficient evidence to support their language decisions and choices for children with autism. These choices hold consequences for the treatment, education and formation of ethnic identities for children with autism. We can infer from the results that bilingualism does not negatively impact EF skills in children with autism, and can actually show an advantage in specific outcome variables of EF tests. We will also report on data from ratings-based measures of EF (using the Comprehensive Executive Function Inventory – CEFI) which assess the EF abilities of the same participants but across a wider time span, in school and home environments, from the perspective of teachers and parents respectively. Finally, we will report on the relationship between EF performance on direct tasks and autism symptoms (as measured by the Social Responsiveness Scale – 2 and rated by teachers), highlighting individual differences in EF performance in children with autism.

412.032 *(Poster)* The Relationship between Cognitive Processes and Social Responsiveness: Investigating Executive Function Patterns in Autism Spectrum Disorders

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Background: A strong relationship exists between executive function and social competencies in youth with ASD (Gilloty et al., 2010; Kouklari et al., 2018). The influences of both executive function and social skills for youth with ASD have been evaluated in regard to quality of life, theory of mind, and adaptive behavior; however few studies have assessed the role of executive function skills in contributing to social skill variability (Berenguer et al., 2018; de Vries & Geurts, 2015; Tsermentseli et al., 2018). As impairments in executive function skills increase from childhood to adolescence for individuals with ASD, exploring the underlying role of specific executive function skills in explaining social behavior patterns warrants further investigation (Pugliese et al., 2015; Rosenthal et al., 2013; Gardiner & Iarocci, 2018). Based on these limited studies, observed relationships between executive function and social functioning in this population are specific to metacognition rather than behavior regulation (Leung et al., 2016; Torske et al., 2018). However, these studies have been limited by small ASD sample sizes (n=70, n=86, respectively), and the only study that examined this relationship with a larger sample size focused on evaluating gender differences while exclusively including metacognitive executive function factors (Chouinard et al., 2019). Therefore, the detailed relationship between executive function skills and social functioning remains unclear.

Objectives: This study extends limited previous published evidence utilizing a larger sample size to investigate the unique roles of executive function elements (see Table 1). These study objectives will examine variability in social responsiveness factors including social awareness, social cognition, social communication, and social motivation to inform the potential role of underlying cognitive processes in social behavior patterns observed in ASD.

Methods: This investigation utilized a subset of secondary data originally collected through the Autism Brain Imaging Database Exchange II (ABIDE, *N*=171, 138 male, mean age=11.24 years, SD=2.49). The ABIDE database promotes brain connectome and phenotypic characterization of autism by aggregating de-identified neuroimaging and phenotypic data from 19 sites. We performed linear regression analyses, using scores on the *Behavior Rating Inventory of Executive Function* (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) Clinical Scales as a predictor of scores on the *Social Responsiveness Scale* (SRS; Constantino & Gruber, 2005) Treatment Subscales.

Results: Reported executive function clinical scale scores were found to significantly account for 4.5-10% of variability in social functioning measures, with the greatest variability for social motivation followed by social awareness, social cognition, and social communication (see Tables 2-5). Models only indicated organization of materials and planning/organizing to be significantly associated with social functioning when controlling for other executive function skills and was not consistent across all models.

Conclusions: These findings support previous studies' claims that metacognitive executive functions are more strongly associated with social functioning compared to behavior regulation factors. In contrast to previous findings, the model including individual elements of both metacognition and behavior regulation significantly accounted for variability in social motivation (Torske et al., 2018). Next analytic steps include discerning differences in executive function and social functioning relationship associations specific to IQ and gender.

412.033 *(Poster)* The Relationship between Performance on a Musical Working Memory Task and Parent Reports of Working Memory: A Comparison between Typically Developing Children and Children with ASD.

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Background: Autism Spectrum Disorder (ASD) is often associated with strengths in music perception, which requires auditory working memory, although parent reports often suggest difficulty with working memory in daily life.

Objectives: We thus aim to **1)** compare the performance of typically developing (TD) children and children with ASD on a musical working memory task and **2)** investigate the relationship between the performance on a musical working memory task and (non-musical) day-to-day working memory skills.

Methods: Eighteen children with ASD (age= 6-12) and eighteen TD children (age= 7-11) participated in this study. To assess musical working memory, sequences of 3, 4, and 5 pitches were presented in pairs and participants were asked to identify whether sequence-pairs were similar or different. The 4 and 5 pitch sequences included two conditions: 1) the different sequence-pairs introduced a new pitch, or 2) the different sequence-pairs used already introduced pitch but inversed their position in the sequence. The goal of creating these two conditions (e.g., 4 pitch vs. 4 pitch with inversion) was to increase the task's complexity. Total performance was calculated as Hits minus False Alarms. The Working Memory Scale of the Behavior Rating Inventory of Executive Functions-2 (BRIEF-2) parent questionnaire was used as a potential correlate of the participants' task performance.

Results: 1) Independent sample t-tests revealed that total performance on the musical working memory task did not differ between the ASD and TD groups, nor did it differ on the 3- 4- 5-pitch and 4- 5-pitch with inversion conditions (all *p*-values >.05). However, when comparing the performance within groups, the TD group performed significantly lower on the 4-pitch with inversion vs. the 4-pitch condition (p=.001), while the ASD group's performance did not differ between conditions (p=.110). Both ASD and TD groups performed significantly lower on the 5-pitch with inversion vs 5-pitch condition (p=.01) **2)** Independent sample t-test revealed that there was significantly lower BRIEF-2 working memory skills in the ASD compared to TD group (p=.01). However, BRIEF-2 working memory skills were not related to musical working memory task performance for either group.

Conclusions: Our findings reveal that children with ASD performed equally well on the musical working memory task in comparison to TD children. While the 5-pitch sequences were more difficult for both groups, the ASD group's performance on the 4-pitch sequences with and without inversion revealed that they were not as impacted by the complexity and difficulty of the task in comparison to TD children. This finding is in line with documented strengths of people with ASD in musical perception. Furthermore, parent reports of working memory were not related to task performance for either group. Results provide preliminary evidence for the use of music as a strength-based modality to assess the working memory abilities of children with ASD to complement traditional tests and questionnaires.

412.034 *(Poster)* The Role of Executive Functioning, Language Ability, and Theory of Mind in Autistic Adults' Interview Performance

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Background: Formal social interactions such as police interviews, healthcare consultations, and job interviews are complex, often ambiguous, social situations that provide a microcosm of the problems experienced by autistic people in everyday life. Producing appropriately detailed, accurate, relevant, and coherent responses to questions requires monitoring of one's cognitions, generating and planning an appropriate response, holding in mind various reporting options, inhibiting reporting of details deemed to be irrelevant or inaccurate, and selecting an optimal level of detail whilst switching between one's own and the interviewer's perspective. These are all areas of difficulty for autistic people, and are particularly exacerbated under open questions.

Objectives: To examine the role of executive functioning (EF), Theory of Mind (ToM) and language ability on autistic adults' interview performance under different levels of support and question types, using data collected across two separate interview studies.

Methods: Tests of EF, ToM, and language were measured in two studies (reported elsewhere) investigating adaptations to interview questions: 1) a study of autobiographical memories in police, employment, and healthcare contexts, with 30 autistic adults and 30 typically developing (TD) comparisons interviewed both with and without question support; and 2) a study adapting employment interview questions based on employer ratings of answer quality, with 25 autistic and 25 TD comparisons, again interviewed both with and without question support. Tests included inhibition, working memory, ERRNI mean length of utterances (MLU), ERRNI forgetting index, Adult-Theory of Mind (A-ToM), and the Tower test.

Results: For study 1, multiple linear regression predicting specificity in the 'no support' condition was conducted, with group (autistic or TD) as the predictor in step 1, and all measures as above in step 2. Both models were significant (p = .048 and p = .015). Group was no longer a significant predictor at step 2, p = .366, with working memory (forward span) the only predictor, p = .004. Models were non-significant when predicting residual specificity difference between the 'no support' and 'support' conditions, ps > .323.

For study 2, a regression was conducted predicting answer quality ratings at Phase 1 (no support), with group as predictor in step 1, and all additional measures in step 2. Both models were significant (p = .002 and p = .010). At step 2, group remained significant, p = .016, as well as working memory (forward) p = .012, and ToM, p = .027. Models were non-significant when predicting residual difference between answer quality ratings for the supportive and non-supportive questions, ps > .654.

Conclusions: When open, unsupportive questions are asked, recall quality is related to working memory and ToM abilities in an employment interview context. However, when questions are sufficiently supportive, EFs and ToM do not predict recall. Under open questioning, respondents may rely on working memory to hold the question in mind. During employment interviews, ToM skills may be additionally required to determine the most appropriate response to a question. These findings provide insight into which EFs may be scaffolded in order to effectively support autistic people's recall in interviews.

412.035 *(Poster)* Towards a Model of Neurodevelopmental Continuum for ASD, ADHD and Schizophrenia

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Background: According to the Neurodevelopmental continuum hypothesis, neurodevelopmental disorders, including ADHD, Autism and Schizophrenia, should be reconceptualised as lying on an aetiological and neurodevelopmental continuum, with the individual disorders reflecting various degrees of abnormal brain development and resulting functional abnormalities. The model stands on recent findings of shared genetic risk factors, as well as overlapping pathogenic mechanisms.

Objectives: Genetic predisposition is expressed by different degrees of cognitive impairment and persistence of functional impairment. Coherently, our primary goal is to explore commonalities and diagnostic specificities among the three conditions in various cognitive subdomains.

Methods: Four groups of young adults were included: 26 with Autism Spectrum Disorder (ASD, 19.7±1.9, 25 males), 28 with Attention-Deficit/Hyperactivity Disorder (ADHD, 19.9±1.4, 15 males), 21 with Early-Onset Schizophrenia (SCZ, 19.7±1.7, 15 males), 29 typically developing participants (TD, 19.8±1.6, 12 males). Participants were matched on age and full-scale IQ. Eye movements were recorded binocularly at 1000 Hz using the Eye Link 1000+ system, while four basic ocular-motor tasks (prosaccade (PRO), antisaccade (ANT), memory-guided saccade (MEM), fixation (FIX)) were administered in counterbalanced order.

Results: With respect to saccadic RT, ASD and ADHD did not differ from TD in the measure of intra-subject variability (ISV) for PRO, ANTI, MEM. Conversely, SCZ were significantly more variable than TD in all tasks, than ASD in PRO, but not compared to ADHD, while being significantly slower than TD and ASD for PRO and ANT, marginally compared to ADHD for ANT. Increased percentage of anticipatory saccades in ASD and ADHD, in comparison to TD, was found for MEM, only marginally for PRO in ASD versus TD, again for all tasks in SCZ versus TD, but also compared to ASD and ADHD in ANT. A significantly higher percentage of direction errors during ANT aggregated all clinical groups, increased frequency of intrusive saccades during FIX gathered SCZ and ASD, marginally ADHD, compared to TD. As for microsaccades, SCZ and ASD showed a higher frequency of microsaccades for FIX (condition without distractors) and PRO (preceding correct saccades), only SCZ for ANT (both preceding correct saccades and direction errors), compared to TD.

Conclusions: Results suggest preserved sensory-motor control in ASD and ADHD, as compared to SCZ. Conversely, increased anticipatory saccades and direction errors support the presence of inhibition deficits across groups, suggesting a common (pre-)frontal functional impairment. Of note, mean RT discriminates the clinical groups better than ISV, thus emerging as a trans-diagnostic process to the three conditions and, uniquely for SCZ, a rather general deficit, independent of the specific task. Finally, atypical microsaccadic frequency might suggest common abnormalities in motor response preparation in SCZ and ASD. Across all tasks, participants with Schizophrenia appear more impaired than those with ADHD and ASD, which often did not significantly differ from each other, which might be related to the idea of a continuum of impairment.

412.036 *(Poster)* Understanding Attentional Strengths and Weaknesses in Autism Spectrum Disorder

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Background: Infants at elevated risk for autism spectrum disorder (ASD), as well as children, adolescents, and adults diagnosed with ASD excel at visual search compared to their typically developing (TD) peers. Paradoxically, slowed attentional disengagement has also been found across the lifespan in those at risk for, or diagnosed with, ASD. However, how these two paradoxical states co-exist within the same individuals and their underlying neurofunctional mechanisms remain to be determined.

Objectives: To 1) examine the relationship between enhanced visual search and impaired disengagement, and 2) assess the role that the locus coeruleus – norepinephrine (LC-NE) system, as indexed by pupil diameter, plays in the manifestation of atypical attentional processes in the same cohort of children with ASD.

Methods: Participants were 26 children with ASD and 26 age- and non-verbal IQ-matched TD children. The study consisted of separate visual search, gap-overlap, and resting eye-tracking paradigms. For the visual search paradigm, participants were instructed to find the target (vertical line) embedded within an array of tilted (10°) distractor lines. The target was present on 50% of trials, and displayed within set sizes of 18, 24, and 36 items. In the gap-overlap task, participants were instructed to fixate on a central crosshair and then move their eyes to a peripheral target once it appeared. Each trial began with a crosshair presented alone for a random duration. Next, a target could appear with either the crosshair remaining on the screen (overlap condition) or 200ms after the crosshair disappeared (gap condition). For the resting eye-tracking paradigm, a black central crosshair was presented on a grey background, and participants were instructed to relax, remain still, and to look at the crosshair. Saccadic latency and pupil diameter were monitored using an EyeLink 1000 Plus remote eye-tracking system.

Results: For the visual search paradigm, groups did not differ significantly for RT or accuracy; although children with ASD showed faster search efficiency (ASD: 26ms/item; TD: 35ms/item), these did not differ significantly. For the gap-overlap paradigm, groups did not differ on overall saccadic RT. Saccadic RT difference scores (overlap – gap, i.e., gap effect) were larger for children with ASD (ASD = 66ms; TD = 39ms), however, these did not differ significantly. Pupil diameter was significantly larger in the ASD group ($p < .05$). Correlations between gap effect and search efficiency measures showed that for the ASD group (but not the TD group), slower disengagement was associated with better search efficiency ($p < .05$). Across both groups, larger pupil size was related to slower disengagement and more efficient visual search ($ps < .05$).

Conclusions: Between-group differences were not present for visual search and disengagement measures. However, for the ASD group, greater search efficiency was associated with slower attentional disengagement. For both groups, increased tonic activation of the LC-NE system (i.e., larger pupil size) was associated with increased search efficiency and poorer attentional disengagement. The present findings suggest attentional strengths and weaknesses are associated in individuals with ASD, and may be linked to atypical activation of the LC-NE system.

412.037 *(Poster)* Visual Attention and Proactive Inhibition in a Social and Non-Social Cueing Task in Autism Spectrum Disorder

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Background: Spatial attention allows to select and process relevant information in the environment. It is classically studied with a cued detection task, in which a visual cue is presented at the future location of the target in order to facilitate its detection. In some trials, the cue is presented at the incorrect location (invalid vs valid trials), leading to longer reaction times (RTs) due to the incorrect orientation of attention. This very-well known paradigm has recently been reexamined in typically developing (TD) subjects, showing that RTs were susceptible not only to attentional factors but also to executive ones like proactive inhibition, preventing inappropriate reactions to events (i.e. the cue in a cueing paradigm).

Autism spectrum disorder (ASD) has been associated with dysfunctions in spatial attention. Previous studies using a cueing paradigm in ASD subjects have found various results. One source of variability is the nature of the cue used to orient attention: central (endogenous) or peripheral (exogenous), and social (e.g. orientation of the eyes) or non-social (e.g. arrow or object). Another source of variability could be the proactive inhibition process, which has never been evaluated in a cueing paradigm in ASD.

Objectives: Our objective was to assess the reaction times in a cued detection task in ASD and evaluate both the influence of the nature of the cue (social or non-social) and of the context (more or less proactive inhibition).

Methods: Twelve ASD (20-37 years old, 3 females) and twelve TD (matched with ASD) adults were included in our protocol. The subjects performed three blocks of peripheral cueing tasks. In the first one, the subjects had to fixate a central cross and to press a button when a target (star) appeared on the left or the right side of the screen. In the two other blocks, trials with only the target (star) were mixed with trials in which the target was preceded by a cue presented on the same side (valid) or on the other side (invalid) of the screen (75% validity). The cue could either be social (a face) or non-social (a butterfly), and was presented at three possible timings before the target. The fixation was controlled thanks to eye-tracking.

Results: Performance and RTs were recorded. Two of the 12 ASD subjects were impaired in cued trials (low performance). In the remaining 10 ASD subjects, RTs were faster in cued than in non-cued trials, a validity effect was observed (valid trials faster than invalid ones), with no difference between social and non-social cues. These results were not significantly different from those of TD subjects. However, the RTs for the first block, allowing to measure the proactive inhibition, showed an impairment in ASD subjects compared to TD subjects.

Conclusions: Exogenous spatial attention does not seem to be atypical in ASD participants, even for social cues. However, proactive inhibition in ASD participants seems very variable and is not comparable with TD subjects. The relationship between this proactive inhibition, spatial attention and clinical measures needs to be explored in further details.

412.038 *(Poster)* Visual Search: A Direct Comparison between Young Adults with ASD, ADHD, Schizophrenia and Healthy Controls

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Background: Superior visual search is a replicated finding in the literature on Autism Spectrum Disorder (ASD). Conversely, results from the literature on Attention-Deficit/Hyperactivity Disorder (ADHD) are more mixed, with some studies showing typical performance and others pointing out less efficient serial search in ADHD. Finally, most studies on visual search in Schizophrenia highlighted deficits in focal attentional processing. However, similarities between attentional impairments in the three clinical groups have also been reported.

Objectives: The primary goal of our study is to determine the diagnostic specificity of search deficits. To our knowledge, the literature systematically comparing the visual search performance in patients with ADHD and Schizophrenia is limited to one study, while no study has so far included an ASD group in the comparison.

Methods: A visual search task was presented to four groups of young adults, namely typically developing (TD; 19.8±1.6, 41% males), ASD (19.7±1.9, 96% males), ADHD (19.9±1.4, 54% males) and Early-Onset Schizophrenia (SCZ; 19.7±1.7, 71% males), while eye movements were recorded with the Eye Link 1000+ system. Participants were matched on age and full-scale IQ.

Results: Initiation of search – latency of the first saccade on the search grid – was typical in all participants except those with SCZ, who had significant higher intra-subject variability (ISV) than both TD and ADHD, but not compared to ASD. Within search, ASD manifested significantly reduced mean and ISV of total search duration – between the first saccade on the grid and the last fixation on target – and of the first part of search – between the first saccade on the grid and the first fixation on target – in comparison with all other groups, including TD. Conversely, both ASD and SCZ showed significantly longer mean duration than ADHD and were more variable than TD and ADHD regarding first fixation on target. Additionally, ASD needed a significant lower frequency of fixations on target than SCZ, but not compared to ADHD or TD. In the post-search phase – between the onset of the last fixation on target and the button press on the keyboard – SCZ were the slowest and most variable group, followed by ASD and ADHD. The overall search performance – between trial onset and button press – resulted in typical manual mean RT in ASD and ADHD, versus TD, while being abnormally long in SCZ, compared to all other groups. ISV was typical in ADHD, below typical in ASD, above typical in SCZ.

Conclusions: Results suggest that the ability to extract individual targets is intact in ASD and ADHD. However, ASD only show a bias toward local information, as indicated by longer first fixation duration, despite intact global processing. Differently, lower search efficiency in SCZ might be explained by both (a) abnormal global processing, due to impairment in the guidance mechanisms that affect the time until the first fixation on target, and (b) a deficit in central discrimination, with resulting difficulties in extracting critical features of the target.

412.039 *(Poster)* Weighting of Perceptual Beliefs and Sensory Evidence: Prediction in Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is characterized by deficits in social communication and interaction, restricted interests and behaviors, and sensory abnormalities. A growing body of work suggests that alterations in predictive processes may contribute to these symptoms, where fundamental differences in the weighting of sensory evidence over prior knowledge can influence the way individuals with ASD approach their surroundings and navigate social situations.

Objectives: Here we assessed the integrity of predictive processes in adults with ASD. To this end, we manipulated stimulus presentation probabilities and measured neural activity with scalp electroencephalography (EEG) and behavioral responses in two separate experiments.

Methods: In one experiment, adults with ASD (n=14, mean age=22.1±7.1 years) and neurotypical controls (NTC; n=14, mean age=22.4±3.7 years) passively participated in an auditory mismatch negativity (MMN) paradigm that comprised of a standard stimulus presented on 85% of the trials and three deviant stimuli each representing 5% of the total trials. Deviant stimuli differed from the standard along the dimensions of duration, frequency, and duration+frequency. Here, participants were conditioned to expect the standard stimulus; the MMN reflects the mismatch in expectations from priors versus the actual auditory stimuli when presented with a deviant tone. We predicted that a bias towards sensory evidence would result in attenuated MMN signal in ASD.

In a second experiment using a Pavlovian learning task, we tested the relative weighting of sensory evidence and prior beliefs (ASD: n=9, mean age=25.2±5.7 years; NTC: n=9, mean age=21.6±3.1 years). We first induced an association between an at-threshold tone (75% likelihood detection) and a visual stimulus through frequent, concurrent presentations. Next, we tested the strength of perceptual beliefs by systematically lowering the proportion of trials with a perceivable tone to subthreshold (50% and 25% likelihood detection levels) or absent, measuring tone detection. Here, a bias towards prior beliefs occurs when participants report hearing tones on trials when none was presented. We posited that ASD participants would report the tone on no-tone trials less frequently than NTCs, again reflecting a bias towards sensory evidence.

Results: Results from the first experiment revealed no significant main effects of deviant type ($F(2,52)=1.80$, $p=0.18$, $\eta_p^2=0.07$) or group ($F(1,26)=0.32$, $p=0.58$, $\eta_p^2=0.01$), and no interaction ($F(2,52)=0.35$, $p=0.71$, $\eta_p^2=0.01$). These results indicate that expectations of deviant tones did not differ between groups.

In the second experiment, there was no significant difference between groups in reports of hearing a tone on tone absent trials ($t(16)=0.09$,$p = 0.93$,Cohen's $d=0.045$). Together, both groups responded to hearing a tone greater than chance on tone absent trials (ASD: $p=0.009$, NTC: $p=0.002$), suggesting greater weighting of prior beliefs. Examining the neural response, we found a significant interaction between threshold level and group, $F(3,48)=4.48$, $p=0.007$, $\eta_p^2=0.22$, such that ASD participants showed comparable neural response across threshold levels whereas NTC participants demonstrated attenuated neural response at the lowest threshold levels (25% likelihood detection and tone absent).

Conclusions: In two sperate experiments, we found no evidence of compromised prediction processing in ASD in the context of beliefs about the occurrence of low-level auditory sensory input.

Cognitive Neuroscience

PANEL SESSION — **COGNITIVE NEUROSCIENCE**

203 - Examining Neural Dynamics of Social and Nonsocial Cognitive Control in ASD: Converging Evidence from EEG and MEG

Panel Chair: So Hyun Kim, *Psychiatry, Center for Autism and the Developing Brain, White Plains, NY*

Executive function (EF) difficulties are one of the core cognitive deficits in ASD. However, there is still limited evidence for the neural mechanisms underlying the cognitive control deficits in individuals with ASD. Using cutting-edge, advanced electroencephalogram (EEG) and magnetoencephalography (MEG) methods, we will capture spatial and temporal dynamics of both social and non-social cognitive control in individuals with ASD across a wide age range (2-19 years). The first (Arthur et al.) and second presentations (Thomas et al.) use the EEG analyses of theta oscillations to examine distinctive EF-related neural profiles in children with ASD and their unique patterns of associations with an early infant brain function (Arthur et al.) or to concurrent functional outcomes at school-entry (Thomas et al.). The third presentation (Cremone-Caira et al.) aims to unpack the individual and group heterogeneity in EF using both resting EEG and ERPs among school-age children with ASD, ADHD, or typical controls. Finally, the fourth presentation (Vandewouw et al.) is focused on temporal and spatial neural correlates of response inhibition and emotional regulation in those with and without ASD using an emotional go/no-go task using MEG recordings.

203.001 *(Panel)* Mapping Cognitive Flexibility from 8 Months to 7 Years in a Longitudinal Sample of Infants with Older Siblings with ASD

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Background: Autism Spectrum Disorder (ASD) is known to strongly overlap with other developmental conditions such as Attention Deficit Hyperactivity Disorder (ADHD). Both ASD and ADHD have been linked to differences in executive function and cognitive flexibility which can have mild to severe impacts on an individual's daily living. In the present study, we explored the brain mechanisms that may underpin cognitive control in a longitudinal cohort enriched for later ASD and ADHD outcomes.

Objectives: Our overarching goals are to map the common and distinct profiles of difficulties with cognitive control/executive functioning in children with and without ASD and ADHD symptoms. Further, we will examine whether profiles of cognitive control in mid childhood are associated with common roots in early infant brain function. We focus on fronto-central theta, a neural signature associated with the implementation of cognitive control.

Methods: We recruited 7- to 10-year-old children from an ongoing longitudinal study who were at an elevated familial likelihood of developing ASD (EL, current $n = 17$; projected $n = 50$), or had a typical likelihood (TL, current $n = 10$; projected $n = 30$). Executive function domains of inhibition control and flexibility were assessed with a battery including a computerised Go / No-Go task where children were asked to respond to a cat and not to a dog in the first block, before switching the response/stimulus mapping in the second block. We examined differences by likelihood group, and how individual differences in mid-childhood cognitive control associated with EEG theta (4-5 Hz) power and connectivity (debiased weighted phase lag index) measured at 14 months while infants passively viewed social and non-social videos.

Results: Preliminary analyses on the Go/No-Go task revealed that the task showed the expected modulation by condition. When the children were asked to switch their response to a different stimulus, children displayed a longer reaction time to Go compared to No-Go trials ($F(1,25) = 632.70$, $p < .0001$, $\eta_p^2 = .567$), but this difference was stronger in the EL group than the TL group (interaction effect between Condition and Group: ($F(1,25) = 6.07$, $p = .021$, $\eta_p^2 = .195$). Furthermore, children who displayed shorter reaction times on the Go trials also tended to exhibit more frontal theta power and increased levels of EEG connectivity (4-5 Hz) during infancy (Power $r_{Spearman} = -.62$, $p = .102$; and EEG connectivity $r_{Spearman} = -.68$, $p = .071$, $N = 8$). Further analyses will focus on associations with ASD and ADHD symptomatology measured via parent report.

Conclusions: Our work suggests that we can detect emerging profiles of difficulties with executive functioning in children with an older sibling with ASD relative to controls, but these difficulties are subtle. However, individual differences in executive functioning were associated with variation in infant brain activity during passive viewing. Further analyses will test whether this could reflect an early-emerging system that could buffer developmental trajectories towards or away from ASD and ADHD symptoms.

203.002 *(Panel)* Neural and Behavioral Impairments in Cognitive Control in Kindergarteners with ASD: EEG Analyses of Theta Oscillations

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Background: Children with ASD demonstrate impairments in cognitive control compared to their typically developing (TD) peers (Happé et al., 2006). At the neural level, cognitive control is known to rely on theta oscillations, arising from the mediofrontal cortex (MFC; Cavanagh & Frank, 2014). MFC theta increases following error responses and predict behavioral adaptations in youth (Buzzell et al., 2019) and adults (Cavanagh et. al., 2011). Preliminary work in young children with ASD show similar error-related changes in MFC theta (Kim et al., 2019); however, direct comparisons of MFC theta in ASD and TD controls are lacking.

Objectives: Examine whether ASD and TD children differ in both behavioral and neural correlates of cognitive control.

Methods: Fourth-four cognitively-able children with ASD (11 females; M_{age}=63.1 months, SD=4.3) and 24 TD children (10 females; M_{age}=63.4 months, SD=4.9) at kindergarten-entry performed a child-friendly go/no-go task ("Zoo Game"). At the behavioral level, overall accuracy was assessed; regression analyses were conducted to examine behavioral differences between the groups. Time-frequency approaches were employed to extract response-locked theta power from two theta band (4-7 Hz) ROIs: 1) an "early theta" ROI from 0-200 ms post-response; 2) a "late theta" ROI from 200-400 ms post-response. A pair of two-way repeated measures ANOVAs (accuracy [correct vs. error-trials] by diagnosis [ASD vs. TD]) examined whether error-related theta differed across diagnostic groups. Pearson's correlations assessed relations between error-related theta and zoo game performance. Partial correlations explored associations between theta and academic outcomes (Woodcock-Johnson III tests of achievement [WJ]; Woodcock et al., 2001).

Results: Children with ASD were significantly less accurate on the Zoo game compared to the TD group, even after controlling for NVIQ, age, and gender (b=0.63, p=0.001). At the neural level, only the late theta ROI yielded a significant interaction between accuracy and diagnosis (F=4.70, p=0.034), such that TD children exhibited a larger error (vs. correct) increase in theta relative to children with ASD (Figure 1). Partial correlations revealed that error-related differences in late theta were significantly correlated with a WJ math subtest (Applied Problems), above and beyond NVIQ and zoo game performance (r=0.39, p=0.011)

Conclusions: Children with ASD demonstrated behavioral and neural deficits in cognitive control, compared to their TD peers. Notably, deficits in error-related theta for the ASD group were most pronounced in a later (200-400 ms) time window. Cognitive control is thought to involve a cascade of processing whereby the need for control is first detected, followed later by recruitment of top-down control to bias behavior favorably. The later theta time window observed in our sample may more closely map onto neural processes associated with the recruitment of top down control, and this second stage of cognitive control could be particularly impaired in ASD. Consistent with such an interpretation, late theta was correlated with high-level cognitive functioning, specifically academic achievement. Ongoing analyses will seek to directly test whether those with ASD exhibit deficits in the recruitment of top-down control by investigating: 1) theta-band connectivity between medial and lateral frontal sites; 2) whether post-error behavior is impacted.

203.003 *(Panel)* An Examination of Event-Related Potentials and Resting EEG Correlates of Executive Function Among School-Aged Children with ASD, ADHD and Typical Development

A. M. Cremone-Caira[1]*, J. I. Nikolaeva*[2]*, V. E. Sanchez*[3]*, R. Gilbert*[4] *and S. Faja*[4]*, (1)Boston Children's Hospital Labs of Cognitive Neuroscience, Boston, MA, (2)Communication Sciences and Disorders, Northwestern University, Evanston, IL, (3)Division of Developmental Medicine, Boston Children's Hospital, Boston, MA, (4)Boston Children's Hospital, Boston, MA*

Background: Executive function (EF) is often impaired among individuals with ASD, even in the absence of generalized cognitive difficulties. EF involves distinct skills including inhibition, working memory, and set-shifting. Understanding the neural profile underlying EF in children with ASD is particularly critical because EF has been linked to academic and social functioning. However, the neural correlates of EF remain poorly understood in ASD, particularly compared to clinical conditions that share EF challenges such as ADHD.

Objectives: To examine group differences in event-related potentials (ERPs) during a Go/Nogo task and resting EEG, and relations between these neural correlates and EF outcomes measured via objective behavioral tasks.

Methods: To date, 21 children with ASD, 24 with ADHD, and 22 with typical development (TD) provided usable ERP data during the Go/Nogo task. Group differences in mean amplitude and latency for the N2, P3, and ERN ERP components were examined for the 'go' and 'nogo' conditions of this task. Resting EEG was also available for 24 children with ASD, 25 with ADHD, and 24 with TD. Relative EEG power was extracted over a cluster of frontal electrodes (F3, F1, Fz, F2, F4) at the theta, alpha, beta, and low gamma ranges. Participants were between 7-11 years, had full-scale IQs of 84 or above, and were not taking stimulant medications during study visits. IQ differed by group and was controlled for in subsequent analyses. Children in the ASD group with elevated symptoms of ADHD (CBCL>65) were excluded. A battery of EF tasks was administered including the Change, Stroop, Digit Span, and Hungry Donkey Task, which indexed behavioral inhibition, interference suppression, working memory, and strategic long-term decision making, respectively.

Results: A significant group (ASD/ADHD/TD) by condition (Go/Nogo) interaction was detected via repeated measures ANOVA for N2 mean amplitude, F(2,63)=4.38, p=.02. No other significant effects were detected for ERPs. Relative EEG power differed by frequency band (theta/alpha/beta/low gamma) for the three groups, F(6,207)=3.88, $p\leq$.01. Across groups, children who required longer warning durations to inhibit a dominant response on the Change Task had lower relative beta power, r(70)= -.283, p=.02. Stroop performance (i.e., suppressing interfering information) related to relative power in the low gamma range, r(68)=.309, p=.01, with children who had larger differences between congruent and incongruent Stroop trials having higher gamma power. Larger P3 amplitude related to better performance on the Digit Span, r(64)=.268, p=.03. Children with more advantageous selections in the final two blocks of the Hungry Donkey Task exhibited the greatest theta power, r(68)=.358, $p\leq$.01, and highest theta-beta ratios, r(68)=.362, $p\leq$.01.

Conclusions: ERPs and resting EEG related to different aspects of EF, suggesting the need for more nuanced examination of neural correlates of EF during early development. Examination across clinical populations provides a way to improve specificity of neural biomarkers as tools for classification versus stratification within group.

203.004 *(Panel)* Understanding Emotional Inhibition in Children and Adolescents with ASD: A Pond Imaging Study

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Background: Emotion regulation is an important aspect of social interactions, and relies on the ability to inhibit responses to emotional stimuli. Autism spectrum disorder (ASD) is classically associated with poor emotional face processing skills, and individuals with ASD also show difficulties in executive functions, particularly in inhibitory control. The underlying spatial and temporal neural dynamics of emotional inhibition has rarely been studied in children and adolescents with ASD.

Objectives: The purpose of this study was to understand the neural underpinnings of response inhibition and emotional regulation in those with and without ASD using an emotional go/no-go task using magnetoencephalography (MEG) functional imaging.

Methods: MEG data were obtained at the Hospital for Sick Children from 127 ASD and typically developing (TD) youth (included in final analyses, out of an initial sample of 206 participants), children aged 7-10yrs (ASD: N=26, TD: N=27) and adolescents, aged 11-19yrs (ASD: N=40, TD: N=34). Blue or purple frames containing emotional distractors (happy or angry faces) were presented, and participants responded rapidly to a target colour in vigilance (25% go trials) and inhibition (75% go trials) conditions. Functional images were generated for each emotion in both conditions for the no-go trials by applying beamformer weights on 100ms sliding windows (25ms overlap, 50–500ms) using SPM12. A factorial design model with task and emotion as within-subject factors and group (TD/ASD) as a between-subject factor was used to test for between-group differences ($p<0.05$, corrected) in inhibition (inhibition/vigilance across emotion), emotion (happy/angry in the vigilance condition), and the interaction of inhibition and emotion.

Results: Comparing the inhibition and vigilance tasks (inhibition>vigilance) across emotion, the TD children showed prolonged increased activation (175–500ms) of the left insula compared to ASD, while this effect reversed in the adolescents at an early time window (ASD>TD, 50–200ms). Comparing emotional faces found that angry faces elicited greater activation of the left inferior frontal gyrus (IFG) in the ASDs compared to the TDs in the children (275–500ms) and adolescents (50–225ms). The interaction of inhibition and emotion in the children showed increased activation of the right inferior temporal gyrus (175–275ms) in TDs, while the ASDs demonstrated increases in the left temporal gyri (100–300ms). The adolescent TDs showed increased activation in the IFG (225–475ms) and right middle temporal gyrus (300–475ms).

Conclusions: In inhibition, differences between TD and ASD children and adolescents in the insula, a region which has been implicated in salience and inhibitory control, shows that while the TD children demonstrated typical increases in processing speed with development, the ASD group only demonstrated some catch up by adolescence. Increased left IFG activation to angry faces in ASDs in the vigilance condition could reflect an increased reliance on an area important in processing angry faces to compensate for known difficulties in understanding this emotion by those with ASD. The IFG is also involved in successfully inhibiting motor responses; the observed interaction in the adolescents demonstrates, however, that this region is not being recruited appropriately during inhibition.

PANEL SESSION — COGNITIVE NEUROSCIENCE
204 - Eye Tracking and the Brain

Panel Chair: Frederick Shic, *Center for Child Health, Behavior and Development, Seattle Children's Research Institute, Seattle, WA*

Discussant: Shafali Jeste, *University of California, Los Angeles, Los Angeles, CA*

This panel examines how eye tracking and neuroscience techniques are working in concert to provide new perspectives on ASD. The panel brings together researchers from both Europe and the United States, with panelists drawn from a wide diversity of backgrounds and seniority in the field, showcasing a range of neuroimaging techniques including functional MRI, electroencephalography, and functional near infrared spectroscopy, as they relate to eye-tracking data. The first presentation highlights how eye movements may index specific subgroups within the autism spectrum associated with distinct neural architecture; the second highlights the interplay between eye tracking and fundamental disturbances in joint attention behaviors in toddlers and children; the third examines within-individual consistency of EEG and eye tracking across repeat visits, homing in on a facet of biomarker development that is both methodologically critical and innovative as a biomarker in of itself; and finally, the fourth study highlights how neuroscience techniques and behavioral biomarkers from eye tracking may provide distinct and complementary information that may, in unison, provide even more predictive power. This work highlights the deepening trend towards multi-modal, interdisciplinary science that is becoming a critical component of our advancing efforts to understand the foundational mechanisms of ASD.

204.001 *(Panel)* The Search for Biomarkers and Phenotypically Meaningful Subtypes of ASD Based on Eye Tracking, Clinical, and Brain Imaging Data

K. Pierce[1], *M. V. Lombardo*[2], *V. Gazestani*[3], *A. Cheng*[4], *S. Nalabolu*[4], *T. H. Wen*[1], *C. Barnes*[5] *and E. Courchesne*[1], *(1)Autism Center of Excellence, Neurosciences, University of California, San Diego, La Jolla, CA, (2)Center for Neuroscience and Cognitive Systems, Laboratory for Autism and Neurodevelopmental Disorders, Istituto Italiano di Tecnologia, Rovereto, Italy, (3)Neurosciences, Univeristy of California, San Diego, La Jolla, CA, (4)Neurosciences, University of California, San Diego, La Jolla, CA, (5)University of California, San Diego, La Jolla, CA*

Background: Markers that define ASD subtypes are extremely valuable because of their potential implications about causes, mechanisms, prognosis, and treatments. However, discovering such subtypes requires not only large sample sizes[3], but also deep clinical and neural phenotyping. We previously published two studies[4,5] totaling 444 subjects, using an eye tracking paradigm, the "Geo Pref Test" that examined the degree to which a toddler preferred to visually fixate on geometric, rather than social, images. Results indicated that ~20% of toddlers with ASD spend very high levels of time visually fixating on geometric rather than social images, a profile not often seen in non-ASD contrast groups. Here we have collected data on an independent sample of 1,180 toddlers that has not yet been published. Presumably, if experience dependent mechanisms play a role in growth and development, hypotheses could be tested that examine relationships between visual attention, behavioral symptoms and brain functional connectivity patterns.

Objectives: Goals were to examine: (1) validation statistics (e.g., specificity) in the overall cumulative sample using the 69% fixation geometric as the critical cut off; (2) correlations with clinical phenotype; (3) neural functional connectivity patterns in a subset of toddlers who participated in both eye tracking and brain imaging. We hypothesized that toddlers that preferred geometric images, or "GeoPref ASD" toddlers, would show a disruption in connectivity between brain regions that support social and visual processing.

Methods: An overall total of 1,624 toddlers participated in eye tracking using the GeoPref Test (age range 12-48 months, N=607 ASD and N=1,017 non-ASD). Fixation duration within each area of interest (i.e., geometric or social) was recorded, and validation statistics examined using standard formulas. Toddlers also participated in clinical tests including the ADOS, Mullen, and Vineland. A subset of toddlers participated in resting state sleep fMRI (N=195). Within this cohort, functional connectivity between networks, including between the Default Mode (DMN) and Occipito-Temporal Cortex (OTC), was examined. **Figure 2A.**

Results: Toddlers with ASD fixated more on geometric images than any other diagnostic group ($F=44.06$, $p<.0001$), and sensitivity and specificity (i.e., 18% and 98%) was similar to previous studies when the 69% cut off was used. **Figure 1.** Significant correlations between percent geometric fixation and clinical phenotype, including overall ADOS ($r=.44$), receptive ($r=-.34$), and expressive language ($r=-.35$) was found (all $ps<.0001$). Examination of resting state data revealed functional hypoconnectivity between "social brain" circuitry including the DMN and OTC in toddlers with ASD when all ASD toddlers were combined regardless of eye tracking, and compared to Non-ASD contrast groups. For example, effect sizes, Cohen's d, illustrating the magnitude of difference between ASD vs TD was $d=.66$, **Figure 2B,** but increased to 1.28 when a subtype model was used and functional connectivity between the GeoPref ASD subtype was specifically compared to TD toddlers. **Figure 2 C.**

Conclusions: Early deviances in brain development may be related to abnormal visual attention in a specific ASD subtype. This in turn may contribute to challenges with language and social interactions during early life, placing such "GeoPref ASD" toddlers at a disadvantage.

204.002 *(Panel)* Eye Gaze and Neural Correlates of Joint Attention in Autism Spectrum Disorders

L. Billeci[1]*, V. Costanzo*[2]*, S. Calderoni*[3]*, F. Apicella*[2]*, A. Narzisi*[4] *and F. Muratori*[3]*, (1)Consiglio Nazionale delle Ricerche (CNR), Pisa, Italy, (2)IRCCS Fondazione Stella Maris, Calambrone (Pisa), Italy, (3)Department of Clinical and Experimental Medicine, University of Pisa, Pisa, Italy, (4)IRCCS Stella Maris Foundation, Pisa (Calambrone), Italy*

Background: Joint attention (JA) is described as the ability to coordinate visual attention with another person and then shift the gaze toward a shared object or event. Deficits in JA are known to be one of the prominent features of Autism Spectrum Disorders (ASD), and have been correlated not only with social and communicative problems, but also with deficits in language development.

Literature reports on two main components of JA: the response to JA and the initiation of JA. Eye-tracking has recently been used during JA tasks in ASD, focusing in particular on RJA and gaze accuracy. Literature has also suggested a correlation between JA abilities and specific neural circuitry, which can be studied by various brain imaging techniques.

Objectives: In this presentation, we will present our research on visual and neural correlates of joint attention in ASD.

Methods: We first review our study describing visual patterns of toddlers with ASD (N=17) and TD (N=15) during RJA and IJA tasks in an eye-tracking scenario. We then present a pilot study in which, using a similar paradigm, we applied an integrated EEG/eye-tracking approach to investigate gaze and neural correlates of RJA and IJA in high-functioning children with ASD (N=11). In this study, we also evaluated changes in brain function and visual pattern after six months of rehabilitative treatment. Finally, we present novel results related to the study of JA processing in younger sibling of children with ASD (N=19).

Results: We found no difference in the RJA task between toddlers with ASD and TD toddlers ($p>.10$), whereas different gaze patterns emerged in IJA tasks ($p=.02$). We hypothesized these differences were due to ASD-related impairments in visual disengagement from faces, in global scanning of the scene, and in the ability to anticipate object action. Our pilot work subsequently showed IJA and RJA subtend both overlapping and specialized neural circuitries. In addition, in a subgroup of subjects, we observed trends of changes in both brain activity and connectivity after rehabilitative treatment in both the two tasks, which were correlated with modifications in gaze measures ($r=.0.80$). Finally, in our study of younger siblings, we applied our previously implemented RJA/IJA eye-tracking paradigm and found an intermediate pattern of visual processing between ASD and TD, with some features similar to that of TD children and some similar to ASD children. As an exploratory study, we also investigated correlations ($r=0.70$, $p=0.03$) between gaze response to JA of these siblings and functional activation of their brain (i.e. asymmetry, coherence) as measured during rest by using high-density EEG.

Conclusions: Overall, our results suggest that the assessment of JA, and in particular of IJA, with eye-tracking can give new insights regarding the atypical development of JA in the very early stages of ASD. In particular, by applying this kind of protocol in younger siblings of children with ASD, it could be possible to identify some biomarkers of the disorder. In addition, by using a multimodal approach, it is possible to characterize JA-related brain circuitries correlating with visual pattern in ASD.

204.003 *(Panel)* Exploring Consistency between Brain Activity and Consistency of Social Viewing in ASD

A. Naples[1]*, A. R. Levin*[2]*, F. Shic*[3]*, D. Senturk*[4]*, R. Bernier*[5]*, G. Dawson*[6]*, S. Jeste*[7]*, K. Chawarska*[1]*, C. Sugar*[7]*, M. Murias*[8]*, J. Dziura*[9]*, C. Brandt*[9] *and J. McPartland*[1]*, (1)Child Study Center, Yale University School of Medicine, New Haven, CT, (2)Neurology, Boston Children's Hospital, Boston, MA, (3)Center for Child Health, Behavior and Development, Seattle Children's Research Institute, Seattle, WA, (4)UCLA, Los Angeles, CA, (5)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, (6)Department of Psychiatry and Behavioral Sciences, Duke Center for Autism and Brain Development, Durham, NC, (7)University of California, Los Angeles, Los Angeles, CA, (8)Duke Center for Autism and Brain Development, Department of Psychiatry and Behavioral Sciences, Duke University, Durham, NC, (9)Yale University, New Haven, CT*

Background: Both electroencephalography (EEG) and eye-tracking (ET) are promising biomarker acquisition tools in ASD. Recent research has highlighted that, within an individual over time, the shape of the EEG power spectral density (PSD) exhibits high levels of test-retest reliability. Similarly, in eye-tracking research, monozygotic in contrast to dizygotic twins exhibit striking levels of similarity in eye-tracking scan paths. Together, these findings suggest that both EEG and ET are under high-levels of biological control that manifest "trait-like" stability. However not all individuals exhibit these high levels of consistency. Rather, there is a wide range of within person consistency, which may represent a meaningful biomarker unto itself.

Objectives: Using EEG and ET data collected from 225 individuals with ASD and 75 typically developing controls at 3 timepoints spanning 6 months, we evaluated: (1) within-person consistency in EEG activity, (2) within-person consistency in ET scan-paths, and (3) whether individual consistency in EEG associated with consistency in ET.

Methods: Data were collected from 225 individuals with ASD and 75 TD controls between the ages of 6 and 11 across five sites as part of the Autism Biomarkers Consortium for Clinical Trials (ABC-CT). EEG was recorded during one quiet, eyes-open resting session at each time point, and ET was collected across 2 sessions at each time point to displays of static and dynamic social stimuli. Individual similarity in EEG was calculated as the correlation of detrended EEG power spectra across frequency bands. Similarity between ET sessions was calculated as the correlation of binned gaze coordinates for identical stimuli and the difference of Shannon entropy between sessions as an index of exploratory gaze behavior.

Results: Analyses of the full sample are ongoing. Our preliminary results show (1): From 49 participants collected during the feasibility portion of the study across two days, on average, the correlation of PSD within individuals was r = .76 and between individuals was .54, ranging from r = 0 to r = .99. Preliminary results from ET from 100 individuals across six weeks revealed: (1) average within person correlations ranged from r = .34 for social movies to .37 for static images. However, within participant correlations ranged from .-.4 to .99 indicating substantial variability across individuals. Diagnostic groups differed in within-person consistency in only 1 of 5 stimulus categories (videos containing high levels of movement) in which TD controls exhibited greater consistency of looking across 6 weeks (p <.001, Figure 1).

Conclusions: Our data reveal that the within person consistency of EEG PSD and ET vary substantially across individuals, with some individuals exhibiting high levels of variability across time points and others almost identical EEG power spectra and ET scan paths. Ongoing analyses explore within person consistency across a span of six months and the relationships between EEG activity and eye-tracking and their relationships with clinical characteristics. Nevertheless, current results demonstrate that within-individual consistency can differentiate diagnostic groups and exploring the sources of within-individual variability offers a novel approach towards refining our use of ET and EEG as biomarker tools in ASD.

204.004 *(Panel)* Biological Motion Perception in ASD: A Combined Functional Near Infrared Spectroscopy and Eye-Tracking Study

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Background: Previous work using functional MRI have found atypical activation of the right superior temporal sulcus and prefrontal cortex in response to biological motion in individuals with ASD. However, these effects have not been replicated using functional near infrared spectroscopy, and little is known about how these brain changes relate to visual attention patterns.

Objectives: To examine bilateral PFC and superior temporal sulcus (STS) modulation by emotional biological motion (biomotion) in participants with ASD compared to typically developing (TD) participants, focused on hemodynamic response as observed from oxygenated hemoglobin (HbO), and to explore relationships among brain activity in ASD, phenotypic characteristics, and eye movement data.

Methods: Children (ASD n=30; TD n=30; Table 1) watched emotional biomotion clips (fear, anger, joy, neutral) interleaved with rotating control point light displays (PLDs) in 40 trials over 12 minutes while wearing a Gowerlabs NTS fNIRS cap covering prefrontal cortex (PFC) and superior temporal sulcus (STS) areas and eye movements tracked with an SR Eyelink 1000 Plus. Changes in oxygenated hemoglobin (HbO) were preprocessed with motion artefact removal involving PCA filtering, channel-wise artefact removal, stimuli/trial rejection, and spline interpolation followed by band pass filtering (0.00hz-0.50hz) and baseline correction using the 2s prior interval of each trial. Results were analyzed with linear mixed effects models and FDR control for 38 channel comparisons. Interpretation compared channel results with brain atlas-registered locations. Examination of relationships between brain activity and phenotype and eye tracking in ASD used Spearman's correlation.

Results: TD participants demonstrated widespread cortical responses to biomotion-rotation, with increased HbO to biomotion in 9 of 38 brain areas. In ASD no channels were significantly activated. ASD-TD comparisons suggested hypoactivation in ASD in response to biomotion in left inferior frontal and left inferior temporal gyri. In ASD, diminished right superior temporal responses to biomotion was associated with increased autism severity (r=-.56, p=.026), whereas increased activation in left frontal inferior orbital and ventrolateral prefrontal cortices were associated with lower IQ and higher autism severity (r=-.62, p=.013; r=.51, p=.040, respectively). Eye tracking analyses revealed group and condition main effects and no interaction, with children with ASD having less trackable data (p<.001), more fixations (p=.049), and more blinks (p<.001) per unit time than TD. Higher blinks/second were associated with higher autism severity (r=.59, p=.014) in ASD. Despite overlap in phenotypic relationships, no eye tracking-fNIRS relationships survived control for multiple comparisons. However, combining strongest fNIRS and eye-tracking associations in predicting autism severity indicated non-overlapping improvements in model fits (r=.65, p<.025) (AIC: 98.3 (fNIRS), 96.1 (ET), 92.3 (combined)).

Conclusions: These results highlight atypical neural response of children with ASD to biological motion as well as disturbed elementary visual exploratory behaviors. Despite strong relationships from both eye tracking and fNIRS to autism severity, there were few relationships between eye tracking and fNIRS. These results suggest that these two outcome modalities, in this study, may be disassociable. Improved model fits in predicting autism severity by combining variables from both modalities may suggest potential advantages of multimodal biomarkers that increase precision by leveraging non-overlapping constructs.

POSTER SESSION — **COGNITIVE NEUROSCIENCE**

413 - Cognitive Neuroscience Posters

413.001 *(Poster)* A Pilot Study of High-Definition Transcranial Direct Current Stimulation (HD-tDCS) to Right Ventrolateral Prefrontal Cortex (vlPFC) in Autism Spectrum Disorder

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Background: Cognitive inflexibility and repetitive behaviours are hallmark features of autism spectrum disorder (ASD) that can significantly impair daily functioning. Cognitive flexibility has been linked to the ventrolateral prefrontal cortex (vlPFC), while reduced activity in the vlPFC in ASD is related to both cognitive inflexibility and restrictive and repetitive behaviours (RRB) patterns. Non-invasive brain stimulation techniques, including high-definition transcranial direct current stimulation (HD-tDCS), can be used to modulate cortical activity with a view to therapeutic outcomes.

Objectives: In a pilot study, we investigated whether anodal HD-tDCS to right vlPFC can improve cognitive and behavioural flexibility in young people with ASD.

Methods: Using a randomized, double-blinded, crossover study design, anodal HD-tDCS was delivered for 20 minutes over the right vlPFC for four consecutive days. Twelve participants (7 Males, mean age = 25 years) underwent both the HD-tDCS active and sham condition, with a one-month interval between conditions. Cognitive Flexibility was assessed before and after HD-tDCS across three domains: cognitive, behavioural, and neurophysiological. The corresponding outcomes assessed in this study were the Behaviour Rating Inventory of Executive Functioning (BRIEF; *shift subscale*), the Probabilistic Reversal Learning Task (PRLT; providing a direct approach to examining flexible choice behaviour), and electroencephalography (EEG; specifically, feedback related negativity).

Results: Generalised linear mixed model analyses were used to examine whether anodal HD-tDCS had an effect on the BRIEF shift scale, PRLT and feedback related negativity, with treatment condition (active versus sham) and time (pre-post) as the independent variables. The analysis yielded no significant differences between HD-tDCS active and sham conditions or between pre-post sessions on the BRIEF shift scale, PRLT and Feedback Related Negativity. In terms of tolerability and feasibility, there were no serious side effects or adverse events reported across conditions.

Conclusions: While the current pilot study supports the feasibility of tolerability of HD-tDCS in ASD, it does not provide support for efficacy of stimulation of right vlPFC when targeting cognitive and behavioural flexibility in ASD. We discuss limitations of our approach, particularly concerning sample size, individualised stimulation parameters, and the heterogeneity of ASD.

413.002 *(Poster)* Action Mindreading in Autism

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Background: The ability to “mindread” the actions of others is crucial to interpret and anticipate their behavior. Children with autism spectrum conditions (ASC) have been proposed to be delayed in the development of this ability, with knock-on on consequences on social interaction across lifespan. However, the exact nature of atypicalities in action mindreading associated with autism remains unknown. Here we report on a study combining motion tracking, psychophysics and computational modelling to compare single-trial computations underlying action mindreading in typically developing (TD) children and children with ASC.

Objectives: To analyze how intention encoding – the mapping of intention to movement kinematics – and intention readout – the mapping of kinematics to ascription of intention – intersect at a single-trial level in TD children and children with ASC.

Methods: Eight- to eleven-year old TD children (n=35) and children with ASC without accompanying intellectual impairment (n=35) watched a hand reaching for a bottle, either to pour or to drink, and decided on the intention of the observed grasp. In a within-subjects counterbalanced order, participants observed grasping acts performed by either TD children or children with ASC (see Fig. 1a). We developed a quantitative framework, employing logistic regression, to analyze single-trial computations involved in extracting intention-related information from the observation of typical and autistic movement kinematics.

Results: TD children performed well above chance on intention discrimination from the observation of both typical and autistic kinematics. Children with ASC instead performed near chance. Single-trial analysis results indicated that the poor performance of ASC children did not reflect a lack of sensitivity of intention readout to movement kinematics. Children in both groups used variations in kinematics to judge intention. The ability to correctly link these variations to the correct intention, however, was significantly reduced in ASC children compared to TD children (see Fig. 1b).

Conclusions: Children with ASC “see” variations in movement kinematics, but are unable to link such variations to the correct intention. These findings contradict the hypothesis that children with autism are “blind” to subtle differences in movement kinematics and suggest that ASC-related difficulties in action mindreading originate at the intersection between intention encoding and readout.

413.003 *(Poster)* Basic Oculomotor Characteristics Are Similar between Young ASD Children and Matched Controls

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Background: A variety of eye tracking studies have reported that children with autism view images and movies of social interactions differently than typically developing children. It is commonly assumed that these differences in gaze behavior are generated by different stimulus preferences such that children with autism choose to fixate on different locations in the presented images/movie as compared with controls. An alternative explanation is that differences may be caused by basic oculomotor characteristics (e.g., saccade frequency or kinematics) that may differ across groups. To test this, we analyzed oculomotor characteristics of toddlers with autism and controls as they watched animated movies and also during presentation of salient targets that elicited saccades.

Objectives: To compare basic oculomotor characteristics between children with autism and controls during presentation of movies and salient targets that elicit saccades.

Methods: A total of 85 children (56 with autism and 29 controls), 2-8-years-old, were recruited by the National Autism Research Center of Israel at Ben Gurion University (www.autismisrael.org). All children participated in an eye tracking study where they viewed two animated movies (each 1.5 minutes long) and 50 trials containing a salient visual stimulus that was presented in different locations on the screen. Segments of the movies where the child was not observing the screen and trials where the child was not fixating during stimulus presentation were excluded. We used the remaining data to compute the frequency of saccades during each of the movies as well as their basic kinematic features including peak velocity, extent, and duration. For trials with salient targets we also computed first saccade latency as well as its accuracy in terms of angle and extent. These characteristics were compared across groups using t-tests and correlated with ADOS and cognitive scores for the autism group.

Results: There were no significant differences between children with autism and controls in all analyses of all measures. There were no significant differences in the frequency of saccades during either movie, nor in their peak velocity, extent, or duration. Saccade latency and accuracy did not differ across groups on trials containing salient visual stimuli. Furthermore, children in both groups exhibited similar velocity by distance scaling in agreement with the isochrony principle. There were no significant correlations between any of the oculomotor measures and ADOS or cognitive scores.

Conclusions: The results demonstrate that basic oculomotor characteristics of children with autism and controls are statistically indistinguishable. This indicates that previously reported differences in gaze behavior are indeed due to differences in visual preferences rather than potential differences in basic oculomotor control. These findings are encouraging from a therapeutic perspective, because they suggest that basic oculomotor function is intact in the majority of cases.

413.004 *(Poster)* Differences in Activity of the Brain's Executive Network in Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is characterized by impairments in executive function (EF) (Hill, 2004; Hughes et al., 1994), suggested to reflect an overreliance of the prefrontal cortex (PFC) when completing EF tasks. This is contrasted by research pointing to poor recruitment of the PFC in individuals with ASD (Gilbert et al., 2008; Minshew & Keller, 2010). Despite the EF dysfunction being a compelling cognitive model of ASD, there has been inconsistencies in findings, particularly in PFC response to EF tasks.

Objectives: In order to assess the emerging consensus across neuroimaging studies of EF in ASD, the current study used coordinate-based anatomical likelihood estimation (ALE) analysis of 18 functional magnetic resonance imaging (MRI) studies.

Methods: EF tasks included Tower of London, Go/NoGo, Flanker Task, False-Belief, N-back, Random Response Generation, etc. This resulted in a meta-analysis of 900 participants (408 ASD, 492 typically developing (TD) individuals). Participants ranged from 7 to 52 years of age and were of average IQ. All studies matched ASD and TD participants by age and IQ, and the majority of the ASD participants were high-functioning.

Results: Within-group analysis (EF task vs. Control Task) revealed that both TD and ASD participants had significant activity in the prefrontal regions. Analysis of group differences indicated greater activation in ASD, relative to TD participants, in the right middle frontal gyrus (MFG) and the anterior cingulate cortex (ACC), and lesser activation in the bilateral middle frontal, left inferior frontal gyrus (LIFG), right inferior parietal lobule (RIPL), and precuneus. Although the prefrontal cortex activation in ASD and TD participants seems relatively similar, the wider network for EF regions including IPL are recruited differentially in ASD participants with distinctly different foci of PFC cortex activation (p = .001; k=50). The reduced parietal activation in ASD participants may reflect a potential lack of interaction between frontoparietal networks with other regions during EF tasks as is seen in TD adults (Lynch et al., 2017). These results support the executive dysfunction hypothesis of ASD and suggests that the differential of activation within frontoparietal circuits may be related to some of the EF difficulties individuals with ASD experience. It is possible that this effect may be determined primarily by inhibitory control (IC) tasks, as out of the 18 fMRI tasks examined in our study, 11 assessed IC using a variety of tasks.

Conclusions: The findings of this study underscore neurobiological differences in EF network recruitment, which in turn may contribute to the development of an executive dysfunction profile for ASD. Examining connectivity profiles of networks like EF may provide more information about the synchronization of core and extended EF regions in accomplishing higher cognitive tasks in ASD.

413.005 *(Poster)* Dynamics of E/I Activity Predict Social and Sensory Symptoms Transdiagnostically

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Background: An imbalance of excitatory and inhibitory (E/I) brain activity has been posited as a mechanism driving symptomatology in autism spectrum disorder (ASD) and other psychiatric conditions, such as schizophrenia spectrum disorders (SZ). However, experimental findings linking E/I measures and symptoms are inconsistent. The slope, or aperiodic component of the EEG power spectrum, is a noninvasive measure of E/I activity that changes in response to task demands, variations in behavioral state, and pharmacological manipulation. Here we explore the hypothesis that dynamic E/I balance over time may provide insight into ASD and SZ symptomology, above and beyond commonly used metrics of E/I that are averaged over time.

Objectives: To explore whether the dynamics of E/I ratio within an individual reflects meaningful variability in symptoms across and between groups.

Methods: In 38 adults with ASD, 57 adults with typical development (TD), and 39 adults with SZ, we collected 4 minutes of resting EEG data. Using a 2s sliding window multitaper Fourier transform, we estimated the power spectral density of the EEG and the slope of activity between 2 and 55hz. We then calculated two measures of variability to capture the dynamics of this activity: (1) Entropy, reflecting the complexity of the signal; and (2) the Hurst exponent, describing the tendency of the slope to exhibit self-similarity in time around its mean.

Results: Consistent with prior research, all individuals in the sample demonstrated a negative slope, indicating that the EEG approximated a power-law distribution; there were no group differences in mean slope. Individuals with ASD exhibited greater entropy (p = .011) than those with TD, and individuals with SZ showed marginally greater entropy (p = .058) than TD controls. Across all participants, increased entropy was associated with greater Autism Diagnostic Observation Schedule (ADOS) severity scores (r = .21, p = .039) and reduced facial recognition performance (r = -.30, p = .002). Across groups, the Hurst exponent correlated strongly with auditory hypersensitivity (Glasgow Sensory Questionnaire, r = .29, p = .007), and overall difficulties with filtering sensory input (Sensory Gating Inventory, r = .29, p = .048), indicating that reduced predictability of E/I ratios over time associated with greater sensory symptomology.

Conclusions: Variability of E/I activity differentiated groups and was associated with symptoms across groups. Our results suggest that intra-individual variability provides useful information about brain activity relevant to transdiagnostic symptom expression. While global differences in E/I balance may drive symptoms, unpredictable shifts in this balance may further exacerbate symptoms. If an individual is unable to predict the severity of their own symptoms, from moment to moment, the impact of these symptoms will invariably be greater. These data suggest that, in addition to characterizing the mechanisms of global E/I balance, it is critical to understand dynamic changes in balance within an individual in the absence of external manipulation. Our findings provide a first step towards characterizing this variability at the individual level within ASD.

413.006 *(Poster)* EEG-Based Brain-Computer Interface (BCI) for Distress Identification for Individuals with ASD

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Background: Individuals with autism spectrum disorder (ASD) often have impaired emotion regulation (ER). There is growing interest in complementing psychosocial therapeutic approaches for ER with technology-based tools to improve therapy efficacy. Our long-term goal is to develop a novel electroencephalography (EEG)-based brain-computer interface (BCI) that will monitor brain activity in adolescents and adults with ASD in order to help cultivate emotional self-awareness, support generalization of ER skills, and provide options for self-learning outside of the therapy session. Here, we provide initial proof of concept for the use of brain activity to support ER studies by using EEG to distinguish between distressed and non-distressed conditions.

Objectives: The present study sought to investigate the effect of distress on the brain activity of individuals with ASD via an EEG-based BCI. We applied machine learning (ML) to recorded EEG data from the Affective Posner Task to classify distressed and non-distressed conditions represented by the LOSE and WIN conditions of the Posner task, respectively.

Methods: Twelve individuals with ASD (9 male; age= 12-19 years) participated. EEG data were collected using a Wearable Sensing DSI-24 system. We identified patterns of brain activity associated with distress during the Affective Posner task, described in Figure 1. Only data from the first game involving deception (randomly generated cues that responses were incorrect, making the $50 contingent reward seem less likely) were utilized in the ML analyses. After pre-processing, 3 seconds of EEG data time-locked to the feedback (wrong, correct or too slow) for each trial were extracted. A total of 15 temporal and spectral features were calculated from the extracted EEG to be used in the classification between WIN and LOSE conditions [1-8]. Radial Basis Function Support Vector Machine (RBF SVM) was used as the classifier. Feature selection was applied to optimize the classification performance[9]. Five-fold cross validation was used to avoid overfitting[10]

Results: Classification performance results are summarized in Table 1 (average accuracy of 83.83% 8.41; specificity of 74.20% ±9.311; sensitivity of 83.34% ±8.97). The most important EEG features for distinguishing distress conditions were the total power of EEG in the frontal cortex, especially in F3, F4 and Fz channels (according to 10-20 international system), and the mean of EEG signal calculated over these 3 channels.

Conclusions: We built an EEG-based BCI to support the study of ER in individuals with ASD, and applied machine learning to demonstrate promising preliminary evidence that EEG-based BCI can be used to distinguish distressed and non-distressed conditions. The most informative features were obtained from the frontal cortex, which have also been identified as important to ER in the broader affective neuroscience literature. Our future work will include a study to investigate the generalization of distressed vs non-distressed condition classification across individuals. Ultimately, once refined, this EEG-based BCI will be utilized to support increasing emotional awareness and generalization of skills learned in the Emotion Awareness and Skills Enhancement (EASE) program, which is an individual therapy designed to improve one's ability to manage intense negative emotions[11].

413.007 *(Poster)* Early Sensory Perception Is Less Influenced By Initial Models in Autism Spectrum Disorder

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Background: Recent theories of autism spectrum disorder (ASD) attempt to explain both social and sensory symptoms of ASD by using the predictive coding framework. Central to these accounts is the hypothesis of a core deficit in the context-sensitive adjustment of predictions, meaning that individuals with ASD have difficulties with estimating in which contexts an event is more surprising and in which it is not. In a recently published study we indeed showed that prediction errors are less modulated by context in ASD on an early sensory level (Goris et al., 2018). Interestingly, however, this decreased context-sensitivity could be caused by either an overestimation of volatility in ASD (i.e., being too fast to update one's model of the world) as proposed by predictive coding theories, or by underestimating volatility (i.e., being slower or "more reluctant" to update one's initial model).

Objectives: In the current study, we aimed to differentiate between the hypotheses of faster versus slower model updating in ASD by investigating how predictions are weighted in relation to the first acoustic context participants were presented with (i.e., their initial model), and to what extent predictions are updated when this context changes. To this end, we used electroencephalography (EEG) to look at the mismatch negativity (MMN) component, reflecting early sensory prediction error processing.

Methods: A group of 27 adults diagnosed with ASD was compared to a gender-, age- and IQ-matched group of 27 neurotypical adults on the well-validated multi-timescale MMN paradigm. In this task, participants were presented with tones that were either standard (presented with a high frequency) or deviant (low frequency) in a block, and these roles reversed every block. The length of the blocks was also manipulated, resulting in slow changing and fast changing alternations. A well-replicated observation in this paradigm is that predictions are shaped by the initial acoustic context: for the initial deviant tone predictions are updated slower (resulting in a larger MMN in slow changing than in fast changing blocks), in comparison to the second deviant tone. If ASD is characterized by faster model updating, we hypothesized the ASD group would be less influenced by the initial context, and thus show a weaker interaction between tone history and block length. If individuals with ASD tend to update models slower, their responses should be shaped more by the initial context, resulting in a stronger interaction.

Results: The ASD group was less influenced by the initial acoustic context, as their MMN responses to the initial deviant sound were less influenced by block length compared to the second deviant. In fact, the MMN modulation by block length was stronger for the second deviant than the initial deviant tone in the ASD group. This interaction effect also correlated with total scores on the ADOS-2, assessing ASD symptoms.

Conclusions: These results suggest that individuals with ASD are less influenced by initial contexts, and update predictions more when contexts change. This is consistent with the idea that people with ASD overestimate the volatility of the environment, as proposed by predictive coding theories.

413.008 *(Poster)* Effect of Reduced Gabaergic Signaling on Temporal Order Judgment in Mice

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Background: Individuals with autism spectrum disorder (ASD) often show sensory abnormalities and an altered γ-aminobutyric acid (GABA)-mediated signaling in brain. We found increased sensory hyper-responsiveness in ASD associates with greater temporal resolution of stimulus order judgment (Ide et al., 2019, *Journal of Autism and Developmental Disorders*). Previously, we reported that GABA concentration in the autistic brain negatively correlated with severity of sensory hyper-reactivity measured by self-report questionnaire (Atsumi et al., 2019, INSAR). However, the role of GABAergic neural signaling in task performance during temporal order judgment (TOJ) is unknown.

Objectives: We hypothesized that lower GABAergic signaling heightens temporal resolution of stimuli. The present translational study examined whether blocking GABA-A receptor improves stimulus temporal resolution of tactile-TOJ.

Methods: We used three mice as animal model and trained them to perform the TOJ task (Wada et al., 2005). In one trial, the animal was delivered air-puff stimulations successively to its left and right whiskers. If the subject correctly nose-poked the side stimulated latter, a liquid reward was delivered, otherwise a 5 ~ 14 sec time-out trial was delivered as punishment. We trained the animals with ±300 ms of stimulus onset asynchronies (SOA). During testing, we added eight new SOAs (±5 ~ 240 ms) to the conventional sets (baseline) and de-livered them randomly. Temporal resolution was calculated by fitting cumulative Gaussian function to the response data in each SOA. We administered a GABA-A antagonist, (+)-Bicuculline (1 mg/kg: BIC) and its vehicle (saline with DMSO: CON) intraperitoneally on different days, prior to the sessions. Either drug/vehicle was injected every second day, and the response data from three days were pooled.

Results: The mice needed 28 ~ 34 days to acquire the task. Pharmacological test revealed all the three mice showed better temporal resolution with BIC (64, 6, and 92 ms, respectively) than CON (234, 11, and 105 ms, respectively; Figure 1). We performed generalized linear mixed model (GLMM) analysis to examine the effect of dose on task performance, by setting subjects and sessions as random factor (Aarts et al., 2014). An analysis of variance revealed the main effect of dose, indicating better performance in BIC than in control ($p < 0.05$).

Conclusions: The preliminary result suggests that administration of GABA-A blocker may improve TOJ performance in mice. There is a possibility that GABAergic neural dysfunction in ASD brain may induce greater neural response to temporal processing of external stimuli, resulting in their heightened perceptual intensity. Future studies should aim to reveal the mouse brain areas analogous to humans that relate to temporal resolution of stimuli, and examine whether the GABAergic signaling in that area associates with sensory hyper-responsiveness.

413.009 *(Poster)* Emotion Cues Improve Visual Temporal Resolution in Individuals with Autism Spectrum Disorders

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Background: Atypical sensory profiles across a variety of sensory modalities are well known in autism spectrum disorders (ASD). Sensory hyper-responsivity is a diagnostic characteristic derived from these sensory abnormalities. We earlier reported that tactile temporal resolution to judge the orders of two successive vibrotactile stimuli associates with the symptomatic severity of ASD (Ide et al., 2019, *Journal of Autism and Developmental Disorders*). A study in typically developed (TD) individuals previously demonstrated that anxiety modulates the effect of emotions on low-level visual processing (Ferneyhough et al., 2013). Considering the reports of high prevalence of co-morbid anxiety disorders (20 %～40 %) in ASD, we hypothesized that anxiety also affects emotion induced change in higher-order visual processing in ASD.

Objectives: We investigated if sudden presentation of facial emotion cues (Disgust vs. Neutral) change the visual temporal resolution in individuals with ASD compared to TD individuals. We then examined whether individual anxiety level associates with magnitude of the change.

Methods: ASD (N = 14) and typically-developed individuals (N = 15) participated in the current study. Participants reported the laterality of the last of two sequential, brief Gaussian blob flashes (Fig1). The key manipulation was presentation of an irrelevant picture prime for a duration of 100 ms, randomly 300～500 ms before the Gaussian blobs. The trials in two separate blocks contained Disgust and Neutral facial emotions randomly intermixed with scrambled images as baseline. Temporal resolution was calculated for each participant by fitting cumulative Gaussian function to the response data. Comparisons were done after adjusting the temporal resolution in each type of facial emotion trials to their respective baseline and thereafter subtracting values of Neutral trials from those of Disgust. Individual anxiety levels were estimated by using self-report questionnaire of State-Trait Anxiety Inventory (STAI: Spielberger et al., 1983).

Results: Tests of within-group difference of means from the reference value zero (= no effect of emotion signals) revealed a significant improvement of visual temporal resolution with Disgust>Neutral facial cue in ASD (mean ± sem = -12.50 ± 4.47; t (13) = -2.79, p = 0.01) but not TD (1.78 ± 3.68; t (13) = 0.48, p = 0.63) (Fig2). Additionally, the extent of improvement in ASD was significantly better than TD (t (27) = -2.48, p = 0.02). The magnitude of the change in temporal resolution with Disgust>Neutral associated positively with subjective state-anxiety scores (r = 0.46, p = 0.04) only in ASD.

Conclusions: We found that Disgust emotion cues markedly enhanced the temporal resolution in ASD compared to TD. Furthermore, individual state-anxiety scores significantly modulated the temporal resolution change in ASD. In contrast, there was neither an apparent emotion-induced effect on temporal resolution nor any modulatory trend of the same by state-anxiety in TD. Collectively, the findings reveal that task-irrelevant visual affective signals interact with individual state-anxiety levels to predominantly alter the higher-order, temporal processing of visual information in ASD.

413.010 *(Poster)* Examining the Links between Language Ability and Working Memory Impairments in Preschoolers with Autism

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Background: There is evidence of executive function impairments in autism spectrum disorder (ASD). Investigations have yielded inconsistent findings regarding impairments in working memory, although visual-spatial working memory is more consistently disrupted (WM) (Kenworthy et al., 2008). Although it has been theorized that executive dysfunction can be mediated by language deficits, specifically a failure to use language for self-regulation (Joseph et al., 2005), relatively little is known about how language ability underlies executive functioning in preschoolers with ASD.

Objectives: The present study aims to test the internal and external language processes that may support WM performance in young children with ASD.

Methods: As part of a larger study charting the trajectory of executive control in ASD, preschoolers with ASD (n=37) and typical development (n=46) were assessed at 2 and 4 years. All analyses controlled for nonverbal IQ (Mullen Scales of Early Learning [MSEL] visual reception T-score) because diagnostic groups differed on nonverbal IQ. Internal language capacity was operationalized as the MSEL verbal developmental quotient (verbal DQ). External verbal behavior was operationalized as percentage of trials in which a child used verbal strategies (i.e., self-speech) during the Self-Ordered Pointing (SOP) task (Hongwanishkul et al., 2005). Working memory was measured with a composite of two behavioral WM tasks administered based on participant age. All children completed an adapted version of the PEFB Hide & Seek Task (Garon et al., 2014). In addition, children in the 2-year-old cohort completed a 3- and 6-box-stationery & scrambled Boxes Task (Griffith et al.,1999), and children in the 4-year-old cohort completed the SOP Task.

Results: After controlling for VR T-scores, TD children had higher correct search scores in Hide & Seek, F(1, 79)=7.93, p=.006, and completed larger spans in the SOP, F(1, 41)=4.13, p=.049. Groups did not differ in Boxes performance or use of verbal strategies. Within the ASD group, WM measures correlated and were combined to create a WM composite score (2-year-olds: Boxes and Hide & Seek, r(21)= .547, p=.010; 4-year-olds: SOP and Hide & Seek, r(16)= .657, p= .006). Verbal strategies and Verbal DQ were not significantly correlated, r(15)= -.29, p=.30. Further, while verbal DQ scores positively predicted WM performance (β=.36, p=.03), verbal strategies negatively predicted WM performance (β= -.49, p=.06) among children with ASD.

Conclusions: WM performance was reduced on the SOP and Hide & Seek among preschoolers with ASD relative to controls when nonverbal IQ was controlled. For the ASD group, use of verbal strategies and verbal IQ predict WM performance independently such that children with higher verbal DQ scores performed better on WM tasks and four-year-olds who used verbal strategies during SOP tended to have worse WM performance. This suggests that, although language level is related to WM performance, children with ASD who employ verbal mediation may not be successful in overcoming challenges related to spatial WM. Results also revealed verbal strategies and verbal DQ were not related, suggesting that verbal strategies may be used regardless of underlying language ability.

413.011 *(Poster)* Neural Corelates of Schema-Dependent Encoding in Children with Autism Spectrum Disorders: The Role of Behavioral Flexibility

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Background: Children with autism spectrum disorder (ASD) exhibit behavioral rigidity and difficulties adapting to novel situations. Schemas are frameworks of real-world knowledge that support superior memory and generalization to novel contexts, which is important for flexible adaptive behavior. Neuroimaging studies with adults show that medial prefrontal cortex (mPFC) supports memory formation of schema-congruent information whereas the medial temporal lobe (MTL) supports memory formation of schema-incongruent information. Whether this pattern of neural engagement is observed in typically developing (TD) or autistic children is unknown. Further, whether these neural correlates relate to behavioral flexibility has not been examined. Due to known atypicalities in MTL and mPFC in ASD, we hypothesized that the neural correlates of schema-dependent memory will differ between TD and ASD and vary by behavioral flexibility.

Objectives: Assess differences in MTL and mPFC activation supporting schema-memory between ASD and TD children and examine associations with behavioral flexibility.

Methods: Children aged 8-16 years with confirmed diagnosis of ASD (N=12,Males=3,FSIQ=114) and TD (N=19,Males=5,IQ=122) performed an associative encoding task on object-scene image pairs that varied in schema-congruency (Congruent=snorkel-reef; Intermediate=flowers-playroom; Incongruent=cabinet-canyon) during functional magnetic resonance imaging at 3T. They were tested for recognition memory for objects and their associated scene 20 minutes later outside the scanner. Encoding-related activation for subsequently remembered vs forgotten object-scene pairs was examined for congruency differences with separate one-way ANOVAs in anatomical masks for MTL and mPFC, and for each group (ps<0.05 corrected). Parents completed the Flexibility Scale (Strang et al., 2017, Autism Dev Disord, 47) assessing their child's behavioral flexibility. These scores were used to examine the association with activation in ASD.

Results: In a GroupxCongruency ANOVA, groups did not differ in object recognition or associative memory, which was higher for schema-congruent pairs relative to intermediate and incongruent pairs $F(2,57)=12.8$,$p<0.001$. In TD children, a main effect of congruency emerged in one cluster in mPFC and one in left MTL; follow-up 2X3 ANOVA on beta values showed greater mPFC and reduced MTL activation for intermediate pairs and the opposite pattern for congruent pairs $F(2,57)=15.9$,$p<0.001$. ASD children exhibited no significant clusters responsive to congruency. For direct group comparison, we applied TD clusters as region-of-interest to ASD data and compared extracted beta values with two-sample t-tests – mPFC activation was reduced in ASD for intermediate pairs $t(29)=2.34$,$p=0.02$ and in the MTL for congruent pairs $t(29)=2.87$,$p=0.005$. Intermediate-pair mPFC activation was significantly higher in children with ASD with better behavioral flexibility $r=-0.61$,$p=0.03$. Further, whole-brain correlational analysis revealed a significant cluster in left dorsolateral prefrontal (BA9/44/46) where higher activation was associated with better flexibility in ASD.

Conclusions: Neural correlates supporting schema-dependent memory encoding differed in TD children relative to published adult findings, such that intermediate, rather than congruent, level of schema-congruency engaged the mPFC most and MTL least. Only in ASD, mPFC engagement for intermediate pairs depended upon behavioral flexibility such that inflexible children exhibited minimal sensitivity to congruency. Further work is needed to disentangle the direction of causality between schema-dependent memory processing and behavioral flexibility.

413.012 *(Poster)* Neural Processing of Formant-Exaggerated Speech and Nonspeech in School-Age Children with and without Autism Spectrum Disorders

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Background: Previous studies have provided evidence for atypical auditory processing of infant-directed speech (IDS) in autism spectrum disorders (ASD). But the underlying neural mechanisms of processing multiple attributes of IDS remain unclear. Apart from the prominent pitch exaggeration, formant exaggeration in IDS can lead to significant enhancement in neural activation in 6- to 12-month-old healthy infants (Zhang et al., 2011).

Objectives: The present event-related potentials (ERP) study examined neural coding of formant exaggeration in school-age children with and without ASD. The stimuli included both speech and nonspeech to tease apart 'phonetic' versus 'acoustic' processing. There were three research questions. First, did the school-age typically-developing (TD) children also show neural enhancement towards the formant exaggeration in IDS? Second, did children with ASD show a similar neural processing pattern towards formant-exaggerated IDS? Third, did the two groups differ when processing the pure acoustic changes of formants embedded in nonspeech sounds?

Methods: Seventeen high-functioning children with ASD (all boys, age mean = 8.6 years, range 6.1~11.6 years) and 17 TD children (all boys, age mean = 8.4 years, range 6.4~10.8 years) participated in this study. These two groups did not differ in terms of age, non-verbal IQ, and working memory. Compared with adult-directed (AD) speech sounds, the IDS had lower F1 and higher F2, while holding F0, F3 and F4 constant (Zhang et al., 2011). The corresponding AD and ID nonspeech sounds shared exactly the same F1, F2 and F3 as the speech while removing other frequencies. There were two conditions: speech and nonspeech, and two alternating blocks: ID and AD blocks, which were counterbalanced among subjects. Duration and intensity of the stimuli were normalized. Each type of sounds was repeated 200 times, with a total of 800 trials.

Results: Based on the grand mean data, three ERP components were analyzed: N1, N250, and late negative response (LNR) (Fig. 1). In the speech condition, both ASD and TD children showed no sensitivity to formant exaggeration in all three components (Fig. 2D, 2E, 2F). In the nonspeech condition, there were significant effect of stimulus type (AD vs. ID) on mean amplitude in all three components of N1, N250, and LNR for ASD group, and in two components of N1 and LNR for TD group (Fig.2A, 2B, 2C). Furthermore, TD group exhibited stronger neural responses to speech sounds in right recording sites than the ASD group (Fig. 1B).

Conclusions: These findings suggest that both school-age TD and ASD children did not show neural enhancement to the formant exaggeration in IDS, which reflected a declined discrimination of within-category variations in their native speech sounds as children age. However, they were still sensitive to such subtle formant changes in nonspeech sounds, which reflected a deviated pattern between acoustic and phonetic processing. Moreover, children with ASD were more sensitive to acoustic formant changes embedded in nonspeech, which corroborated the view of enhanced spectral processing capacity beyond pitch processing in ASD.

413.013 *(Poster)* Phenotypic Factors That Interfere with the Severity of Autistic Spectrum Disorder.

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Background: Autistic Spectrum Disorder (ASD) is a neurodevelopmental disorder that develops in the early years of life. Behavioral observation forms the basis of the diagnosis, with criteria focused on social disabilities and restricted and repetitive patterns of behavior, interests or activities. However, there is great heterogeneity in clinical presentation. Studies support the existence of subtypes in ASD, but it is not yet clear whether specific subtypes with characteristic symptom profiles are considered or as part of a continuum of severity.

Several works to explore underlying TEA structures have contributed to a more dimensional view proposed in the DSM-5 for the diagnosis of TEA. In this sense, most studies using factor analysis or PCA and cluster analysis used as input characteristics measures of sociability, stereotyped and repetitive movements, measures related to communication and IQ.

The relationship between the main symptoms of ASD, IQ and severity of clinical presentation is well established in the literature, however, we cannot say the same, including temperament measures. Studies that seek continuous severity in critically ill patients are scarce. In addition to the symptomatology of ASD, this study found a continuum of children aged 6 to 7 years with ASD in a sample composed only of patients with IQ <75.

Objectives: To find out if the inclusion of measures that can provide us with temperament and functionality variables, as well as the central symptoms variables of ASD and IQ, can contribute to better explain phenotypic variability in a sample of ASD patients with IQ <75.

Specific Objectives: 1) Is it possible to separate stable groups of patients by phenotypic composition? 2) Test association between severity of clinical presentation, as measured by the Childhood Autism Rating Scale (CARS) and phenotypic composition.

Methods: 60 patients diagnosed with ASD and aged between 6 and 7 years.

Assessment tools: Autism Diagnostic Interview - Revista-ADI-R; IQ assessment using the SON-R 2½-7 instrument; Vineland Adaptive Behavior Scale (VABS), Child Behavioral Checklist (CBCL) and CARS.

Descriptive statistical analysis and comparison of scales were performed using the R Studio software, and Principal Component Analysis was performed to assess the contribution of different behavioral assessment scales to explain the variation of patients' phenotypic construct and regression analyzes were performed. to predict the severity of the presentation as measured by CARS.

Results: The analysis suggests that, in general, there are components that contribute to the phenotypic variability related to the cognition / functionality of the patient, a second related to the presence of behavioral problems associated with emotional regulation and two, with different contributions that are communication and behaviors. stereotyped and repetitive forms of ADD. Analyzes suggest greater functionality variability, changes in sociability, cognition, and greater presence of emotional behaviors, stereotyped and repetitive behaviors, and communication. Through multiple regression analysis, no significant causal correlations were found between the components and the variables age and CARS.

Conclusions: The inclusion of temperament measures increased the explanation of the clinical presentation variability; However, different phenotypic compositions were not related to severity in clinical presentation.

413.014 *(Poster)* Reduced GABA Concentration in the Supplementary Motor Area Underlying Difficulty in Inter-Limb Coordinated Movements in Individuals with Autism Spectrum Disorder

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Background:

Coordinated movements between bilateral hands and feet are needed in various situation of daily life (e.g., riding a bicycle), and most of individuals with autism spectrum disorders (ASD) show difficulties in those movements. Generally, rhythmic hand-foot coordinated movements in the ipsilateral side of body (e.g., left hand and left food) are more difficult when the person moves the limbs in the opposite direction than in the same direction (directional constraint: Baldissera et al., 1982). In considering that difficulties of coordinated movements are prominent in ASD, we assumed that excitability/inhibitory imbalance known as a remarkable feature of ASD brain possibly contributes deficits of the movements. We hypothesized that decreased inhibitory metabolite, such as gamma-aminobutyric acid (GABA) level in the brain motor areas results in stronger directional constraint in ASD than typically developed (TD) individuals.

Objectives:

We investigated whether stronger d irectional constraint during inter-limb coordinated movements are obvious in individuals with ASD. Then, we addressed whether decreased GABA concentration in the brain motor areas (i.e., primary motor area [M1] and supplementary motor area [SMA]) links to severer difficulty of the movements.

Methods:
Nineteen ASD (mean age: 19.0 ± 1.3 years, 6 females) and 20 TD (mean age: 19.0 ± 2.7 years, 6 females) participants whose IQs were above 75 participated the study. The participants performed ipsilateral hand-foot rhythmic movements (i) in the same direction and (ii) in the opposite direction, which were measured as a part of Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2) (i.e., Tapping feet and fingers). GABA concentration in M1 and SMA were measured by using 1H-magnetic resonance spectroscopy (1H-MRS). The GABA concentration was quantified relative to creatine by using Gannet 2.0 (Harris et al., 2015).

Results:
The numbers of successful rhythmic movements in ASD group in the opposite directional condition were less than those of TD ($t(37) = -2.92$, $p = 0.005$; Figure 1). There was no group difference in the same directional condition. In addition, we found that the numbers of successful rhythmic movements in the opposite directional condition were positively correlated with GABA levels in SMA only in ASD group ($r = 0.54$, $p = 0.018$; Figure 2).
Conclusions:
Reduced GABA levels in SMA associated with stronger directional constraint during ipsilateral hand-foot coordinated movements in ASD. One previous study found strong neural activation in SMA when directional constraint of hand-foot movements was observed (Nakagawa et al., 2016). Our findings suggested that disinhibition derived from reduced GABA concentration in SMA may be underlying strong directional constraint in ASD. Impairments in modulating neural activation in the brain motor areas by inhibitory metabolites may link to difficulties of coordinated movements observed generally in individuals with ASD.

413.015 *(Poster)* Social Attribution in ASD: fMRI Task Data from the Pond Network

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Background: Theory of Mind (ToM) is the ability to think about mental states and understand that others can have a different mental state from one's own. ToM skills enable the explanation and prediction of other individual's behaviours, strongly influencing the quality of social interactions. A defining characteristic of autism spectrum disorder (ASD) is difficulty in social interactions, which is thought to be driven by poor social cognition and a lack of ToM skills. The social attribution task (SAT), consisting of videos of geometrical shapes performing complex social (both positive and negative interactions) or random movement, prompts recruitment of ToM skills, and has been shown to activate ToM brain regions.
Objectives: The purpose of this study was to examine the neural underpinnings of ToM using the SAT during fMRI, in a large cohort of children and adolescents with and without ASD.
Methods: fMRI data (3T Siemens PrismaFIT scanner) were acquired during the SAT (3 runs of 8 pseudorandomized blocks of positive social interactions, negative interactions, and random interactions) in 60 ASD and 47 TD participants aged 5 to 19 years at the Hospital for Sick Children. Data were slice-time and motion corrected, censored of high-motion volumes, smoothed, intensity normalized, cleaned of nuisance signals, bandpass filtered, and ICA de-noised. Within-run time-series analysis was performed using FSL's FILM, with task conditions (positive social, negative social, and random) as explanatory variables and examining their pairwise contrasts. Contrasts were averaged over runs within each subject, and group-level analysis was performed using t-tests to examine group differences with FSL's FLAME. Gaussian Random Field theory was used for cluster-level multiple comparisons correction ($Z>2.3$; $p<0.05$, corrected).
Results: While watching both the social compared to random interactions, both the TD and ASD participants showed increased activation in classic ToM areas including the bilateral temporal parietal junctions, superior frontal gyri and right temporal regions. The random interactions elucidated increased response in primary visual regions and default mode network in both groups. There was a significant between-group difference in the left orbital inferior frontal gyrus, with the TDs deactivating this region to social interactions compared to baseline and the ASDs showing little difference. Compared to the ASDs, the TDs also activated the right superior temporal pole significantly more to both the positive and negative interactions. Breaking down the social interactions, the TDs activated the left medial superior and inferior frontal gyri, right frontal operculum cortex, and right orbital middle frontal gyrus significantly more than the ASDs. In the physical compared to negative social interactions, the TDs activated the bilateral anterior cingulate cortex, middle frontal gyrus, and right temporal pole significantly more than the ASDs.
Conclusions: Both the ASD and TD participants recruited classic ToM regions during the SAT, supporting the usefulness of this complex task to examine social cognition. Increased activation to the random interactions in the TD compared to ASD participants may indicate that reduced "switching-off" in those with ASD.

413.016 *(Poster)* Where to Draw the Line: Evaluating Visuospatial and Attentional Processing in Individuals with Autism Spectrum Disorders

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Background: Autism spectrum disorders (ASD) are neurodevelopmental disorders that are characterized by repetitive behavioral patterns and difficulty with social interaction and communication. These difficulties include impaired emotional facial recognition that usually involves attending more to another's mouth, while neurotypical individuals focus more on another's eyes during social interactions. Previous studies have shown that when performing a vertical line bisection task, neurotypical individuals exhibit a top-end bias.

Objectives: This study aims to elucidate whether the downward bias in facial recognition in individuals with ASD will correspond with a downward bias during vertical line bisection and quadrisection tasks. Evaluating how individuals with ASD attend to visual space is important for understanding the cognitive mechanisms behind such biases, as it will help identify whether facial fixation points are correlated with performance on an objective spatial reasoning task.

Methods: To answer this question, this study looked at 20 participants with ASD and 20 age, IQ, and sex-matched control participants between the ages of 6 and 23. The participants were asked to bisect, quadrisect from the top, and quadrisect from the bottom vertical lines placed in their left, center, and right visual spaces using both their left and right hands. Each participant completed 6 trials in each of the 18 conditions for a total of 108 bisection and quadrisection attempts. Distance from the true midpoint and quadripoint were calculated for each trial and compared between the two groups.

Results: There was no significant difference between the ASD and control groups for vertical line bisections or bottom quadrisections. One participant with ASD did not appear to understand the quadrisection instructions. However, for those who did comprehend the task, there was a significant difference for top quadrisections, with ASD participants having a greater deviation above the true top quadripoint than control participants ($t(37)=1.74$, $p=0.045$).

Conclusions: From this evidence, it does not appear that the preference for attending to the mouth over attending to the eyes in ASD has a correlation to spatial representation, since this would have been reflected in a downward bias on the bisection and quadrisection tasks. In fact, for the top quadrisections there appears to be an upward bias in the ASD group. This may be due to the more focal attentional demands of the quadrisection task. Future studies will need to confirm this finding and additionally evaluate the role of focal vs global and allocentric vs egocentric attentional demands in this upward top quadrisection bias.

413.017 *(Poster)* Granular Informatics for Understanding ASD: Categorial Granularities in Brains and Cognition

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Background: ASD people have, according to its diagnostic criteria, impairments of social communication and restricted interest. A number of researchers have tried to find a unified model behind the phenotypical diversity; however, any plausible model that well-explains the diversity has not yet been proposed.

A neuro-anatomical research (Casanova 2006) on ASD brains reported that mini-columns in ASD brains have higher density than that of TD. Higher density of mini-columns in ASD suggests that an ASD brain employs a larger number of mini-columns in information processing. It also suggests that ASD brains process information in less integrated way because the smaller mini-columns reduce long-distance connection between them. (Fig.1)

Objectives: We show that “cognitive granularity” function as endophenotype of ASD. Cognitive granularity represents the size of the basic elements that are operable in one’s cognitive system. In other words, it represents the size of semantic units (schema, basic level categories, etc.) to articulate and recognize the environment. Cognitive granularity also represents the level of abstraction at which one can efficiently predict and control the physical and social world.

We assume that the granular characteristics of the brain structure determines the cognitive granularity, which in turn determines information processing styles of ASD and TD populations. Since it is measurable by psychological experiments, cognitive granularity can function as an endophenotype of ASD, which should explain the relationship between the two qualitatively different behavioral criteria for ASD diagnosis and also the diverse and sometimes enigmatic symptoms of ASD.

Methods: We conduct a series of psychological experiments to determine the size of perceptual, linguistic, and mentalizing categories, as an indicator of cognitive granularity. (Fig.2)

(Perception) The subjects discriminate colors, geometrical shapes, facial expressions (real and computer generated). We evaluate the discriminating thresholds and category sizes.

(Language) The subjects name a set of objects (in photos), sort the objects into groups. We identify the prototypes and their semantic extent.

(Mentalization) The subjects predict behavior of animated or robotic agents, which show a variety of goal-directed behavior. We measure how effectively they predict the behavior, from which we estimate the level of abstraction from the individual cases.

Results: Our preliminary experiments showed that ASD people have smaller perceptual and linguistic categories compared to TD. This suggests the finer cognitive granularity in ASD. We also observed the way ASD people are good at memorizing individual samples of the agents’ behavior. However, for a set of behavior that share the same goal, they tend to fail to find the sameness and so fail to predict the behavior. This suggests that ASD people have difficulty in mentalizing the agents’ behavior in terms of goals or intentions.

Conclusions: We showed the relationship between the anatomical granularity in brains and the cognitive granularity in categorial abstraction. Also, we showed that the cognitive granularity is psychologically measurable. Although the research is still in a preliminary stage, we are proceeding toward constructing a unified model of ASD based on the cognitive granularity.

Communication and Language

ORAL SESSION — COMMUNICATION AND LANGUAGE
307 - Speech and Communication Development and Individual Differences

307.001 *(Oral)* Distinct Speech Progression Following an Early Speech Regression in Autism: A Retrospective Study on 2047 Children

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Background: Approximately 25% of autistic children show an early speech regression (ESR) of previously acquired words within their first three years of life, a particularity rarely encountered in non-autistic children. Whether regression represents a core autistic symptom associated with higher prototypicality, an extreme of a continuum of loss in autism, a subcategory of autism, or even a distinct condition is uncertain. Progress in this language phenotype may advance the issue of autism heterogeneity, increasing our capacity to build a mechanistic model of autism.

Objectives: Specify and quantify the effect of ESR and associated communicative atypicalities on autistic speech development and phenotypic features up to 18 years.

Methods: Retrospective data from 2047 unrelated autistic children were extracted from the Simons Simplex Collection. The language progression pattern of children classified according to ESR were presented by Kaplan-Meir plots and tested for differences by Cox proportionate hazards models (ages in months). We modeled the probability of being a fluid speaker depending on ESR, age and intellectual disability (non-verbal IQ<70), using multiple logistic regression. Stepwise variables selection based on a logistic regression model was used to select atypical communicative features associated with ESR; their relative pattern in the autistic population was evaluated using multiple correspondence analysis (MCA) and their association with communicative and behavioral outcomes was computed using linear regression analysis. All results are shown with 95% confidence intervals.

Results: First words emerged earlier in children who experienced ESR (HR=3.4 [95% CI, 2.7-4.2]; p=1.6e-26), so did first phrases if ESR happened after (HR=5.1 [4.1-6.3]; p=1.0e-45), and first phrases emerged later if ESR happened before (HR=0.59 [95% CI, 0.5-0.7]; p= 1.7e-10). Distributions of speech milestones achievement age are shown in figure 1a,b,c. Speech fluency was delayed in children with ESR (figure 1d). However, over 97% autistic children without intellectual disability, with or without ESR, will reach fluid speech by 18years (ESR: 0.98 [95% CI, 0.97-0.99] ; No-ESR: 0.99 [0.989-0.996]), and over 70% of those with intellectual disability (ESR: 0.73 [0.64-0.81] ; No-ESR: 0.87 [0.82-0.91]). Once fluid speech was reached their level of communication was not affected by ESR. The best selection of atypical communicative features associated with ESR highlighted a combination of three features: no nodding at age 4-5 (OR=2.08; [1.4-3.1]; p=2.3e-04), having had a persistent confusion with pronouns (OR=1.9; [1.3-2.8]; p=9.4e-04) and limited comprehension of simple language at age 4-5 (OR=1.9; [1.3-2.8]; p=2.38e-03). These features present a similar pattern in the entire autistic population when computed in the MCA. Presenting all three features increased the chance of having had an ESR by 7.2-folds ([3.8-13.8]; p=1.4e-09). The combination of those features was significantly associated with higher severity of autistic traits, independently of IQ.

Conclusions: Autistic children with ESR show a distinct pattern of language acquisition marked by early typical speech development, a regression/plateau followed by a catch-up with their peers. This catch-up is associated with a group of autistic communicative features that might be representative of a core language development profile in autism whose properties may not be extended to the entire spectrum.

307.002 *(Oral)* An Exploratory Population Study of Social Communication Disorder (SCD) Relative to Autism Spectrum Disorder (ASD)

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Background: There is considerable debate about how to conceptualize and assess Social Communication Disorder (SCD) versus autism spectrum disorder (ASD). Children who meet DSM-5 diagnostic criteria for SCD have persistent difficulties in social uses of verbal and nonverbal communication but do not have restricted interests and repetitive behaviors (RRB) seen in children with ASD. The onset of SCD may begin early in development but cannot be diagnosed until at least 4 years of age when abilities in and expectations for social communication increase. SCD can co-occur with language disorder but not with ASD, intellectual disability (ID), or global developmental delay (GDD).

Objectives: We compared social communication functioning and RRB in children with Probable SCD to children with non-SCD developmental delay and children with ASD.

Methods: We used data from the Study to Explore Early Development (SEED) Phase-1 (2007-2011) and Phase-2 (2012-2016). SEED is a multi-site case-control study designed to examine risk factors for ASD. Our sample consisted of children ≥ 4 years (mean age 5) who had past diagnoses of developmental delay (DD) or screened positive for ASD symptoms (N=1,502) and were seen for a comprehensive in-person evaluation. Children were classified as having ASD based on results of the Autism Diagnostic Observation Schedule – Second Edition (ADOS-2) and Autism Diagnostic Interview - Revised (ADI-R). Based on Foley-Nicpon et al. (2017), we assessed SCD symptoms among children not classified as having ASD, ID or GDD using a subset of items from the ADI-R that reflect diagnostic criteria for SCD. Potential SCD groups were determined by creating tertiles of total score for SCD-related items. Probable SCD cases were children with total ADI-R item scores in the highest tertile, Possible the second tertile, and No SCD first tertile. ID was defined as deficits in nonverbal cognition on the Mullen Scales of Early Learning (MSEL) and adaptive function on the Vineland Adaptive Behavior Scales, and GDD as deficits in all domains on the MSEL.

Results: Five groups of children were analyzed in this study: ASD+ID (N=388), ASD-No ID (N=642), DD Probable SCD (N=163), DD Possible SCD (N=173), and DD No SCD (N=136). ADOS-2 social affect and RRB algorithm scores were significantly higher for children with ASD (with and without ID) than the Probable SCD group (p values<.00001). Mean ADOS-2 scores for the Probable SCD group tended to be higher than for the No SCD group but were not significantly different (p values between 0.1702 and 0.2028). The ADI-R revealed a consistent pattern in which both ASD groups had significantly higher scores than the Probable SCD group which in turn had significantly higher scores than the No SCD group across Social, Communication, and RRB domains (p values <.0001).

Conclusions: Some children who have social communication delays but do not meet criteria for ASD may qualify for a diagnosis of SCD. Our results suggest that SCD may fall along a continuum involving elevated deficits (relative to DD with No SCD) in social communication and presence of RRBs that do not reach the clinical threshold for ASD.

307.003 *(Oral)* Relative Importance of Prosody Versus Voice Quality for Clinician Assessments of Speech in ASD

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Background: Trained clinicians (Nadig and Shaw, 2012) and untrained peers (Grossman, 2015) are able to distinguish speakers with ASD from NT speakers on the basis of short samples of speech. However, they are not always aware of which acoustic features or combination of features they are responding to (Nadig and Shaw, 2012; Redford et al., 2018). Prosody and voice quality both contribute to the overall impression of a speaker, but a recent meta-analysis (Fusaroli et al, 2017) found almost no studies of voice quality in ASD.

Objectives: To assess whether trained clinicians' classification of adolescent speakers as either ASD or NT on the basis of speech alone is based primarily on acoustic features supporting prosody or voice quality.

Methods: We analyzed speech data (8 scripted sentences per participant) from 15 adolescents diagnosed with ASD (mean age = 14.4 years, SD = 1.48) with IQ scores in the typical range, and 15 adolescents with typical development (TD; mean age = 14.1 years, SD = 1.91); groups did not differ on chronological age or full-scale IQ. Participants in both ASD and the NT groups demonstrated average to high average performance on standardized language measures (see Mayo, 2015, for details).

Using acoustic features selected on the basis of previous literature (Fusaroli et al, 2017; McCann & Peppé 2003), we constructed two Bayesian logistic regression models. Model 1 predicted clinicians' classifications on the basis of *prosody measures*: standard deviation of the fundamental frequency, utterance duration, and articulation rate. Model 2 added measures of *voice quality* (creak, jitter, shimmer, and H1H2) to the prosody measures of Model 1.

Results: Model 1 (*prosodic measures only*) had an accuracy of 0.74 (CI: 0.72 - 0.76), sensitivity of 0.66 (CI: 0.62 - 0.70), and specificity of 0.82 (CI: 0.78 - 0.85). Model 2 (*prosodic plus voice measures*) had an accuracy of 0.72 (CI: 0.69 - 0.75), sensitivity of 0.68 (CI: 0.63 - 0.73) and specificity of 0.76 (CI: 0.72 - 0.80). Thus, there was no gain in adding measures of voice quality when predicting clinical rater intuitions.

Conclusions: Judgements based on clinical intuition display high sensitivity (0.86) and specificity of (0.86) in classifying these samples (Eigsti, Mayo and Simmons, INSAR 2016). Although the literature suggests that the speech of people with ASD may be atypical in terms of both prosody and voice quality, these data suggest that clinicians may base their assessment primarily on prosodic features supporting pitch and rhythm.

307.004 *(Oral)* Backchanneling Frequency of Older Children with and without ASD

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Background: Research on conversational skills of people with ASD have mostly focused on the individual's contribution to communication as a *speaker*, but not as a *listener*. But listener behaviors are arguably as important for maintaining smooth and successful conversation as speaker behaviors are: Listeners provide verbal and nonverbal responses called "backchannels" (e.g., saying "*uh-huh"* or nodding one's head), which serve to signal interest, comprehension, and turn taking behavior. Lacking or inadequate listener backchanneling distresses the speaker (Rosenfeld, 1967) and their speech becomes more disorganized and harder to understand (e.g., Bavelas et al., 2000; Kraut et al., 1982). Further, listeners who backchannel less, are perceived as generally less desirable social partners (Vinciarelli et al., 2012), leading to negative social interactions and poor communication outcomes.

Objectives: In spite of its importance for successful communication, hardly anything is known about backchanneling behavior in ASD. The current study compares the frequency of backchanneling signals between children with and without ASD during a conversation with a researcher.

Methods: Forty-three older children participated (ASD N = 20; TD N = 23). Participant groups did not significantly differ on age (ASD *M* = 13.8, TD *M* = 13.4; *p* = 0.553), sex (ASD 16m:4f, TD 14m:9f, *p* = 0.17), language (ASD *M* = 110, TD *M* = 113; *p* = 0.52), or IQ scores (ASD *M* = 116, TD *M* = 112; *p* = 0.37). All participants were video-recorded while engaging in a "Double Interview" with a researcher (Garcia-Winner, 2002). First, the researcher asks the participant questions about family, holidays, hobbies, and school. Then, the roles are reversed, and the participant asks the researcher similar questions. The second half of the interview – when participants acted as interviewers – were coded for verbal and nonverbal backchanneling. We focused on the second half of the Interview because the researcher produced longer turns in their responses, resulting in more time that the participants were in the listener role.

Results: Participants with ASD produced significantly fewer backchannels per minute than their TD peers (ASD *M* = 3.45, TD *M* = 6.56; F(1,41) = 14.03, *p* = 0.001). Both participant groups backchanneled more during times of mutual eyecontact between conversation partners (*F*(1, 41) = 5.89, *p* = .020); there was not a significant interaction between gaze and group on backchanneling frequency (*F*(1, 41) = 2.60, *p* = .15). See Figure 1. Backchanneling frequency significantly correlated with scores on the Social Communication Questionnaire. See Figure 2.

Conclusions: Older children with ASD backchannel less frequently than TD controls, regardless of whether they are sustaining eye contact with their conversation partner. Because backchanneling is crucial to conversational success, reduced backchanneling by individuals with ASD likely negatively affects their social interactions with others. Consequently, developing interventions targeting appropriate and effective use of listener behavior, including backchanneling, could be of critical importance for improving social outcomes in ASD.

POSTER SESSION — COMMUNICATION AND LANGUAGE
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414.001 *(Poster)* A Dimensional Exploration of Social Communication (pragmatic) Abilities Using an Interactive Assessment Protocol

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Background: Social communication (SC) or pragmatics, is a key diagnostic criterion of ASD, and the characterizing feature of social communication disorder (SCD). The study of autistic traits in sub-clinical and neurotypical populations offered a broader scope of SC. Nevertheless, this broader examination has mostly relied on self, parent, or teacher reports, rather than on ecologically valid assessments that could characterize subtle variations in SC.

Objectives: To evaluate an ecologically valid SC assessment protocol with a sample of children representing clinical, sub-clinical, and normative levels of SC.

Methods: Participants were 120 children (48 females), aged 8-13 (M=10.08; S.D.=1.26), with normative intelligence. Eleven children had ASD, 17 had SCD, 12 had subclinical communication difficulties, and 80 were neurotypical. Children participated in a semi-structured interaction with an examiner, comprising (1.) ten minutes of free-chat, (2.) a favorite book/movie description, (3.)+(4.) personal stories of positive and negative social experiences, and (5.) telling a story from a picture book. Participants were videotaped and coded by reliable raters, who were blind to the child's condition, on context-appropriate structural-verbal (e.g. balanced narrative, initiation and response) and non-verbal (e.g., facial expressions, intonation) components of SC. In addition, proportions of mental and physical verbs used in children's narratives (parts 2.-5.) were calculated. Children self-reported on the Emotion Awareness Questionnaire (EAQ, Rieffe et al., 2008) and parents filled out the Social-Responsiveness Scale (SRS-2; Constantino & Gruber, 2012) as external validators.

Results: Exploratory factor analysis of the 20 free-chat activity scorings yielded a general factor which explained 38.56% of the variance, with internal consistency of .91. These items were summed as a single free-chat score.

Internal consistency of codings for narrative activities (2.-5.) ranged between .60-.93. Hence, scores were summed over and above activity. Exploratory factor analysis of the 16 narrative scorings yielded a general factor which explained 46.50% of the variance, with internal consistency of .90. These items were summed as a single narrative score.

Proportion of physical and mental verb use in participants' narratives were averaged over and above narrative activities into single 'physical' and 'mental' content scores.

Correlation analysis revealed the free-chat and narrative scores were positively correlated (r=.83, p<.001). Physical verb use was negatively correlated with both free-chat (r=-.33) and narrative (r=-.26) factors (p<.01 for both). Mental verb use was only marginally correlated to the free-chat factor (r=.16, p<.1), and not correlated to the narrative factor.

Both free-chat and narrative factors correlated with the SRS-2 Social Communication Index (SCI; r=-.65, and -.51, respectively, p<.001 for both). Only the free-chat factor was correlated with the EAQ general score (r=.34, p<.001). Physical verb use was correlated with SRS-2 SCI score (r=.18, p<.05) and marginally correlated with the EAQ score (r=.17, p<.1). Mental verb use showed no significant correlation with either EAQ or SRS-2.

Conclusions: The current study demonstrated an ecologically valid protocol, dimensionally characterizing SC abilities across a clinical, sub-clinical and neurotypical sample, which correlates well with existing measures. Our results highlight the centrality of context dependent verbal and non-verbal behaviors in the assessment of SC.

414.002 *(Poster)* ASQ: A Questionnaire for the Assessment of Communication, Language and Speech of Young Children with ASD

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Background: Each child diagnosed with autism spectrum disorder (ASD) has the right for an early intervention program tailored to his overall clinical profile (Dromi, 2018). The selection of specific targets for intervention requires a detailed and reliable evaluation of the clinical profile of each child. The goal of the present study was to develop an instrument for speech-language pathologists (SLPs) that would enhance their selection of intervention goals for young children diagnosed with ASD. The Autism Spectrum Questionnaire (ASQ) was designed for this purpose.

Objectives: To construct a questionnaire to be used by SLPs and to examine its internal consistency, reliability, and discriminant validity.

Methods: The ASQ consists of 53 items that are classified into six sub-domains: Emotional Engagement, Communication, Symbolic Representation, Language Comprehension, Motor Planning / Sensory Regulation, and Speech Production. Responses in each item range from 1 (never) to 5 (always). Scores are calculated separately for each domain, and a total score is provided from the sum of all items. Twenty-five SLPs participated in this study. All of them had at least four years of experience working with children with ASD. Each SLP filled in the ASQ twice: Once on a child with ASD between the ages of 3-6 years, and in the second time on a child with typical development (TD) between the ages of 2-5 years. All the children with ASD had previously undergone thorough developmental assessments by a neurologist and a psychologist utilizing the ADOS-2 or the ADI; all had Developmental Quotient (DQ) scores noted in their medical records. All children with ASD were receiving language therapy for at least 3 months prior to the beginning of this study.

Results: The ASQ clearly differentiated between the two groups of children (ASD and TD). The distribution of the total score of each group were compared by the Wilcoxon Two Sample test. ROC analyses were performed to assess the ASQ's discriminant validity and revealed the scale's high ability to distinguish children with ASD against TD children (AUC= 0.98 -1.00). Positive high correlations were found between the ADOS-2 and the ASQ total scores [$r(25)=-0.7$, $p<.0003$]. Correlations between the scores in each of the six domains of ASQ and the ADOS-2 total score varied. The ASQ scores and the DQ scores were highly correlated with each other [$r(25)=0.61$, $p<.05$] (Table 1).

Conclusions: The ASQ was used successfully by SLPs and provided a clear direction for selecting intervention goals for children with ASD. Further research is needed in order to attempt a full standardization of the ASQ measurement, as well as for testing its applicability for children with other neurodevelopmental disorders.

414.003 *(Poster)* Acoustic-Perceptual Analysis of Oral Narratives in Individuals with Autism

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Background: Acoustic differences in the speech, voice and prosody of individuals with autism include increased pitch variability, atypical/shallow vocal quality, fast or slow rate, exaggerated/decreased pitch, and inappropriate phrasing, stress and resonance. Research supports that human listeners can perceive speech differences under controlled conditions that distinguish children with ASD from typically developing (TD) peers. For example, human listeners distinguished children with autism from TD controls as sounding significantly “different” on the basis of story sequencing, articulation, fluency, and emotional language (Andrianopoulos et al., 2015); using more words per utterance during elicited story telling tasks (Dahlgren, 2018); and speech intelligibility (Redford et al., 2018). There is limited consensus regarding which acoustic features contribute to the perception of prosodic differences in autism. The clinical usefulness of perceptual ratings of prosody remains limited. Continued empirical research investigating the ability of trained listeners to identify individuals with autism on the basis of speech, voice and prosody could contribute to the development of an objective definitions of “atypical prosody” to be used across clinical, diagnostic, and research settings.

Objectives: The following research questions were addressed: Do individuals with autism have acoustic differences in their speech, voice, and prosody during oral narrative productions compared to controls?; Are speakers with autism described by trained human listeners as sounding “different” with respect to perceptual correlates of prosody; Are speakers with autism identified by trained human listeners based on their speech, voice, and prosody?

Methods: A between-group study was conducted to investigate acoustic-perceptual features of the voice during an oral narrative re-telling task in individuals with autism (n=15; 12 males, 3 females) compared to TD controls (n=15;) matched for age, gender and language. Participants were monolingual speakers of English, between 7;10 to 15;1 years of age. Testing took place in a 1:1 setting in a sound-treated, double-walled chamber with an ambient noise level of 25 dBA. Participants’ produced an oral narrative using controlled picture stimuli, which was audio recorded for analysis. The duration of each story (seconds), average fundamental frequency (f0), f0 range, standard deviation of f0, rate, and intensity was measured per participant using the Multi-Dimensional Voice Program and compared between groups. Trained listeners used a novel perceptual rating tool consisting of Likert scales to describe the oral narratives with respect to pitch, intonation, rate, fluency, timbre, loudness, and group membership (ASD vs. TD).

Results: The acoustic-perceptual analysis of 18 participants’ oral narratives has been completed. The group means for duration and fundamental frequency during an elicited storytelling task are presented in Table 1. Data collection and analysis will be complete by December 2019. Planned statistical analysis includes one-way analysis of variance, t-tests, Fisher’s Exact, Cohen’s d, and Cohen’s kappa for intra- and inter-rater reliability of perceptual judgments.

Conclusions: Published empirical **r**esearch findings are contradictory. The results of this study support differences in duration during elicited spontaneous storytelling tasks (Dahlgren et al., 2018; Redford et al., 2018). Clinical implications and directions for future research require reliable operational metrics to assess prosody in autism.

414.004 *(Poster)* Aspects of Language Divergently Map Onto Motor Deficits, Dyspraxia and Symptom Severity in Children with Autism

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Background: Language deficits commonly observed in the autism spectrum conditions (ASC) span a wide range, including impairments in pragmatics (i.e., social-contextual aspects of language), word choice differences, and poorer use of grammatical structures. In storytelling, which is a critical skill for school performance and social interactions, narratives of children with ASC have a shorter and less coherent structure as compared to those of typically-developing (TD) children (see meta-analysis by Baixauli et al., 2016). Children with ASC also use fewer mental-state terms (e.g., "know", "think") to express others' perspectives, and have more difficulty comprehending social-emotional words (Tager-Flusberg et al., 2006). Certain grammatical structures, such as first-person quoted speech, may also be indicative of perspective-taking abilities (Brunye et al., 2009), but whether first-person speech use is impaired in ASC requires further investigation. A recent longitudinal study (Bal et al., 2019) reported that early motor skills strongly predicted language skills at age 19, indicating the importance of examining relations between language and motor skills in ASC.

Objectives: This study examined (a) whether narrative structure and first-person speech usage is impaired in children with ASC, and (b) how each linguistic variable is linked with other autism-associated impairments, namely: autistic trait severity (Social Responsiveness Scale-2: SRS-2), dyspraxia (child-modified version of Florida Apraxia Battery: FAB-child), and impaired basic motor control (Physical and Neurological Examination of Subtle Signs: PANESS).

Methods: Fifty-five 8- to 12-year-old children (29 ASD, 26 TD) participated in a storytelling game, during which they watched a narrator tell a story, and then retold this story. Key story elements were identified a priori; the proportion of key elements included in retellings was the measure of narrative structure. The proportion of first-person speech usage to utterances was calculated.

Results: Narrative structure and first-person speech were significantly correlated (r= .57, p< .0001). Further, children with ASC produced significantly shorter narrations ($F(2,52)$= 10.358, p = .02) and fewer first-person speech utterances compared to peers with TD ($\chi^2(55)$= 5.45, p= 0.02; Table 1). Impaired narrative structure was associated with increased ASD severity (SRS-2: r= -.33, p= .02) and poorer motor ability (PANESS: r= -.49, p= .001), but not with praxis performance (Figure 1). Decreased first-person speech production was associated with poorer praxis (FAB-child: r= -.37, p=.05), but not with motor ability or autistic trait severity (Figure 1).

Conclusions: Children with ASC showed reduced command of two language variables, narrative structure and first-person speech usage, during story retellings. Importantly, the two variables showed divergent patterns in their relationship with other autism-associated impairments. Strong associations of narrative structure with motor ability and ASC severity support previous research that narrative structure is a core social-communicative impairment in ASC. First-person speech being uniquely associated with dyspraxia may reflect the perspective-taking demand that is common in both measures. These findings provide insight into how different aspects of language use can map onto the highly heterogeneous autism phenotype.

414.005 *(Poster)* Autistic Adults Show More Lexically-Guided Perceptual Learning

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Background: In our social interactions, we continuously tune into individual speakers, who pronounce words differently, depending on their accent, dialect, gender, age or other factors. This tuning is supported by a type of learning referred to as lexically-guided perceptual learning: When hearing ambiguous speech sounds, we use our lexical and phonotactic knowledge to infer which sounds we have heard. Subsequently, we adjust our phonetic categories (broadly speaking: our expectations for how different phonemes ought to sound) to include such ambiguous sounds. The continuous adjustment of phonological categories, driven by lexical knowledge and recent speech input, enables us to process ambiguous speech more efficiently.

Many theoretical accounts of autistic perception have suggested that autistic people present difficulties in calibrating their perceptual systems to current environments by using knowledge accrued from their recent sensory experiences. Such difficulties have been shown mainly in non-linguistic domains. In this study, we hypothesise that similar difficulties are also present in speech perception and affect lexically-guided perceptual learning. If so, autistic people should present less pronounced lexically-driven perceptual learning compared to neurotypical individuals.

Objectives: We sought to test this prediction by examining lexically-guided perceptual learning in autistic and neurotypical adults.

Methods: We tested 13 autistic adults aged between 19 and 46 (M = 33.80; SD = 11.71). We also tested 14 neurotypical adults of comparable age, and verbal and reasoning abilities.

Participants were tested on a lexically-guided perceptual learning paradigm (Drozdova et al., 2015), which had an 'Exposure-Test' design. In the Exposure phase, participants listened to a short story which contained an ambiguous sound selected from the [l/r] continuum (based on pretesting). Each participant heard one of two versions of the story ('learning conditions') in which the ambiguous sound replaced either all [r] sounds or all [l] sounds in the story.

In the Test phase, participants completed a phonetic-categorisation task on ambiguous sounds from the continuum between [l] and [r] sounds.

We analysed the responses in the phonetic-categorisation task with statistical modelling, using the number of responses that were consistent with the learning condition as the dependent variable. The statistical model included effects of group and of the level within the continuum of ambiguous sounds.

Results: Our analyses showed that both autistic and neurotypical participants presented reliable lexically-driven perceptual learning effects. Contrary to our prediction, lexically-driven perceptual learning was more pronounced in autistic participants compared to neurotypical participants.

Conclusions: Our results suggest that the difficulties of autistic people in calibrating their perceptual systems to current environments do not generalise to lexically-driven perceptual learning. By contrast, autistic people presents enhanced abilities to use lexical or phonotactic knowledge to adjust their phonetic categories to recently speech input.

These findings are consistent with accounts suggesting that autistic people present enhanced perceptual abilities, including enhanced speech perception abilities. These findings are also consistent with our earlier findings that neurotypical individuals with higher levels of autism traits present more lexically-driven perceptual learning. Our current work involves examining these differences developmentally.

414.006 *(Poster)* Autistic Children Show a Preference for Subtle Averted Gaze Versus Direct Gaze

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Background: Atypical eye contact is often quoted among the socio-communicative deficits that define Autism Spectrum Disorder (ASD). Sensitivity to eye gaze and the ability to make eye contact are necessary to engage in joint attention, which plays an important role in language development. Both impairments in joint attention and delays in language acquisition characterize the developmental path of autistic children. Additionally, deficits in visual social attention are largely reported in ASD. However, there is currently no robust eye-tracking evidence that autistic children systematically display abnormally low attention to the eye region. Interestingly, at least one study found that infants at high risk for ASD show a preference for static images of faces with an averted versus direct gaze.

Objectives: Building on this finding and on the idea that sensitivity to direct gaze is a precursor of joint attention, and therefore of language, we explore the preference for direct versus averted gaze in 3- to 5-year-old typically-developing (N=55) and verbal and non-verbal autistic (N=29) children. The aim is to investigate whether they (1) can differentiate direct from averted gaze, and (2) show a preference for direct or averted gaze.

Methods: Stimuli were two identical videos of a person uttering a sentence with neutral emotion, displayed on each side of a screen equipped with a mobile eye-tracker. In one video, the speaker's gaze fixated the camera, while the other was manipulated so that the gaze was averted. There were two conditions of averted gaze. Original gaze was either modified slightly resulting in a subtle averted gaze or more strongly resulting in an obvious averted gaze. Following the stimuli presentation, videos with direct gaze were always rewarded with an animation after a short anticipation window (see Figure 1).

Results: There was a significant main effect of stimulus type (χ^2 (1) = 124.4272, $p<0.001$), with more fixations on the video with direct gaze than with either averted gaze. There was also a significant interaction between stimulus type and group (χ^2 (1) = 48.6249, $p<0.001$). Overall, typically-developing children made more fixations on the video with direct gaze than with either averted gaze. There was no significant difference between the two stimulus types for autistic children. Finally, there was a significant interaction between stimulus type, group and intensity of averted gaze (χ^2 (1) = 70.0481, $p<0.001$) (see Figure 2). Both groups made more fixations on the video with direct gaze when the averted gaze was obvious. However, when the averted gaze was subtle, typically-developing children made more fixations on the video with direct gaze, and autistic children on the video with averted gaze.

Conclusions: Preliminary results suggest that typically-developing children show a preference for direct gaze regardless of intensity of averted gaze. Autistic children show the same preferential pattern when the averted gaze is obvious. However, they show a preference for averted gaze when the gaze is averted more subtly. In the future, analyses of the anticipation phase will be conducted, as well as analyses including ASD symptomatology severity and level of language.

414.007 *(Poster)* Bilingualism in School-Aged Children with and without ASD: A Multi-Case Study

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Background: Worldwide, bilingualism is common (Tucker, 1998). Many families of children with autism are told to refrain from using their minority language with their child for fear that it will exacerbate language deficits (Yu 2013). Such recommendations are not evidence-based and may lead to reduced participation in conversations, diminished abilities to communication with certain family members and limited access to their cultural community (Kremer-Sadlik, 2005; Yu 2013). Moreover, preschool-aged bilingual children with autism (B-ASD) can develop similar language abilities to those of their monolingual children with autism (M-ASD; Hambly & Fombonne, 2012; Ohashi et al., 2012). However, little is known about their linguistic abilities when language demands change during the school years and how BC-ASD compare to neurotypically developing bilingual (B-ND) children in one or both of their languages.

Objectives: The following study aims to shed light on this subject. Specifically, we asked: Are there differences in the performances of B-ASD on French language tasks of receptive vocabulary, receptive language and expressive language skills, when compared to (a) French M-ASD, (b) to their B-ND peers, and (c) to French M-ND peers? And if so, how do B-ASD differ from these peers?

We predicted that B-ASD will overall have similar performances to their monolingual peers with autism. We expected that both B-ASD and M-ASD may have stronger vocabularies relative to their overall receptive language abilities (Kjelgaard & Tager-Flusberg, 2001), a pattern which we did not expect in ND children. We also expected that B-ND would present an expressive-receptive gap (Gibson et al., 2012), which we did not expect in B-ASD, as some children with autism are reported to have better performances on expressive versus receptive language tasks (Eigsti & Bennetto, 2009).

Methods: A multiple-case study was conducted focusing on three French-English B-ASD and two French M-ASD, as well as 19 French-English B-ND and 12 French M-ND children. All children were recruited from the Greater Montréal Region and Greater Ottawa Region, had NVIQs >70, no speech or language disorders, and were six to nine years of age. Autism diagnosis was confirmed through the *Social Communication Questionnaire*. Bilingual children's expressive and receptive language abilities were assessed using the *Clinical Evaluation of Language Fundamentals* in French and in English and receptive vocabularies through the *Peabody Picture Vocabulary Test* and the *Évaluation en images Peabody*. Monolingual children were assessed only in French.

Given the small sample size of children with autism, we opted to complete two different *k-means cluster analyses*: the first analysis examined how the four groups clustered on French-language measures and the second one the performances of the two bilingual groups on French and English-language measures

Results: We found that B-ASD showed similar performances on language measures to those of M-ASD and of B-ND and M-ND children. Additionally, we did not find an ASD language pattern for either of our language groups.

Conclusions: Results from this small-scale study indicate that these B-ASD seem to develop similar language abilities to those of M-ASD, and of their ND peers, be they monolingual or bilingual.

414.008 *(Poster)* Children with Minimal Verbal Skills and Autism Use of Communicative Functions and Communication Partner across Naturalistic Setting

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Background:

- Communication necessities and demands differ based on context, environment and the communication partners. For children with minimal verbal abilities and Autism, information of their communication skills in a naturalist setting can provide necessary information for planning intervention.
- In the current study, we assess children's communicative functions in relation to the naturalistic setting to understand the probable pattern of responses using Communication Complexity Scale (CCS, Brady et al. 2012)

Objectives:

- Similarities and differences in the functions of communication based on naturalistic setting
- The effect of context and communication partner on communicative function

Methods:

- Thirty children (22 Male, 8 Female) between the ages of 3 and 15 years, with minimal verbal skills and autism were observed in three different naturalistic contexts within their schools.
- Observations were coded for 10-minutes in three different settings. We used time sampling procedures, with30 seconds of observation followed by 10 second coding intervals, generating 16 observation intervals. The three contexts are as follows:
    - Structured (e.g. group circle time, art)
    - Unstructured (e.g. snack, free play)
    - Structured One-on-One (e.g. goal work, speech therapy)
- The CCS was used to assign scores to the most complex communication act observed during each observation interval for the naturalistic contexts.
- For the current analysis, the CCS scores of 6 or above, that associated with communicative functions directed towards a communication partner (Adult or Peer) was used:
    - Behavior regulation (BR) - requests and protests
    - Joint attention (JA) - social comments
    - Response to question (RQ) - responses to the communication partner's questions
    - Prompted, imitation, reading (PIR) - prompted communications, imitates based on the communication partners, and readings activities that produces communication acts
- Reliability of the CCS scores was examined for 33% of the naturally occurring contexts. Average percent agreement was 73.02% for function and score combined.

Results: Context and Communicative Function

- The frequencies of communication acts with functions of JA, BR, RQ, and PIR varied somewhat according to the setting. Chi-square test indicates a significant difference between the communicative functions across settings, χ^2 (6, N =483) = 75.046, p <.0001.
- PIR was the most common function in the One-on-One and Structured settings, while BR and JA occurred with approximately equal frequencies across settings.
- Table 1 shows the distribution of functions across setting

Communicative Partner and Function

- Significant differences in the communicative function (only scores 6 and above) were found for communication used with adults or peer communication partners, χ^2 (3, N =244) = 11.934, p = .008.
- Overall, communication was directed more towards adult (96%) than peers (4%).

Conclusions:

- Differences across communicative functions between contexts may reflect differences in expectations and support in different classroom contexts. This information may help in setting goals for student progress.
- Regardless of the settings, students communicated more with adults than their peers. Student communication directed towards peers fostered relatively more JA and RQ. However, communication directed towards adults produced more PIR and BR. Therefore, goals focused on increasing peer communication and JA functions might benefit from activities designed around unstructured settings.

414.009 *(Poster)* Comparing Standardized Assessment Scores to Parental Report in Communication

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Background: Previous research completed on an earlier version of a community-based developmental assessment clinic database produced no correlation between the *Differential Ability Scales, Second Edition, Early Years' (DAS-II)* Verbal Skills scale and the Communication domain on the *Vineland Adaptive Behavior Scales, Second Edition, Parent/Caregiver Rating Form (Vineland-II)*. This previous finding suggested that parents may be inflating their child's communication deficits. However, other research conducted suggests that parents are generally reliable reporters regarding their child's language capabilities (Miller, Perkins, Dai, & Fein, 2017).

Objectives: This study aims to add to the previous research conducted on this database with the inclusion of new data and hypothesizes that children who score higher on the Verbal Skills scale of the cognitive functioning assessment called the *Differential Ability Scales, Second Edition, Early Years and School-Age Battery (DAS-II)*, will also yield higher scores on the Communication domain as measured by the *Vineland Adaptive Behavior Scales, Second or Third Edition, Parent/Caregiver Rating Form (Vineland-II, 3)*.

Methods: Participants included 110 children (Males n = 87, Females n = 23) evaluated at a community-based developmental assessment clinic, over the span of three years. Ages of participants ranged from 30 to 214 months (μ= 78.18 months) and they were assessed using the *Vineland-II* or *Vineland-3*. The sample consisted of 34.5% Caucasian, 23.6% African American, 22.7% Latinx, 10.9% biracial, and 1.8% Asian Americans participants. It is important to note that 0.9% selected 'other' in relation to ethnicity. All participants were at-risk for autism spectrum disorder (ASD), as determined by a phone screening method prior to the evaluation. However, not all participants were ultimately diagnosed with ASD.

Results: As hypothesized, there was a significant positive correlation ($r = .513$, $p < .01$) found between the subjects on the *DAS-II's* Verbal Skills scale and the *Vineland's* Communication domain.

Conclusions: These results suggest that the higher the scores on the *DAS-II's* Verbal Skills Scale, the higher the scores on the *Vineland's* Communication domain. Contrary to previous research utilizing an earlier version of the database, parents/caregiver report on the adaptive measure is aligned with the results of the cognitive assessment.

414.010 *(Poster)* Comparing Treatment Gains in Joint Attention in Structured and Unstructured Contexts

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Background: Several studies have demonstrated the effectiveness of interventions aimed at improving joint attention skills in children with Autism Spectrum Disorder (ASD; Kasari et al., 2006; Kasari et al., 2014). In a randomized control study by Kasari et al. (2014), parents of children with ASD were either actively trained by interventionists to prompt for joint attention during everyday activities (CMM group) or they were educated on ways to teach their children social communication skills (CEM group). The researchers found that both groups showed improvements in initiating joint attention (IJA), and the CMM group displayed significantly more IJA skills than the CEM group. The researchers measured IJA using the Early Social Communication Scales (ESCS; Mundy et al., 2003), a structured assessment designed to elicit joint attention skills. It is unknown whether the acquired joint attention skills that children exhibited on the ESCS could be generalized to less structured play assessments, which are not designed to elicit joint attention. It is important to understand whether interventions are effective at increasing IJA in more naturalistic contexts.

Objectives: Compare IJA skills exhibited on a structured assessment versus a play assessment among a subset of participants from Kasari et al. (2014).

Methods: This secondary data analysis consisted of a subset of children (n= 28) between 2 and 5 years of age with ASD who participated at the UCLA site of a larger multi-site study (Kasari et al., 2014). Children received the ESCS and the Structured Play Assessment (SPA) at entry, exit, and follow-up. During the SPA, the child plays with five sets of toys independently without being prompted for social communication. The ESCS and SPA were coded for coordinated looks, alternate gazes, points, gives, shows, and language at all three time points. IJA frequencies were then calculated. For each assessment, a generalized linear mixed effect model with a random intercept was conducted, holding chronological and mental age constant.

Results: On the ESCS, children displayed 47% more IJA skills at exit ($p = 0.04$) and 64% more IJA skills at follow-up ($p < 0.01$) compared to entry. On the SPA, children displayed 38% more IJA skills at exit ($p = 0.06$) and 67% more IJA skills at follow-up ($p < 0.01$) compared to entry. Comparing the two assessments, children displayed 19% more IJA skills on the SPA than on the ESCS ($p = 0.05$).

Conclusions: These findings indicate that interventions aimed at improving joint attention are effective at improving IJA skills in structured assessments as well as in naturalistic play settings. In fact, children exhibited higher rates of IJA during play than on the ESCS. One limitation of our study was the sample size – due to limited power, we were unable to explore differences in IJA between treatment groups. Our next steps will be to compare IJA in the ESCS and SPA across time and treatment for all 112 participants.

414.011 *(Poster)* Comparison of Communication Level Based on Ethnicity for Children at Risk for Autism Spectrum Disorder

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Background: Research has shown different prevalence rates for autism spectrum disorder (ASD) among different ethnicities. ASD has been shown to be diagnosed more often in White children compared to Latinx and Black children (Durkin, 2017). There are multiple areas of functioning that are taken into account when diagnosing ASD that can impact these ethnic disparities, such as overall communication. Previous research suggests that White children score significantly higher on the domain of understanding communication compared to Latinx and Black children with ASD (Stronach & Wetherby, 2017). However, these researchers also found no significant difference between the different ethnicities based on their use of communication (Stronach & Wetherby, 2017). Therefore, differences in communication level based on ethnicity may vary by specific communication domain for children with ASD.

Objectives: This study aims to add to this body of research and to determine whether communication level differs based on ethnicity for children with ASD. Based on the above findings, it is hypothesized that White children will score significantly higher on the Communication domain of the *Vineland Adaptive Behavior Scale, Second or Third edition, Parent/Caregiver Rating Form (Vineland-II, 3)*, which incorporates different domains of communication.

Methods: Participants consisted of 184 children who completed a comprehensive developmental assessment at a community-based developmental assessment clinic over the span of three years. Out of the 184 participants, 119 participants (64.7%) were diagnosed with ASD. A majority of the participants were male (77.2%) and ages ranged from 19 to 253 months (μ= 68.78). There were 39.7% participants who identified as White, 35.3% identified as Latinx, and 25% identified as Black. Seven participants were excluded due to missing data. The participants completed a comprehensive developmental assessment that included the *Vineland-II, 3*, as part of a testing battery(Sparrow, Cicchetti, & Balla, 2005; Sparrow, Cicchetti, & Saulnier, 2016).

Results: A series of independent samples *t*-tests were utilized for analysis. The results revealed a significant difference for communication level between White children (M = 80.59, SD = 18.08) and Latinx children (M = 71.92, SD = 18.44) who were diagnosed with or at risk for ASD; $t(132) = 2.74$, $p = .007$. No significant difference in communication level was found for White and Black children (M = 75.47, SD = 18.75; $t[111] = 1.44$, $p = .152$) or for Latinx and Black children ($t[105] = -.968$, $p = .335$) who were diagnosed with or at risk for ASD.

Conclusions: The results partially supported the hypothesis because White children who were evaluated for ASD had significantly higher communication scores on the Vineland compared to Latinx children. These results may be due to cultural differences in how language is understood and expressed between White and Latinx cultures.

414.012 *(Poster)* Comparison of Language Characteristics Associated with Autism Spectrum Disorder, Intellectual Disability, and Co-Morbidity in a Diverse Clinical Sample

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Background: Children with autism spectrum disorder (ASD), global developmental delay (DD), and intellectual disability (ID) are at increased risk for severe language difficulties. Some research has suggested unique language profiles for children with ASD, with stronger expressive than receptive language scores. However, little is known about language profiles of individuals with ASD and DD/ID in diverse samples. Given the importance of language skills for independent functioning for those with ASD and those with DD/ID, it is critical to understand language profiles associated with ASD and ID to assist in developing tailored, individualized interventions.

Objectives: The purpose of this study was to compare language profiles associated with children diagnosed with ASD, DD/ID, comorbid ASD and DD/ID, and those without either diagnosis on measures of language in a clinical sample of predominantly Hispanic children and adolescents in the southwestern United States.

Methods: Participants included 337 children and adolescents (73.8% male; *M*age = 6.70, *SD* = 4.27) age 3-21 years who were evaluated between January 2015 and October 2017. All participants were referred for evaluation of possible ASD. Clinical diagnoses were made based on results of interviews, *Autism Diagnostic Observation Schedule, Second Edition* (*ADOS-2*), cognitive, language, and adaptive behavior assessments. Four groups were formed: children with ASD but no DD/ID (38%), DD/ID but no ASD (7.7), both ASD and DD/ID (19%), and no ASD or DD/ID diagnosis (35.3%). Inclusion criteria were (a) aged between 3 and 21, and (b) spoke English as their primary language.

Measures: The *ADOS-2* and clinical interview were used to assess ASD symptoms. Cognitive abilities were measured by the *Differential Ability Scales, Second Edition*. Adaptive behavior was measured using the *Vineland Adaptive Behavior Scales, Third Edition* or the *Adaptive Behavior Assessment System, Third Edition*. Receptive and expressive language skills were assessed with the *Oral and Written Language Scale*-2 or the *Preschool Language Scale-5*.

Results: Significant differences were found in percentages of children who had language impairment (standard score of 70 or below on a language test) among the four groups by chi-squared proportion test, $X2(3, 331) = 94.37$, $p = 0.000$. More children with DD/ID and comorbid ASD and DD/ID had language impairment compared with children with ASD only and those without either diagnosis (see Table 1).

For children with ASD only, receptive language scores ($M = 77.90$, $SD = 19.55$) were significantly higher than expressive scores ($M = 73.05$ $SD = 18.62$), $t(127) = 5.175$, $p < .000$, CI [2.996-6.707]. For children with DD/ID only and those with combined ASD and DD/ID, receptive language scores were not significantly different from expressive scores (see Table 2).

Conclusions: Regarding overall language performance, scores indicate Neither Diagnosis > ASD > DD/ID > ASD and DD/ID, suggesting an additive effect of diagnosis. Unlike previous research demonstrating relatively more impaired receptive than expressive language in children with ASD, a pattern of significantly stronger receptive language ability was only found in children without either diagnosis or in children with only ASD, further suggesting unique language profiles.

414.013 *(Poster)* Comparisons of Steps in Theory-of-Mind Development between Autistic and Typically Developing Children in Hong Kong and Mainland China

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Background: While a meta-analysis has shown that false belief (FB) understanding of typically developing (TD) children in Hong Kong (HK) develops much later than that of children in mainland China (Liu et al., 2008), whether the former also acquire other theory-of-mind (ToM) skills later than the latter remains unclear. Moreover, no study has compared ToM skills of HK autistic children with those of mainland Chinese autistic children. Wellman and Liu (2004) have devised a ToM scale to investigate the developmental sequence of five ToM skills: diverse desires (DD), knowledge access (KA), diverse beliefs (DB), contents FB (CFB), and hidden emotion (HE). Given Liu et al.'s finding, we hypothesize that both autistic and TD children in HK will perform worse than their mainland China counterparts in CFB. Furthermore, given Zhang et al.'s (2016) finding that the developmental sequence of the five ToM skills in mainland Chinese autistic children deviated from that in TD children, we hypothesize that the same will be observed in HK autistic and TD children.

Objectives: To examine HK autistic and TD children's performance on Wellman and Liu's (2004) ToM scale, and to compare the results with those from mainland Chinese autistic and TD children reported by Zhang et al.

Methods: 47 ASD ($M = 6.16$; range: 3.5–9.58) and 93 TD children in HK ($M = 5.10$; range: 3.33–6.83) participated. They were matched with Zhang et al.'s autistic and TD groups on age. To compare the developmental sequence of ToM between HK autistic and TD children, another TD group ($N = 137$; $M = 5.61$) matched with ASD group on language ability was formed. The tasks used by Zhang et al. (translated into Cantonese) assessed understanding of the five ToM skills.

Results: Among the five ToM tasks, chi-square analyses showed that HK TD children's passing rates were significantly lower than mainland Chinese TD children on KA and HE (see Table 1). In contrast, HK autistic children significantly outperformed mainland Chinese autistic children on KA, DB, and CFB (see Table 1). Like Zhang et al., we found that HK autistic children's developmental sequence of the five ToM skills (i.e., KA < DD < DB < CFB < HE) deviated from that of HK TD children (i.e., DD < KA < DB < CFB < HE) (see Table 2). Moreover, the developmental sequence of the five ToM skills in HK autistic children differed from that of mainland Chinese autistic children, which was DD < DB < KA < CFB < HE (see Table 2).

Conclusions: This study partially confirmed our hypothesis: the developmental sequence of the five ToM skills in HK autistic children deviated from that of HK TD children. However, contrary to our hypothesis, neither TD nor autistic children in HK performed worse than their mainland Chinese counterparts on CFB. Our finding that the developmental sequence of the five ToM skills in HK autistic children differed from that of mainland Chinese autistic children supports the idea that the developmental sequence of ToM is subject to cross-cultural/regional variations.

414.014 *(Poster)* Comprehension of Presupposition Trigger Ye 'also' By Mandarin-Speaking Children with Autism Spectrum Disorders

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Background: Pragmatic deficits have been reported to be a hallmark in individuals with Autism Spectrum Disorders (ASD) (Tager-Flusberg, 1999). However, little research has been done to investigate understanding of presuppositions, especially the comprehension of specific presupposition triggers, in ASD population.

Previous research (Bergsma, 2006; Höhle, Berger, Müller, Schmitz, & Weissenborn, 2009; Hüttner, Drenhaus, van de Vijver, & Weissenborn, 2004; Lee, 2002; Liu, Pan & Hu, 2011; Matsuoka, Miyoshi, Hoshi, Ueda, Yabu, & Hirata, 2006; Müller, Höhle, Schmitz, & Weissenborn, 2009; Nederstigt, 2003) revealed that TD children were able to produce 'also' as early as one and half years old across different languages, but they could not demonstrate adult-like interpretation until late seven years old (for relevant reviews, see Berger and Höhle, 2012). Note that the test stimuli in the above-mentioned comprehension work are isolated sentences. The stimuli are inappropriate when there is no discussion of others maintaining the same activity, or some other activities conducted by the same individual/s under discussion (Höhle et al., 2009; Stalnaker, 1974, 2002), which might contribute to preschool children's failure to comprehend 'also' in an adult-like manner.

Different from the large amount of research done with TD children, no study has been conducted to extend the investigation of comprehension of presuppositions to individuals with ASD. Cheung (2019) reported that Cantonese-speaking children were selectively impaired in comprehending different types of presupposition triggers, namely, definite description, factive predicates, change-of-state verbs, implicative verbs, iteratives and counterfactual conditionals and temporal clauses. The study did not include the counterpart of 'also' in Cantonese as a stimuli. In another word, no data with respect to the comprehension of presupposition trigger 'also' in ASD population has been reported before.

Objectives: The present study tried to advance the current understanding of pragmatic deficits in ASD individuals by investigating the comprehension of presupposition trigger *ye* 'also' in Mandarin-speaking preschoolers with ASD and their typically developing (TD) controls. Moreover, we were interested to investigate whether preschool Mandarin-speaking children are capable of interpreting presupposition trigger *ye* 'also' in an adult-manner when presupposed parts are introduced with proper context.

Methods: Picture Selection Task was adopted. Participants were instructed to select correct pictures after they hear the stimuli. Stimuli are compound clauses, which are comprised of two simple clauses, for instance, *the boy is running, the girl is also running*. The verb phrases of the first clauses were replaced by sounds of 'cars passing by'. In this way, the stimuli provide felicitous context for presupposition trigger 'also'.

Results: Children with ASD and TD children were matched on age, language ability and cognitive ability as well as executive function. We found that 22 Mandarin-speaking ASD children (4-5yrs) performed significantly worse than their matched 29 TD peers, who interpreted *ye* 'also' in an adult-like manner.

Conclusions: Preschool TD children do have the knowledge of 'also'; children with ASD are impaired in presuppositions of 'also', which is another area of pragmatic inferences.

414.015 *(Poster)* Computational Assessment of Verbal Entrainment in Individuals with Autism Spectrum Disorder and First-Degree Relatives

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Background: Difficulties in prosody (e.g., intonation, volume, rate), turn-taking, and overly formal speech constitute common social communication deficits in autism spectrum disorder (ASD), which can significantly hinder social interactions (Paul et al., 2009). Subtle, parallel differences in social communication have also been noted in parents of individuals with ASD (Landa et al., 1992). In typically developing (TD) individuals, social interactions are supported by entrainment, or the unconscious tendency to become more similar to one's communicative partner. Verbal entrainment is evidenced across lexical, semantic, syntactic, and prosodic domains. However, objective characterization of how deficits in these areas, specifically prosody, impact broader social communication in ASD remains a challenge in research and clinical contexts. Given the clinical and etiologic heterogeneity of ASD, assessment of verbal entrainment in parents may inform understanding of traits linked to genetic liability of ASD. Therefore, this study implemented a comprehensive, computational investigation of lexical, semantic, syntactic, and prosodic entrainment in individuals with ASD and their parents.

Objectives: To objectively measure verbal entrainment in individuals with ASD and their parents.

Methods: Individuals with ASD (n=26), their parents (n=53), and respective control groups (n=26 ASD controls; n=30 parent controls) participated in a 10-minute interactive game with an examiner. The pair conversed to determine if the silhouettes they were independently viewing matched. Lexical entrainment was based on lemmatized words, semantic entrainment on Word2Vec representations of the corpus and using word embeddings (Goodkind et al., 2018), and syntactic entrainment on 2-grams of part-of-speech-tags (Duran et al., 2019). Prosodic entrainment was measured using the contour-based, parametric, and superpositional intonation stylization toolkit (Reichel, 2011). Measures of cognitive ability, ASD symptom severity, and ratings of pragmatic language ability were examined in relation to entrainment within each domain.

Results: Analysis of the full sample is ongoing. In a preliminary sample of 12 individuals with ASD and 12 TD controls, individuals with ASD exhibited reduced lexical (p=.03) and syntactic entrainment (p=.09). In a sample of 22 parents of individuals with ASD and 19 parent controls, parents of individuals with ASD demonstrated significantly reduced semantic entrainment (p=.02). Lower full-scale IQ was marginally associated with poorer lexical entrainment in ASD (p=.08). Increased ASD severity in the social affect (p=.01) and restricted interests and repetitive behaviors (p=.03) domains was associated with poorer lexical entrainment in individuals with ASD. Across individuals with ASD and TD, decreased lexical entrainment was associated with greater pragmatic language violations in a separate conversational context (p=.01). In parents of individuals with ASD, reduced lexical entrainment was associated with a socially reticent personality style (p=.02).

Conclusions: Reduced entrainment detected in individuals with ASD and their parents highlights verbal entrainment as a potential mechanism underlying social communication impairments in ASD and more subtle differences in parents, potentially marking genetic liability to ASD. Findings that objective, computational measurements of entrainment are highly associated with ASD symptom severity and ratings of pragmatic language, as well as personality styles consistent with the broad autism phenotype in parents, highlight the promise of such computational tools in research and intervention studies.

414.016 *(Poster)* Contextual Differences in Joint Attention Behaviors Among Children with Autism

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Background: Children with autism spectrum disorder (ASD) often exhibit deficits in joint attention compared to their typically developing peers. The fluidity of naturalistic social interactions requires children to constantly assess and reassess the context of their environment while making judgements about themselves, their social partner, and objects or events of interest (Mundy & Jarrold, 2010). It is likely that children's social behaviors are influenced by different task demands, and therefore it is important to understand how contextual differences and task demands may be related to joint attention behaviors of children with ASD.

Objectives: The purpose of the present study is to examine joint attention behaviors of children with ASD in three contexts including *competing demands*, *teaching*, and *free play* in order to gain insights into aspects of social contexts that may promote or discourage joint attention.

Methods: Participants included 44 children with ASD (35 males) between the ages of 30 and 66 months (*Mage*= 49.33, *SD*= 10.01 months). Children with ASD and their mothers participated in a series of interactions including *competing demands, teaching* and *free play,* each of which lasted 5 minutes. An adapted version of the Early Social Communication Scales (Mundy et al. 2003) was administered to capture children's initiations of joint attention (IJA), and response to mother's bids for joint attention (RJA). Coding was completed by two research assistants, and measures of reliability were conducted by an independent coder (IJA ICC = 0.74-0.85; RJA ICC = 0.72-1.0).

Results: To test whether IJA and RJA differed as a function of context, mixed models were fitted with context as a fixed factor and participant as a random factor. Children's expressive and receptive language were controlled, and post-hoc pairwise contrasts using Bonferroni corrections were analyzed. For IJA, the model revealed a significant difference between the competing demands task and teaching task, t (86) = 6.82, $p < .001$, and the competing demands task and free play task, $t(86) = 5.77$, $p < .001$, while the difference was non-significant between the teaching task and free play task, t (86) = -1.04, $p = .55$. For RJA, the model indicated a significant difference between the competing demands task and teaching task, t (86) = -3.15, $p = .006$, and the competing demands task and free play task, t (86) = -3.54, $p = .002$, however the difference was non-significant between the teaching task and free play task, t (86) = -0.39, $p = .92$.

Conclusions: The rate of children's joint attention differed depending on the context of their interaction. Children exhibited greater frequency of IJA during the competing demands task, and greater frequency of RJA during the free play and teaching tasks. The utility of assessing child and parent behaviors in different contexts may relate to *functions* of the demands inherent in the tasks. The competing demands task may tap into children's social motivation, whereas the teaching task may relate to their attention more broadly - each task exerting unique pressures on the social interaction.

414.017 *(Poster)* Developmental Relationships between Joint Engagement and Child Vocabulary

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Background: Higher-order supported joint engagement (HSJE), wherein caregivers and children reciprocally engage with toys, is longitudinally associated with autistic children's language (Bottema-Beutel et al., 2014). Follow-in utterances refer to parent talk that is semantically related to children's focus of attention. This type of talk, when embedded within HSJE (HSJE + FI), is also longitudinally associated with autistic children's language (Bottema-Beutel et al., 2014). At present, the direction of effect is not clear- do early HSJE and HSJE + FI influence later vocabulary, or does the pathway work in the reverse direction? Cross-lagged panel analysis is one way to answer this question.

Objectives: To determine if there were superior cross-lagged effects for:

(a) Early HSJE + FI and later expressive vocabulary vs. early expressive vocabulary and later HSJE + FI

(b) Early HSJE + FI and later receptive vocabulary vs. early receptive vocabulary and later HSJE + FI

(c) Early HSJE and later expressive vocabulary vs. early expressive vocabulary and later HSJE

(d) Early HSJE and later receptive vocabulary vs. early receptive vocabulary and later HSJE

Methods: This project is a secondary analysis of data collected on 91 autistic children who were 3-4 years old at study entry. Video recordings of caregiver-child interactions at Time 1 and 8 months later were coded for duration of HSJE and HSJE + FI at each timepoint. The MCDI was also collected at both timepoints to measure children's expressive and receptive vocabulary. Structural equation modeling (SEM) was used to calculate standardized coefficients and *p*-values for cross-lagged associations, while accounting for all other concurrent and longitudinal associations between variables. Coefficients for relevant cross-lagged associations were compared via linear combinations to identify a superior pathway, which allows for inferring a direction of effect.

Results: See Figures 1 and 2 for SEM results. Analyses indicated:

1. Effects of early HSJE + FI on later expressive vocabulary were significant while effects of early expressive vocabulary on HSJE + FI were not.
2. Effects of early HSJE+FI on later receptive vocabulary were significant while effects of early receptive vocabulary on later HSJE + FI were not.
3. Effects of early HSJE on later expressive vocabulary were significant while the effects of early expressive vocabulary on later HSJE were not.
4. Effects of early HSJE on later receptive vocabulary were significant, while the effects of early receptive vocabulary on later HSJE were not.

However, none of the coefficients within the pairs of crossed lagged coefficients listed in a-d were significantly different from each other (all *p*'s > .05).

Conclusions: While statistically superior pathways were not found for any of the 4 sets of cross-lagged panels, it is notable that all cross-lagged associations between early joint engagement and later vocabulary were significant, while none of the cross-lagged associations between early vocabulary and later joint engagement were significant. This provides some evidence that HSJE and HSJE + FI are useful starting points for promoting autistic children's vocabulary development in early intervention contexts, as compared to considering vocabulary a prerequisite for advancing developmentally important forms of joint engagement.

414.018 *(Poster)* Divergent Associations of Emotional Prosody Perception, Executive Function and Advanced Theory of Mind in School-Aged Children with High-Functioning Autism

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Background:Impairment in theory of mind (ToM) and executive dysfunction have been proposed to explain social-communication deficits of autistic spectrum disorder (ASD). Inhibition and planning of executive function (EF) were related to first-order false-belief task in school-aged children with ASD (Joseph & Tager-Flusberg, 2004). The typically-developing (TD) school-aged children continue to master their higher-order ToM ability, and inhibitory control was associated with recognizing transgressions of social norms (in the faux pas task) and social reasoning (in the eyes tasks) (Osterhaus, Koerber, & Sodian, 2016). Children with high-functioning autism (HFA) performed less accurate to judge emotions of speech prosody (Wang and Tsao, 2015).

Objectives: The goal of this study was to evaluate the ToM deficit hypothesis in school-aged HFA children through exploring development of emotional prosody perception, EF and ToM, as well as investigating subcomponents of EF skills for developing higher-order ToM.

Methods: *Participants.* HFA (*n*=53, mean age=10.08 years) or TD children (*n*=60, mean age=9.93 years) in Taiwan. Inclusion criteria of HFA group: CAST (Childhood Asperger Syndrome Test) score≧5 and FSIQ of WISC-IV>85. **Table 1** lists tasks of emotional prosody perception, lower-order ToM, advanced ToM and EF.

Results: (a). ***developmental trends.*** Children were divided into middle (n=76, mean age = 9.31 years) and late (n=37, mean age = 11.42 years) childhood groups. Results of AgeXGroup 2-way ANOVAs showed that HFA group performed poor than TD group in lower-order ($p<.001$) and advanced ToM (eyes task, $p=.017$, faux pas task, $p=.013$). The Age effect was significant in all ToM tasks. AgeXGroup interaction effect was only significant in the lower-order ToM ($p=.040$). On emotional prosody perception, the Age effect was significant (p=.007), but neither Group nor AgeXGroup effect was significant. The Age effect was significant in each task of EF, except Wisconsin card sorting task (WCST). The Group and AgeXGroup effects were not significant in EF tasks.

(b). developmental associations. For HFA group, results of partial correlation (control for Age) revealed that eyes task was associated with faux pas ($r=.288$), emotional prosody ($r=.342$), and WCST (shifting, $r=.376$). The faux pas task was associated with ToL (moves, $r=-.363$) and WCST (errors, $r=-.437$). Emotional prosody was associated with WCST (shifting, $r=.520$, and errors, $r=-.437$). For TD group, the eyes task was associated with emotional prosody ($r=.397$), but faux pas task was not significantly associated with other tasks.

For HFA group, the path analysis ($\chi^2(1)=.824$, $p=.364$, RMSEA=0.000 and GFI=.992) showed that shifting directly related to recognize emotions from pictures and voices (**Figure 1a**). Additionally, planning directly relate to detect faux pas. In contrast, the path analysis (**Figure 1b**) for TD group ($\chi^2(1)=.659$, $p=.417$, RMSEA=0.000 and GFI=.993) revealed that eyes task directly link to emotional prosody but indirectly link to planning.

Conclusions: The HFA group exhibit impairments in recognizing complex emotions and detecting social transgressions of higher-order ToM. Results of path analysis for HFA children highlight the importance of shifting to identify mental states but the involvement of planning to detect violations in social context.

414.019 *(Poster)* Do High- Vs. Low-Risk Toddlers Differ in Production of Functional Acts in Early Adult-Child Interactions?

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Background: Infants at high risk for autism spectrum disorder (ASD) demonstrate reduced gesture usage as young as 12 months of age (Choi et al., 2019). Toddlers with ASD, for example, demonstrate weaknesses in deictic gesture production (e.g., pointing toward items; Manwaring et al., 2018; Özçalışkan et al., 2016). As such, previous work has largely targeted exposure to and use of deictic gestures in this population. In contrast, less work has examined functional acts (e.g., twisting a jar open or giving a bottle to one's mother), which emerge in typical development around 8-to 10-months of age (Capone & McGregor, 2004). Functional acts involve action upon items and thus are often excluded from gesture analyses (Özçalışkan & Goldin-Meadow, 2005). However, they constitute a key nonverbal communication strategy commonly considered in diagnostic evaluations (Lord et al., 2012) and are also observed less frequently in children with ASD (e.g., Wetherby et al., 2007). Closer consideration of functional acts may offer a more comprehensive view of nonverbal communicative development in typical and atypical development.

Objectives: We examined child use of functional acts in the context of play interactions with a clinician and a primary caregiver during a structured social communicative play assessment (Wetherby & Prizant, 2003). We examined whether differences emerged in use of functional acts between children who were identified as high-risk *vs*. those identified as low-risk, a subset of whom later received a diagnoses of ASD (n = 13 high-risk infants, n = 1 low-risk infant).

Methods: A sample of 35 24-month-old toddlers (20 male, 15 female; 82.9% Caucasian) has been drawn from a larger prospective, longitudinal study examining the development of ASD symptoms in high-risk infant siblings of children with ASD (n = 15) as compared to low-risk infants (n = 20). Video recordings of the children engaged in a structured 15- to 20-minute assessment of initiations and responses to clinician communicative bids were coded following earlier gesture work (Özçalışkan et al., 2017). Specifically, the team used a coding protocol that classified gestures by type and function as well as functional acts. Moreover, the team coded whether gestures and functional acts occurred in isolation or with speech or eye contact.

Results: Preliminary findings (n = 35) indicate that children later diagnosed with ASD tended to engage in fewer functional acts directed toward an adult (M = 10.29, SD = 5.95) as opposed to children without a diagnosis (M = 15.48, SD = 8.52; $t(33) = 1.975$, $p = .057$). However, frequency of functional acts did not significantly differ based upon risk status ($p = .123$).

Conclusions: Early gesture predicts language outcomes in typical and atypical development (e.g., Choi et al., 2019; Sauer et al., 2010; Özçalışkan et al., 2017). Given the relatively lower production of gestures in children with ASD, exploration of nonverbal communicative strategies other than gestures, such as functional acts, can inform early diagnosis of ASD and consequently, more positive language learning outcomes in this population.

414.020 *(Poster)* Does Multilingual Exposure Have an Effect on the Severity of Autistic Traits?

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Background: Current research suggests multilingualism may have a significant impact on various aspects of autism. Recent evidence shows that multilingual autistic individuals demonstrate improved executive function and communicative competence.[1,2,3,4] All of the mentioned abilities are abilities that are also found to be impaired in autism.[5,6,7] If multilingualism affects a number of autistic deficits, it is possible that it could interact with the way in which autistic traits are expressed.

Objectives: This study investigates the relationship between multilingualism and the prevalence of autistic symptomatology, as measured by the Social-Responsiveness Scale (SRS-II).

Methods: Data from the children in this sample were taken from two separate research projects conducted at the University of Cambridge and UCL's Institute of Education. In total, 22 monolingual and 30 multilingual autistic children (mean age = 12.9 years, sd ± 11.05) were tested as at UCL's Institute of Education and at the University of Cambridge. Parents of these children completed an extensive language background questionnaire, where they reported on the number of languages spoken, proficiency and frequency of use in each language. Parents of children were additionally asked to complete the SRS-II, a questionnaire aimed at identifying autistic traits.

Results: Firstly, we ran an independent t-test to assess whether the average SRS-II scores differed between the monolingual and bilingual groups, where the bilingual group was defined as any child who was reported as being exposed to more than one language. The independent t-test showed no significant difference between the average total SRS scores for bilinguals (mean score = 78.772) and monolinguals (mean score = 81.125) (t(38.334) = -0.793, p-value = 0.4328). Finally, we looked at whether proficiency and frequency of use in multiple languages among the bilingual group predicted differences in SRS scores in the second cohort. The regression models revealed that overall level of multilingualism, measured as a combination of proficiency and frequency of use, significantly predicted differences in total SRS-II scores. We found that higher levels of bilingual proficiency and frequency of use predicted overall lower SRS-II scores ($F(1, 30) = 2.415$, $p = 0.004$, > 0.01; $r^2 = 0.22$).

Conclusions: Our results showed a tendency towards lower SRS scores in the children growing up in multilingual environments, with bilingual proficiency predicting lower presentations of autistic traits. The findings from this project will help inform our knowledge of autism and how strong environmental factors, such as multilingualism, may influence its aetiology.

414.021 *(Poster)* Emergent Literacy Skills in Children with and without Autism Spectrum Disorders

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Background: Emergent literacy is the stage, usually occurring during the preschool period, during which the skills, knowledge, and attitudes that are precursors to reading and writing start to develop (Whitehurst & Lonigan, 1998). Children with Autism Spectrum Disorder (ASD) are at risk for poor literacy skills because characteristics of ASD can produce limited engagement in the typical learning experiences that encourage emergent literacy skills development (Travers et al., 2011). However, few studies have been conducted with children with ASD who are in this early literacy stage (e.g., Lanter etal., 2012; Westerveld et al., 2017).

Objectives: Emergent literacy skills include code-related and meaning related emergent skills. Code-related skills include letter knowledge, print concepts, early name writing, and phonological awareness. Meaning-related skills include vocabulary, and oral narrative retelling and comprehension (NICHD, 2005). The primary objectives of this study were to explore the strengths and weaknesses of code-related and meaning-related emergent literacy skills in children with and without ASD.

Methods: Thirty-seven children participated, 17 children with ASD and 20 neurotypical (NT) children (see Table 1 for demographic information). All children were recruited through schools and other community organizations that serve children with and without ASD. Following informed consent procedures, measures assessing code-related emergent literacy skills (letter knowledge, print concepts, early name writing, phonological awareness), meaning-related emergent literacy skills (receptive vocabulary, oral narrative recall, oral narrative comprehension), theory of mind (ToM) and joint attention (JA) were administered.

Results: On code-related emergent literacy skills, children with ASD did not differ from NT children in letter knowledge or phonological awareness. However, group differences were found for print conventions and name writing, $t(35) = 2.22\text{-}2.81$, $p > 0.003$, d = 0.72 - 0.91, respectively. Children with ASD scored significantly lower on both tasks than NT children (see Table 2). For meaning-related emergent literacy skills, children with and without ASD did not differ on receptive vocabulary, $t(35) = 1.92$, $p = 0.06$, $d = 0.63$. However, the quality of the oral narratives produced by children with ASD was significantly lower, $t(35) = 4.99$, $p = 0.0001$, $d = 1.64$. Moreover, their oral narrative comprehension was significantly lower than that of the NT children, $t(35) = 5.2$, $p = 0.0001$, $d = 1.73$. Regression analysis showed that JA but not ToM predicted the results for children with ASD.

Conclusions: Children with ASD were able to name letters and letter sounds as well as NT children, but had more difficulty than their NT peers with print conventions and name writing. For example, while 75% of NT children earned full points on the name writing task, only 18% of the children with ASD were able to do so. In terms of meaning-related emergent literacy skills, children with ASD were less likely than NT children to answer questions about a story they heard correctly, and they were less likely to include the necessary details when retelling the same story. Results also showed that joint attention may play an important role in emergent literacy skills development in children with ASD.

414.022 *(Poster)* Evidence for the Dimensional and Categorical Accounts of Language Development in Children with Autism Spectrum Disorder

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Background: Children with ASD have significant delays in early language acquisition, but unlike neurotypical late talking children, the language development in children with ASD is accompanied by restricted interests, repetitive behaviors and social communication deficits. Might the language delay and the core deficits of ASD be related? This question highlights one of the central theoretical controversies surrounding lexical development in children with ASD. That is, are the language delays associated with ASD merely adjustments along a continuum of development, where differences are primarily quantitative and along a single dimension (*dimensional account*)? Or are the delays the result of a categorical difference in the way children with ASD learn language, giving rise to distinct language profiles that are not simply delayed versions of typical development (*categorical account*)?

Objectives: We investigated evidence for the dimensional and categorical accounts of lexical development among children with ASD by conducting a large-scale comparison of early lexical profiles (syntactic class and semantic categories) with typically developing (TD) toddlers and late talkers. We also examined whether the verbs that children with ASD produce differ in their social characteristics, relative to verbs produced by typically developing toddlers.

Methods: We compared the lexical composition of 216 children with ASD, aged 11 to 173 months, with 7,287 TD toddlers with and without language delay, aged 8 to 30 months, who were matched on expressive vocabulary. Expressive vocabulary was measured using the Communicative Development Inventory (CDI; Fenson et al., 2006). The data from children with ASD were obtained from the National Database for Autism Research (Payakachat et al., 2016) and TD data came from the Wordbank database (Frank et al., 2017). Children who did not have an ASD diagnosis were subclassified as either typical talkers (TTs) or late talkers (LTs). Late talking toddlers where those who scored at or below the 10th percentile on the CDI. We examined the syntactic composition of the children's lexicons using the syntactic classifications specified by Bates et al. (1994) and semantic composition using the categories specified on the CDI. To assess our second aim, we collected social ratings of the verbs on the CDI from a sample of 54 adults.

Results: Children with ASD and LTs produced a lower proportion of nouns and a higher proportion of predicates than TTs (Figure 1). All groups demonstrated a noun bias (producing more nouns than predicates); however, children with ASD had a reduced noun bias relative to TTs and LTs ($ps < .001$). Additionally, the ASD group produced a higher proportion of action words than either TTs or LTs, a lower proportion of sound effects than TTs, and a higher proportion of places than TTs. Also, children with ASD produced fewer high-social verbs ($H(1) = 11.16$, $p < .001$; Figure 2). All differences were found for children who produced fewer than 75 words, except for places (>300 words).

Conclusions: The group differences across syntactic classes, semantic categories, and social features of verbs highlight unique features of early vocabulary development in children with ASD and provide partial support for the categorical account.

414.023 *(Poster)* Executive Functions in Bilingual and Monolingual Children with Low and High Levels of Autistic-like Traits

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Background: Research on bilingualism has shown cognitive advantages in executive functions, such as in attentional control (Adesope et al., 2010) and working memory (Carlson & Meltzoff, 2008). Alternatively, the same areas are often impaired in autism (Schuh & Eigisti, 2012). Therefore, studying bilingualism and autism offers an avenue for investigating interaction between contrasting cognitive profiles. However, diagnosing autism may be more complex and qualitatively different in bilinguals than in monolinguals. Specifically, the same levels of autistic traits tend to be acknowledged to a significantly different degree across various cultures (Burke et al., 2015). As bilinguals are often bicultural, investigating potential interactions of bilingualism and autism only in diagnosed samples suffers a risk of leaving out a large part of the spectrum caused by the cultural bias in the diagnosis.

Objectives: The study investigates the interaction of bilingualism and autistic-like traits (ALTs) in a general sample of children in relation to their cognitive skills. By looking at children with low or high levels of ALTs from a general population sample, without requiring a clinical diagnosis of autism, we eschew any disparities that might arise between monolinguals and bilinguals caused by the diagnostic bias. The following questions are addressed: (1) do bilinguals and monolinguals differ in their executive function skills? (2) does the level of ALTs affect children's executive function skills? (3) does bilingualism have ameliorating effects on cognitive skills in children with high ALTs?

Methods: The sample included 19 bilinguals with high ALTs, 25 bilinguals with low ALTs, 21 monolinguals with high ALTs, and 28 monolinguals with low ALTs, matched on age (*M* = 9;1, *SD* = 1;7) and the socioeconomic status. Monolinguals spoke English, and bilinguals spoke English and another language. Low ALTs indicated virtually no impairment in social communication/interaction and in restricted interests/repetitive behaviour (³ -1SD from the population mean on the ALTs measure). High ALTs indicated difficulties in the same areas (³ +1SD from the population mean on the ALTs measure). ALTs were measured with the Social Skills Improvement System-Rating Scales (Gresham & Elliott, 2008) and the Social Communication Questionnaire (Rutter et al., 2003). Demographics were collected through a caregivers' questionnaire. The dependent variables were measured with three executive function tasks.

Results: We identify three patterns of findings. On the inhibition measures, bilinguals showed a trend towards advantage, with no difference between children with low and high ALTs. On the switching and the visual working memory measures, there were no differences between the groups no matter the language status (bilingual vs. monolingual) or the level of ALTs (low vs. high). Finally, on the audio-visual working memory measure, monolinguals with low ALTs outperformed bilinguals with high ALTs.

Conclusions: These findings make a unitary account of executive functions and bilingualism unlikely. We suggest that investigating sociolinguistic variables, such as the community norms of how languages are used could help solve this predicament. Considering ALTs, the majority of tasks do not show negative effects of ALTs on executive functions. Nevertheless, children with higher levels of ALTs might experience executive function difficulties.

414.024 *(Poster)* Exploring Examiner Responsiveness during the ADOS with Minimally Verbal Individuals with ASD

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Background: Previous research studies have examined how children's gestures affect how their caregivers respond to gestures (Choi et al., 2019; Dimitrova et al., 2016; Leezenbaum et al., 2014). Caregiver responsiveness, specifically contingent responses (semantically relevant) in turn, shape children's language development (Goldin-Meadow et al., 2007; Tamis-LeMonda et al., 2014). However, less is known about whether *different* communication modalities (speech, speech/gesture, gesture, sign) and the *quality* of pragmatic communication (e.g., precise gestural forms vs approximations) produced by MV individuals with ASD may influence responding by an *unfamiliar* conversational partner.

Objectives: To examine how the conversational partner (examiner) responds based on the communication modality and quality of form used by MV individuals with ASD.

Methods: Forty-four MV individuals with ASD (33 males; *M*age: 12.22 years, *SD* = 4.17) were administered the ADOS (Module 1). Transcripts of the ADOS were coded for each occurrence of the participants' requests. The requests were coded for modality (speech, gesture, speech/gesture, or sign), and quality of form (precise/clear or approximate/modified). Following each request, the response of the examiner was coded as contingent or non-contingent. Contingent was defined as a verbal or nonverbal examiner response that is semantically related to the participant's request and produced within one utterance. Non-contingent was defined as a verbal or nonverbal examiner response that is not semantically related to the participant's pragmatic communication or a failure to respond. 1) A logistic regression was used to determine if modality (speech, gesture, etc.), age, and gender could explain variance of examiner responding; 2) A second logistic regression model included quality of form, age, and gender on examiner responding.

Results: 1) In the first model, speech (p = .002) resulted in more contingent responding by the conversational partner compared to non-speech modalities (Fig. 1). Specifically, there was a 75% chance that the examiner would respond contingently to a speech-based request compared to a 53% chance if the participant did not use speech. Neither age nor gender were significant. 2) In the second model, quality, age, and gender had no statistically significant effect on explaining examiner responding (Fig. 2).

Conclusions: The use of speech plays an important role in responding by the conversational partner in contrast to the lack of influence based on quality of form for MV individuals with ASD. These findings suggest that interventions should target the expansion of pragmatic functions (e.g., commenting) without the need to focus on sharpening the quality of form. The study findings can allow for appropriate alterations in language and communication intervention techniques to incorporate a multidimensional view of social communication which considers the influential role of the conversational partner and interactional context on the pragmatic communication abilities of MV individuals with ASD.

414.025 *(Poster)* Exploring the Relationship between Prosodic Control and Social Competence in Children with and without Autism Spectrum Disorder

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Background: The ability to communicate thoughts, ideas, and emotions is integral to social development. We know this in part because of conditions such as autism spectrum disorders (ASDs), where early social communicative deficits (e.g., joint attention) are predictive of later language deficits. As children develop, speech becomes the dominant form of social communication, as it allows complex ideas and emotions to be conveyed between individuals. Social aspects of speech production, such as prosody (e.g., vocal pitch), must be carefully regulated to accurately express information about the emotionality, excitability, and intent of the speaker. Thus, a child may acquire fluent, even excellent speech articulation, but their social communication may be compromised due to poor prosodic control.

One way to investigate the prosodic control of speech is by utilizing the frequency altered feedback paradigm. Previous research has demonstrated that when the fundamental frequency of a speaker's auditory feedback is briefly altered, a manipulation that is perceived as a change in vocal pitch, the speaker produces a compensatory response in the direction opposite to the manipulation. The size and timing of these responses to frequency altered feedback have allowed researchers to gain valuable insight into how auditory feedback is used to regulate vocal pitch.

Objectives: The objective of this research is to gain a better understanding of how auditory information is used to regulate the prosodic aspects of speech in children with and without ASD. Furthermore, this research aims to explore the relationship between the prosodic control of speech, or more specifically the control of vocal pitch, and social communication abilities.

Methods: Seventy-five children between the ages of 3 and 13 years, with and without ASD, produced vocalizations while being exposed to unaltered and frequency altered auditory feedback. The parent-report multidimensional social competence scale (MSCS) and the autism quotient (AQ) were also used to assess social functioning and autism characteristics, respectively.

Results: MM-ANOVAs were conducted to compare the effect of experimental condition and diagnosis on vocal response magnitudes and latencies. While a main effect of experimental condition indicated that all children produced compensatory responses to the frequency altered auditory feedback, $F(2, 146) = 499.946$, $p < .001$, $np2 = .873$, vocal response magnitudes were similar across children with and without ASD, $F(1, 73) = .182$, $p = .671$, $np2 = .182$. However, children with ASD produced faster responses to the auditory feedback manipulation, $F(1, 73) = 8.042$, $p = .006$, $np2 = .099$. Hierarchical multiple regressions indicated that these faster responses were associated with poorer parent-rated social competence, MSCS $R2 = .236$, $F(3, 48) = 4.935$, $p = .005$, and higher autism symptom scores, AQ ($R2 = .150$, $F(3, 51) = 3.002$, $p = .039$.

Conclusions: These findings suggest that basic speech production differences are present in at least a subgroup of children with ASD. These results represent a key step in understanding how atypicalities in the mechanisms supporting speech production may manifest in social-communication deficits, as well as broader social competence, and vice versa.

414.026 *(Poster)* Expressive and Receptive Vocabulary Impairments in Primary-School-Aged Children with Autism Spectrum Disorder: A Pilot Study in Russian

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Background: Children with Autism Spectrum Disorder (ASD) usually have comorbid language impairments even at the single-word level, failing in expressive and receptive vocabulary assessment tests (Kjelgaard & Tager-Flusberg, 2001). Importantly, previous studies disagree on the difference between receptive and expressive domains in autism: there is an evidence of more impaired expressive vocabulary (Jarrold et al., 1997), more impaired receptive vocabulary (Seol et al., 2014), and no difference in expressive-receptive domains (Kjelgaard & Tager-Flusberg, 2001). These inconsistencies can come out due to high heterogeneity of autistic groups as well as criteria for including children into studies, e.g., age or non-verbal IQ.

Objectives: The goal of the present study is to clarify whether primary-school-aged Russian children with ASD have difficulties at the single-word level et either expressive and receptive vocabulary.

Methods: 30 children participated in the study: 15 children with ASD ($M_{age} = 8.69$, $SD = 0.99$), varying in non-verbal IQ (range 40 – 110), and a control group of 15 typically developing children, TD ($M_{age} = 8.58$, $SD = 0.94$). All children with ASD had a clinical diagnosis within the autism spectrum (F84.0, F84.1 or F84.5) according to ICD-10 and were assessed by licensed psychiatrist with Autism Diagnosis Observation Schedule (Lord et al., 2000).Expressive and receptive vocabulary has been scored by the Test for assessment of language development in Russian *KORABLIK* (Lopukhina et al., 2019). For expressive vocabulary assessment, we used picture naming ($N = 48$), and for receptive vocabulary assessment, we used word-to-picture-matching paradigm ($N = 48$) in which each visual set consisted of four pictures – target, phonological distractor, semantic distractor, and unrelated picture. All stimuli were taken from the Verbs and Nouns Stimuli Database for Russian (Akinina et al., 2014, 2015, 2016) and were counterbalanced.

Results: We showed that children with ASD have impairments in both word production, 87% vs. 96%, $Est. = 1.45$, $SE = 0.38$, $z = 3.73$ $p = 0.0001$, and word comprehension, 91% vs. 97%, $Est. = 1.64$, $SE = 0.50$, $z = 3.25$ $p = 0.001$. Importantly, children with ASD displayed a difference in expressive and receptive vocabulary: production was more impaired then comprehension, 87% vs. 91%, $Est. = 0.66$, $SE = 0.19$, $z = 3.45$ $p = 0.0005$. Finally, in ASD group, for both word production and comprehension we found a correlation between accuracy and non-verbal IQ (for production, $r = 0.55$, $p = 0.03$, for comprehension, $r = 0.57$ $p = 0.02$), but there was no a correlation with age.

Conclusions: Similarly to the previous studies, we showed that children with ASD had impairments at the single-word level, and accuracy both in production and comprehension correlated with non-verbal IQ (Kjelgaard & Tager-Flusberg, 2001). Crucially, our results demonstrated that expressive vocabulary is more impaired than receptive. However, we acknowledge that this is a pilot results with a relatively small group size. Data from a larger group would provide much precise information on expressive-receptive abilities of Russian children with ASD.

414.027 *(Poster)* Frequency of Household Book Reading May Explain SES Disparities in Expressive Language – Findings from a Nationally-Representative Sample of Children with ASD

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Background: While most studies have focused on identifying the neurobiological bases of language impairments in ASD (Groen et al.,2008), few have explored how the environment shapes language development in this population. One study found that children with ASD from higher socioeconomic status (SES) families had greater language abilities (Grandgeorge et al.,2009), which may be explained by differences in language learning experiences, such as book reading. Book reading has a positive impact on language development for children with and without ASD (Boyle et al.,2019; Hoff,2013), but it occurs less frequently in low SES households (Yarosz & Barnett,2010). Previous research on typically-developing children has demonstrated that book reading mediates the relation between SES and language (Farrant & Zubrick,2011), yet no studies have explored this relation in ASD.

Objectives: The current study used data from the 2018 U.S. National Survey of Children's Health to investigate whether expressive language (EL) in children with ASD differs based on family SES and frequency of household book reading, and to determine whether book reading mediates the relation between SES and EL.

Methods: The sample included $N = 95$ children with ASD (15 females), ages 2–5 years, whose parents completed all survey items of interest. On 3 items, parents reported whether or not their child was able to use 1, 2, and 3 word sentences; yes/no responses from each item were converted (1=yes/0=no) and summed to form an EL composite score. SES was operationalized as the highest education level attained by parents, and book reading frequency as the number of days during the past week that someone at home read to the child.

Results: The Mann-Whitney U test showed that EL was higher for children whose parents completed a higher education level (U=485.00,p=.025;Figure 1.a.). The Kruskal-Wallis H test showed that EL was higher for children who were read to more frequently ($\chi^2(3)$=11.698,p=.008;Figure 1.b.); the only comparison to survive post-hoc Bonferroni correction was 1–3 days versus 7 days (p=.009). Results of the mediation analysis (Hayes,2017) revealed that parent education was indirectly related to child EL through its effect on book reading frequency (Figure 2). Children whose parents completed more than high school were read to more frequently than children whose parents completed high school (B=.610,p=.017). Also, children who were read to more frequently had higher EL than children who were read to less frequently (B=.314,p=.005). The relation between parent education and child EL became non-significant when controlling for book reading frequency (B=.450,p=.101), demonstrating full mediation. This effect remained significant even when child age was included as a covariate (B=.186;95% CI=.008–.459), although ~80% of the variance in child EL was not accounted for in this model.

Conclusions: Results suggest that book reading may play a significant, although small, role in language development for children with ASD. Future studies should use qualitative methods to understand why parents from low SES families are reading less frequently to their children, so that these aspects of the proximal environment can be targeted in interventions that improve language abilities in children with ASD.

414.028 *(Poster)* Growth in Morphological Awareness of Children with ASD and Typical Development: Associations with Age, Verbal Ability, and Reading Comprehension

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Background: Morphemes are the smallest units of meaning within words and Morphological Awareness (MA) refers to the awareness of and ability to manipulate morphemes in words. The development of MA relies on additional verbal abilities (e.g. semantics) and has been shown to improve over the school-aged years (Carlisle et al.,2010); extant research indicates that many children with ASD demonstrate deficits in MA (Eigsti et al.,2011). These language skills support proficient reading comprehension (RC) in typically developing (TD) children (Carlisle et al.,2010). The development of reading comprehension (RC) is a significant challenge for many children with ASD (McIntyre et al., 2017) and little is known about their MA development or how it relates to their RC outcomes. This study was designed to examine the relations between MA, RC, verbal abilities, and age in a sample of children with ASD and no ID as compared to those with TD.

Objectives: 1) To examine the development of MA over a 30-month period in school-aged children with ASD or TD using latent growth curve modeling, 2) To test the hypothesis that age and verbal abilities are significantly related to MA development among these children, and 3) To examine the hypothesis that MA development predicts reading comprehension outcomes in both samples.

Methods: Participants included eighty-five 8- to 18-year-old children with ASD and forty-four with TD (Full-scale IQ ≥ 70). Data were collected at 3 timepoints (TP) across 30 months. ASD symptoms confirmed with ADOS-2. Verbal ability (VIQ) was measured by WASI-2. MA was measured with the Test of Derivational Morphology (Carlisle, 2000). Reading comprehension (RC) was measured with the Gray Oral Reading Test-5 (GORT-5).

Results: The final growth model fit the data adequately, CFI=.98, SRMR=.08. 1) ASD group scored lower than TD on MA across all TPs and growth was best represented by nonlinear model: greater growth TP1-2 than TP2-3 (Figure 1). 2)TD and ASD TP1 age and VIQ significantly and positively predicted variation in intercepts of MA growth curves and slopes of MA for TD. For ASD, only TP1 age predicted MA slope, with younger children demonstrating greater growth. 3) In both groups TP3 RC was significantly associated with both intercept and the slope of MA growth curves.

Conclusions: Both groups improved in their morphological awareness skills with similar 30-month growth rates regardless of initial scores, but the ASD group scored lower on average and did not catch up with the TD group. Being older and having higher VIQ was significantly associated with better initial MA performance and both factors impacted growth rates in TD while only age predicted growth for ASD, with younger children demonstrating greater growth. In both groups, initial MA and growth in MA were significantly and positively associated with reading comprehension at TP3. These data provide unique details about the language development of school-aged children with ASD as compared to TD and raise the possibility that morphological awareness is an important intervention target to improve reading comprehension in both groups of children.

414.029 *(Poster)* Higher Autism Spectrum Quotient Scores Predict Higher Permissiveness of Pragmatic and Semantic Impairments

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Background: Based on a previous finding that individuals with autism spectrum disorder (ASD) show empathy toward autistic characteristics we reported that the higher the maternal autism spectrum quotient (AQ) score, the lower the tendency to perceive pragmatic impairments as problematic. In the present study, we investigated whether these results could be replicated for adult males and semantic impairments.

Objectives: The purposes of the present study were to clarify 1) whether higher AQ scores would predict increased permissiveness of pragmatic impairments when using the Communication Checklist - Adult (CC-A) with both males and females included as raters, 2) whether higher AQ scores would predict higher permissiveness of semantic impairments, and 3) whether higher AQ scores would predict higher permissiveness of language impairments.

Methods: The AQ was administered on all study participants (124 adults [60 males, 64 females]; mean age ± standard definition [SD], 35.04 ± 8.01 years). All participants rated 21 pragmatic, six social engagement, and seven language impairment subitems from the CC-A on a five-point scale. Additionally, they rated 25 collocation errors produced by 12 individuals with ASD on a five-point scale. Correlation coefficients were calculated between AQ scores and age, the mean scores for 27 pragmatic and social engagement impairment subitems, and the mean scores for seven language impairment subitems. Covariance structure analysis (CAS) was then applied to these variables and path diagrams were produced.

Results: The mean ± SD AQ score was 17.94 ± 7.47. Four adults whose AQ scores were higher than the cut-off 33 were not excluded from the analysis. Significant correlations were found between AQ scores and the mean scores of the 27 pragmatic and social engagement impairment subitems ($r=.185$, $p<.05$), and between AQ scores and the mean scores of the 25 collocation errors ($r=.235$, $p<.01$); however, no significant correlation was found between AQ scores and the mean scores of the seven language impairment subitems. In addition, no significant correlations were found between any of the variables and age. However, differences were seen between males and females in terms of correlations relating to the mean scores of the 25 collocation errors. A significant correlation was found between AQ scores and the mean scores of the 25 collocation errors in females ($r=.262$, $p<.05$), but not in males. A significant correlation was seen between age and the mean scores of the 25 collocation errors in males ($r=.348$, $p<.01$), but not in females. Additionally, the mean scores of the 25 collocation errors were significantly lower in females than in males ($F=6.054$, $p<.05$).

Conclusions: Higher AQ scores predicted higher permissiveness of pragmatic impairments when males were included as raters of the pragmatic and social engagement impairment subitems on the CC-A. Higher AQ predicted higher permissiveness of semantic impairments when combining males and females. However, higher AQ did not predict higher permissiveness of language impairment subitems on the CC-A. These findings suggest that females are less permissive toward semantic impairments than males, who seem to become more permissive of these impairments with age. Further investigation is needed in this regard.

414.030 *(Poster)* How Do Autistic Adults Use Syntactic and Prosodic Cues to Manage Spoken Discourse? Exploring Discourse Strategies with Basic Discourse Units

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Background: Within the framework of discourse analysis, segmentation units are crucial to explore how spoken discourse is realized and organized. To date, most segmentation units are delineated either by syntactic cues or by prosodic cues. However, while syntax and prosody can be considered as two distinct levels of surface segmentation, they are also interdependent and come together at a discrete organizational level. In the framework of Basic Discourse Units (BDUs; Degand & Simon, 2008, 2009a, 2009b), segmentation units surface at this latter level when there is a match between the boundary of a syntactic and of a prosodic unit. More interestingly, these two types of boundaries can coincide in different ways, yielding distinct BDUs which reflect different strategies of discourse management and processing. Considering the known prosodic impairments in Autism Spectrum Disorder (ASD), it is important to incorporate prosodic information when representing speech of autistic individuals, as communication difficulties might not only surface in the syntactic organization of the discourse content, but also in prosodic strategies to deliver speech.

Objectives: This study aims at providing novel insight into the communication difficulties in ASD by segmenting a corpus of spoken discourse into BDUs. We hypothesize that autistic adults will display more atypical strategies to convey speech than neurotypical adults, reflecting more difficulties to manage the on-going discourse than neurotypicals.

Methods: The transcriptions of six Experimenter-Autistic Speaker dyads and six Experimenter-Neurotypical Speaker dyads, time-aligned to the audio were segmented into BDUs in two independent phases, viz. a syntactic and a prosodic one. Syntactic units were classified in two categories: 1) dependency clauses and 2) discourse-structuring devices (e.g., because, of course, well). Prosodic units were determined according to silent pauses (> 200 milliseconds). In a third phase, the boundaries of these two types of units were mapped onto each other, following four mapping types, viz. one-to-one mapping (one dependency clause-one prosodic unit; congruent BDU), many-to-one mapping (several dependency clauses-one prosodic unit; silent-bound BDU), one-to-many mapping (one dependency clause-several prosodic units, syntax-bound BDU), discourse-structuring device-one prosodic unit (regulatory BDU) and mismatch mapping (no coincidence between boundaries; mixed BDU).

Results: There was a significant group difference in total number of BDU produced, $\chi^2(1) = 7.2084$, $p = 0.007$. Overall, autistic participants produced significantly more BDUs than neurotypical participants. When looking at types of BDUs separately, and controlling for total number of BDU, results partially corroborated our hypotheses as autistic adults did not produce more discourse units associated with didactic/pedantic strategies and/or processing difficulties (syntax-bound BDUs); $z = -1.727$, $p = 0.08$. Furthermore, they produced more units associated with 'information-packaging' (silent-bound BDUs); $z = 2.625$, $p = 0.008$. However, autistic adults did produce less units associated with strategies of interactional/meta-discursive regulation (regulatory BDUs), $z = -1.957$, $p = 0.05$.

Conclusions: Taken together, the present study provides evidence that multidimensional linguistic units such as BDUs can distinguish the speech delivery strategies of autistic adults from those of their neurotypical peers, even based on simple prosodic cues like silent pauses. Crucially, neurotypical adults used more BDUs reflecting discourse management strategies than autistic adults.

414.031 *(Poster)* How Do Caregivers Design Their Talk to Accommodate Young Children with Limited Spoken Language?

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Background: Much research has examined caregiver talk in interactions with young autistic children (e.g., Meirsschaut, Warreyn, & Roeyers, 2011). Longitudinal studies have shown different types of caregiver talk influence children's language development, marking the importance of this research (e.g., McDuffie & Yoder, 2010). While there is some research examining how caregiver talk influences children's moment-to-moment joint engagement (Bottema-Beutel, Lloyd, Watson, & Yoder, 2017), most research takes a one-sided view of language, and examines only the caregiver's contribution to the interaction. Given that interventions have been developed that attempt to influence how caregiver's design their talk in interactions with their children (Venker et al., 2012), it is critical to understand how caregiver talk structures particular interaction formats, that in turn serve as a vehicle for the development of language and interactional competence. Of particular interest is understanding how different caregiver utterance types build upon children's ongoing activities, and project and constrain children's subsequent interactive moves (Schegloff, 1982), especially in interactions with autistic children who have limited language.

Objectives: The purpose of this study is to explore (1) the ways that caregivers design their turns at talk within play interactions with young autistic children who have limited spoken language, and (2) the interactive sequences that unfold following caregiver talk.

Methods: Data are comprised of 15-minute caregiver-child free play sessions of 3-5 year old autistic children that were video recorded for a larger project. All children spoke fewer than 5 words at study entry; the current study uses videos collected 8 months later. Five videos were randomly selected from each of three child-language levels (low, medium, and high; total $n = 15$) based on MCDI scores. Caregiver's and children's talk and actions were transcribed using conversation analysis (CA) conventions (Jefferson, 2004; Mondada, 2018). Transcripts were analyzed using CA, a micro-analytic, qualitative method used to examine the sequence organization of interactions. According to this framework, interactions are often comprised of sequences of 'first pair parts' (FPPs) and 'second pair parts' (SPPs), whereby an FPP requires the listener to provide an SPP at the earliest opportunity (e.g., summons-response, question-answer) (Schegloff, 2007). We focused our analysis on caregiver FPPs, and how they were designed to accommodate children who did not yet have the linguistic or interactional competence to provide SPPs.

Results: Our analysis revealed five caregiver strategies. Table 1 provides descriptions and transcript extracts that illustrate each strategy, and the interactional sequence in which they were embedded. First, caregivers formatted their FPP's so that either their own or their child's in-progress actions could be taken as an SPP. Caregivers also provided SPPs after their own FPPs, and attempted to repair 'dangling' FPP's through repetition or reformulation of the original FPP. Lastly, if the child provided a seemingly irrelevant SPP (e.g., the response was not 'type-fitted') the caregiver reframed the FPP so that the child's SPP could be taken as completing the sequence.

Conclusions: Our findings suggest particular caregiver interactional moves create opportunities for children to complete interactional sequences, regardless of their language level or interactional competence.

414.032 *(Poster)* Incremental Validity of Automated and Human-Coded Vocalization Measures for Predicting Expressive Language Skills of Infant Siblings of Children with Autism Spectrum Disorder

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Background: Siblings of children with autism spectrum disorder (ASD) are at elevated risk for communication disorders relative to children with siblings without ASD. Fourteen percent of infant siblings are diagnosed with a language delay and an additional 19% are diagnosed with ASD. Predicting expressive language skills based on early vocalizations, which precede spoken words, could provide key information for monitoring the development of infant siblings of children with ASD and for making intervention decisions. When deciding among specific vocalization variable predictors, incremental validity is arguably among the most rigorous methods to demonstrate whether a variable is worth the time and expense. Human-coded measure of vocal complexity and automated measure of volubility (number of vocalizations) exhibited strong construct validity evidence in children with ASD for predicting expressive language. Because validity evidence is population-specific, validity evidence is needed for using these measures with infant siblings of children with ASD.

Objectives: Do volubility and vocal complexity each exhibit incremental validity for predicting later expressive language skills in infant siblings of children with ASD?

Methods: Twenty-two siblings (14 male, 8 female) of children with ASD participated. See Table 1 for participant characteristics at entry into the study. Sixteen participants were reported to be white, 3 to be more than one race, 1 to be Asian, and 1 to be African American. The vocal variables include an automated variable and human-coded vocal variables collected from video-recorded structured procedures (Table 2). Expressive language variables were collected 3 months later. Twenty percent of video recordings were coded for reliability. The primary coder was blinded to which recordings would be coded for reliability. Multiple component measures were aggregated for vocal complexity and expressive language constructs to increase stability (components correlated $r \geq .4$).

Results: For reliability of the vocal communication variables, a two-way random model using absolute agreement indicated an intraclass correlation coefficient of .95, which is very good. In a multiple regression model, both volubility (B=4.26 x 10^4, *SE*=1.84 x 10^4, p=.03, ΔR^2=.12) and vocal complexity (B=2.035, *SE*=.57, p<.01, ΔR^2=27) were significant predictors of later expressive language and exhibited incremental validity. Vocal complexity exhibited a large effect size. The full model with both predictors accounted for 59% of the variance in expressive language skills.

Conclusions: Human-coded vocal complexity exhibited incremental validity above and beyond volubility for predicting expressive language with a large effect size. Automated volubility also accounted for unique variance in later expressive language; however, the effect size was moderate. Findings support the complementary use of automated and human-coded variables, considering their strengths, weaknesses, and costs. Automated analyses require a large initial financial investment with lower maintenance costs. In contrast, human coding costs remain high, but human-coded vocal complexity exhibited a larger effect size for incremental validity than volubility. Different research laboratories, as well as clinical service providers, may differentially weight the expense of automated variables depending on their current access to equipment and software. Future analyses will combine vocal variables from automated and human-coded procedures to potentially optimize predictive power and utility.

414.033 *(Poster)* Indexing Autistic Identities

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Background: There is limited literature centering autistic perspectives regarding their high school experience. Adolescence and early adulthood are formative years, as autistic individuals begin to cultivate their identity. This may include understanding their neurodivergence within neurotypical contexts, all while simultaneously facing biological, physical, and socioemotional transitions (Gobbo & Shmulsky, 2016; Hedges et al., 2014). Narrative analysis can be used to reveal the ways in which individuals understand their experiences to accomplish and perform certain functions. One such function is constructing identities (Van de Mieroop, 2015). Identity is conceptualized as a performance that is constructed and can be transformed through interaction (De Fina, 2015; Depperman, 2015). Because autism is considered a cultural identity and social group (Clary-Lemon, 2010; Parsloe, 2015), and the performance of autistic identities is not widely explored, examining autistic narratives in this way can further contribute to the field.

Objectives: The purpose of this study is to examine how autistic youth index their autistic identity through recounted narratives about their high school experience.

Methods: This micro-analytic study uses narrative analysis (Riessman, 2003) to examine the stories of participants regarding their experiences with peers, family, and school professionals in high school. Using narrative analysis is optimal for this purpose because through storytelling, autistic narrators situate themselves in past settings and describe events that highlight action and/or change (Ochs & Capps, 2001, 2004; Georgakopoulou, 2006; De Fina, 2015). As participants expand on their cognitive and emotional stance, language they use within stories positions them in various ways, performing their autistic identities (Depperman, 2015).

The five autistic participants in this study were not directly asked to tell stories from high school, though four did so in their responses to general interview questions about their high school experiences. Table 1 provides the semi-structured interview protocol. First, narrative episodes were culled from the transcribed dataset. Subsequent passes through identified narrative segments looked for recurring discursive phenomena related to identity construction.

Results: Analysis of narratives reveals how participants use the discursive phenomena of (1) agency, (2) membership, and (3) paradoxical language to index their autistic identities. Narrators vacillated between showing active and passive agency in stories about service provision and self-advocacy. When referencing relationships with other peers or their diagnosis label more explicitly, narratives suggested varying levels of distance from “autism” as an affiliative group. Paradoxical language was evident in participant narratives indicating tenuous relationships with their neurodivergence. Table 2 provides descriptions and examples.

Conclusions: How autistic youth index their identities through stories told about high school can better inform stakeholders, and support other autistic individuals who may share similar experiences. Participant shifts between active and passive agentic roles in narratives about service provision, suggest that autistic youth have difficulties in articulating their goals, strengths, and needs. This emphasizes the importance of developing meaningful support services for building self-determination skills as students prepare to transition out of secondary settings. Findings also suggest how school-based counseling services addressing stigma can help autistic youth who struggle socially with their diagnosis and the choice to disclose.

414.034 *(Poster)* Influences of Language on Emotional Behavior Problems and Sleep Difficulties in Preschoolers with ASD

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Background: Previous research suggests that children with Autism Spectrum Disorder (ASD) tend to experience behavior, emotional, and sleep problems. However, currently, there is limited evidence for whether having limited verbal skills put younger children at greater risk for having those problems.

Objectives: The aim of this study was to examine whether *preverbal* children with ASD are more likely to experience behavior, emotional, and sleep problems than *verbal* children with ASD.

Methods: Preschool children who completed the Autism Diagnostic Observation Schedule (ADOS), and Mullen Scales of Early Learning (MSEL) from the Autism Treatment Network (ATN) dataset were included. This study included 1375 children an average age of 3.90 years (range=1.51 to 6 years). Using the MSEL, *preverbal* term was used to describe children who were classified as having no words or few vocalizations; and the *verbal* term was also used to describe children who were described as having some words and/or phrases. Modules 1 and 2 of the ADOS were administered to all the children to assess for an ASD diagnosis. Parents also completed the Child Behavioral Checklist (CBCL) to gauge information about their children’s behavior, emotional, and sleep problems; and they reported on the number of hours of intervention that children were currently receiving.

Results: Based on the MSEL classification of preverbal and verbal, 336 children (24.44%) were included in the preverbal group and 1,039 (75.56%) in verbal group. Differences between preverbal and verbal groups were assessed using odds ratios in logistic regression analysis while controlling for autism severity (ADOS), chronological age, and total hours of intervention/week. Regarding internalizing problems, children in the preverbal group were described as being at about 1.7 times the odds of having internalizing problems t-score at or above 60 when compared to children in the verbal group (OR=1.71, 95% CI=1.24-2.37, p=0.0011). With respect to externalizing or sleep problems, no differences were found between the preverbal and verbal groups.

Conclusions: Findings from this study suggest that young children with ASD with limited language abilities are more likely to be described by their caregivers as experiencing internalizing difficulties. Clinically, these results suggest that clinicians may need to screen and further assess these problems and to provide appropriate referral and services for these children as needed.

414.035 *(Poster)* Initiation of Joint Attention at 12 Months and Speech-like Vocalizations at 24 Months in Infants at High and Low Risk of ASD

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Background: Autism Spectrum Disorder (ASD) is characterized by deficits in social communication and the presence of repetitive behaviors (American Psychiatric Association, 2013). Joint attention refers to shared focus on an object between two individuals, and typically develops within the first 24 months of life (Lee, et al., 2018; Miller & Markovitch, 2015). Initiating joint attention (IJA) creates a positive social feedback loop between child and parent, promoting social development and language acquisition (Nyström, Thorup, Bölte, & Falck-Ytter, 2019; Morales et al., 2000). Understanding the link between IJA – which is atypical in ASD (Bruinsma et al. 2004) – and infant vocalizations gathered during relatively brief developmental evaluations could help define the overlap between social development and vocalization metrics in infants at high and low familial risk for ASD.

Objectives: In this study, we assess the link between IJA in 12-month-old infants at high and low risk of ASD and vocalization behavior in those same infants at 24 months.

Methods: 171 infant siblings of children with ASD (high risk: HR) or without ASD (low risk: LR) were administered the CSBS (Wetherby & Prizant, 2002) as part of the longitudinal Infant Brain Imaging Study (IBIS) at 12 and 24 months. Assessments were audio/video recorded. At 24 months, infants underwent gold standard assessments to determine diagnostic status: LR, HR without ASD (HR-), and HR with ASD (HR+, Table 1). Infant vocalizations during the CSBS were coded as speech-like or non-speech-like by a reliable team of student raters using ELAN software (ELAN, 2018), and speech-like vocalization count was extracted using in-house R scripts. Generalized linear models (Bates, 2008) used the interaction of diagnostic group and CSBS IJA raw scores at 12 months to predict the number of speech-like vocalizations produced at 24 months after controlling for site, sex, maternal education, recording duration, and 12-month speech-like vocalization rates.

Results: There was a negative relationship between IJA bids at 12 months and speech-like vocalizing at 24 months in the HR+ group compared to the LR group (Estimate: -.15, SE: .02, z=-7.99, p<.001) and the HR- group (Estimate: -.15, SE: .02, z=-8.63, p<.001). In contrast, the relationship between IJA at 12 months and speech-like vocalizing at 24 months did not differ in LR and HR- groups (Estimate: -.001, SE: .01, z=.12, p=.91; Figure 1).

Conclusions: IJA is an early predictor of later language ability as measured by standardized tests (Mundy et al., 2007). This study showed that IJA at 12 months is differentially related to speech-like vocalizations at 24 months in infants that do and do not develop ASD. Whereas IJA at 12 months did not add significant predictive variance to brief vocalization samples at 24 months in HR- and LR infants (after accounting for a variety of relevant variables), the HR+ group demonstrated an atypical trajectory, with greater IJA at 12 months associated with reduced speech-like vocalizing at 24 months.

414.036 *(Poster)* Interpersonal Synchrony and Phonological Memory: Predictors of Vocabulary Size in Children with ASD

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Background: Arunachalam and Luyster (2016) suggest that lexical acquisition is altered in children with ASD due to disrupted intake of linguistic input; yet, the factors that reduce intake of input are not well understood. Because social communication difficulties–by definition–are prevalent in ASD, impaired interpersonal synchrony (e.g., turn-taking) could contribute to reduced input intake, via overlapping speech (Choi & Lee, 2013; Northrup & Iverson, 2015). That is, a child who vocalizes over a conversation partner's utterances may experience impoverished access to those utterances, thereby limiting opportunities for vocabulary acquisition. At the same time, the child's ability to hold linguistic information in mind (i.e., phonological memory) contributes to lexical abilities in children with other sources of language delay, although findings on this relationship for children with ASD have been mixed (Eberhardt & Nadig, 2018; Norbury et al., 2010).

Objectives: This study simultaneously tested the association of overlapping speech and phonological memory with receptive and expressive vocabulary size in children with ASD.

Methods: Participants with ASD (*N*=24) were 3- to 11-year-olds with nonverbal IQs ranging from 34 to 133 (Leiter-3; Roid et al., 2013). See Table 1. Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 2007) and Expressive Vocabulary Test (EVT-2; Williams, 2007) standard scores indexed receptive and expressive vocabulary size. Overlapping speech and phonological memory were assessed during a nonword repetition task (Eaton et al., 2015), in which the participant was prompted to repeat nonwords of increasing length (e.g., "*This is a kog. Can you say kog*?"). The rate of overlapping speech was defined as the count of participant vocalizations during examiner prompts divided by the total number of examiner prompts. Phonological memory was defined as the proportion of nonword consonants correctly repeated. Linear regressions tested overlapping speech and phonological memory as unique predictors of vocabulary standard scores, controlling for nonverbal IQ, separately for the PPVT-4 (*n*=24) and for the subset of participants who completed the EVT-2 (*n*=18).

Results: Overlapping speech and phonological memory were, respectively, negatively and positively correlated with receptive, $r(22)=-0.67$, $p < 0.001$, $r(22)=0.78$, $p < 0.001$ and expressive, $r(16)=-0.72$, $p=0.001$, $r(16)=0.87$, $p < 0.001$, vocabulary size. See Figure 1. Using regression, nonverbal IQ significantly predicted both receptive and expressive vocabulary. For receptive vocabulary, overlapping speech, $b=-8.04$, $SE=3.61$, $t(20)=-2.23$, $p=0.038$, and phonological memory, $b=11.48$, $SE=4.01$, $t(20)=2.86$, $p=0.010$, were unique predictors. For expressive vocabulary, phonological memory was the only significant predictor besides nonverbal IQ, $b=15.04$, $SE=4.48$, $t(14)=3.36$, $p=0.005$.

Conclusions: Phonological memory positively predicted receptive and expressive vocabulary size in children with ASD, parallel to research on children with language delays (Ellis Weismer et al., 2000). Overlapping speech, a measure of interpersonal asynchrony, was negatively correlated with both receptive and expressive vocabulary size and remained a significant predictor for receptive vocabulary when controlling phonological memory and nonverbal cognition. With social interaction being a hallmark weakness for ASD, further investigation into how interpersonal asynchrony disrupts intake of linguistic input for vocabulary acquisition is warranted.

414.037 *(Poster)* Investigation of Linguistic Pitch and Time Processing in High-Functioning Adolescents with Autism Spectrum Disorders

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Background: Previous studies have shown enhanced pitch perception (e.g. Heaton, 2005) and impaired time processing (e.g. Maister & Plaisted-Grant, 2011) in individuals with autism spectrum disorders (ASD). However, it remains unclear whether such deviated patterns of auditory processing in ASD would transfer to higher-level linguistic pitch and time processing. In this study, we focus on two prominent phonological features in Mandarin Chinese, lexical tones and voice onset time (VOT), which utilize pitch and time changes respectively to convey phonemic contrasts.

Objectives: The present study aimed to address two main questions, (i) whether high-functioning Mandarin-speaking adolescents with ASD can perceive two speech continua varying in lexical tone and VOT in a categorical manner, and (ii) whether performance in categorical perception (CP) of speech could index language ability as well as working memory.

Methods: 23 high-functioning Mandarin-speaking adolescents with ASD and 20 age-matched typically developing controls (TDC) participated in this study. For the lexical tone condition, a 7-step continuum ranging from Tone 1 (ba, 'eight') to Tone 2 (ba, 'to pull') was generated (Fig. 1A). For the VOT condition, a 7-step time continuum ranging from ba (unaspirated stop, 'eight') to pa (aspirated stop, 'to lie') was synthesized (Fig. 1B). In addition to the identification and discrimination tasks to test CP performance for the two speech continua, all the participants also took the *Test of Language Ability* (Ning, 2013) and working memory tests (including forward digital span test and nonword repetition test). Table 1 shows the participants' characteristics and scores of language ability, digital span, and nonword repetition.

Results: To avoid inclusion of individuals who had problems in perceiving synthetic speech sounds, a minimum accuracy score of 80% in the identification of two ending stimuli in each continuum was required for the analyses of CP data. All the 20 TDC met the accuracy criterion for both lexical tone and VOT conditions. Of the 23 subjects with ASD, 20 and 15 ASD subjects met the criterion for lexical tone condition and VOT condition respectively. The results indicated that high-functioning adolescents with ASD showed intact CP of lexical tones, as reflected by measures of the identification function and discrimination function similar to those found in TDC. In contrast, ASD participants showed an impaired CP for the VOT continuum, as reflected by much wider boundary width and lower discrimination peakedness compared with TDC. Moreover, the degree of CP of lexical tones correlated with overall language ability and digital span in ASD participants, while no such correlations were detected in the VOT condition.

Conclusions: These findings suggest that the unbalanced acoustic processing capacities for pitch and time can be generalized to higher-level linguistic processing in ASD. Specifically, for the high-functioning Mandarin-speaking adolescents with ASD, the CP of native lexical tones was largely intact, whereas in stark contrast the CP of native aspirated vs. unaspirated stops was severely compromised. Furthermore, the higher degree of CP of lexical tones correlated with better language ability in Mandarin-speaking individuals with ASD.

414.038 *(Poster)* Language Skills and Their Cognitive Correlates in Adults with Autism Spectrum Disorder

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Background: Language impairment is commonly associated with Autism Spectrum Disorder (ASD) (Whitehouse et al., 2010). One approach to bifurcating language ability is separating language structure and pragmatic language (Bishop, Whitehouse, & Sharp, 2009). Current research on cognitive correlates of language difficulties in ASD (Weismer et al., 2018; Volden et al., 2009) mainly focuses on children. Executive function (EF) is a set of skills related to an individual's cognitive control. Understanding how EF relates to language skills may help us to gain a more complete picture of language challenges in ASD and the cognitive profile of autistic people. This study aims to analyze the relationship between executive function skills and language ability in adults with ASD.

Objectives: Analyze the association between EF and language ability in autistic adults.

Methods: Participants were young adults with ASD (n=41; M age=25.60+/-10.28; M IQ=113.49+/-13.86; 32 males) who completed several self-report measures. The Behavior Rating Inventory of Executive Function, Adult Self-Report (BRIEF-A; Roth et al., 2013) was used to assess several components (nine subscales and two indices) of EF. Furthermore, the Communication Checklist Self-Report (Bishop et al., 2009) was used to quantify language skills in two areas: structural and pragmatic language. Correlation analyses were performed relating EF to language skills. Four multiple linear regressions were completed controlling for age, sex, and IQ in step one. Two different sets of variables were used for step two of these analyses: (1) the variables found to have significant correlations with language skills and (2) two indexing variables compiled from the BRIEF-A, the metacognition index and the behavior regulation index.

Results: Lower structural language ability in adults with ASD was correlated with several areas of EF challenge including: inhibition, shifting, self-monitoring, initiation, working memory, planning and organizing, organization of materials, and task monitoring. Moreover, lower pragmatic language ability was correlated with EF difficulties in the areas of: inhibition, shifting, self-monitoring, initiation, working memory, planning and organizing, and task monitoring. Regression models indicate that EF (above and beyond age, sex, and IQ) predicts both structural ($F=5.082$; $p=.002$) and pragmatic ($F=5.608$; $p<.001$) language skills. For structural language this effect can be explained by the metacognition index ($t=-2.860$; $p=.008$). Whereas, within pragmatic language the prediction is driven by self-monitoring ($t=-2.603$; $p=.017$).

Conclusions: EF is positively correlated with language skills in the areas of structural and pragmatic language. After controlling for age, sex, and IQ, we found pragmatic language can be predicted by self-monitoring and structural language can be predicted by the metacognition index. These findings establish a link between executive function and language skills in adults with ASD that has not been previously established. Language impairment is an important target for intervention in individuals with ASD. These findings suggest that improving EF, particularly metacognition, might also cascade to improve language skills (and vice versa). Future intervention studies are needed to examine these possibilities.

414.039 *(Poster)* Lexical Alignment Contributes to Communicative Success during Social Problem Solving

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Background: Typical speakers tend to adopt words used by their conversational partners. This "lexical alignment" enhances communication by reducing ambiguity and promoting a shared understanding of the topic under discussion (Reitter & Moore, 2014). Pragmatic language impairments are central to autism spectrum disorder (ASD), but lexical alignment has been little studied to date; further, it has been studied primarily via structured laboratory tasks that may overestimate performance (Branigan et al, 2016). The current study utilized a task eliciting extended spontaneous discourse to explore lexical alignment and its associations with task performance.

Objectives: Previous work from our team found that task performance (operationalized as a correct interpretation of described routes; see below) was associated with executive functions and ASD symptoms. Here, findings are extended to an examination of *linguistic* features associated with task performance. We hypothesized that adolescents with ASD would exhibit reduced lexical alignment during social communication, and explored associations between lexical alignment and task performance.

Methods: Twenty-nine adolescents (n=15 TD, 14 ASD) completed a social communication Maps Task in which participants collaborated with an undergraduate research assistant (RA; naive to study hypotheses) to navigate a series of maps. Participants alternated between "Tourist" and "Guide" roles, completing six maps. "Guide" maps (Figure 1a) contained a route drawn from a starting point through a series of landmarks to a finish point; the corresponding "Tourist" map contained similar landmarks, without the route, which the Tourist was asked to draw with a pencil. Routes were digitized for analysis (Figure 1b). ***Path Deviation*** was operationalized as the number of pixels contained within the area formed by the spatial difference between correct and drawn routes (Figure 1c). ***Lexical alignment*** was operationalized as the proportion of shared vocabulary produced by Guides on successive maps.

Results: Path Deviation was higher for ASD+RA pairs, F=8.61, p=.007, suggesting less efficient or accurate route-drawing. Group differences held whether the participant or RA was drawing the route, indicating that group differences were not only due to motor differences. With the participant as Guide, repeated-measures ANOVA revealed a significant group difference, F=4.507, p=.04, with reduced alignment in the ASD group (Figure 2). There was no effect of trial and no interaction between group and trial, p's>.18. When the RA was the Guide, alignment did not differ for the ASD and TD pairs, F=.36, p=.55, and there was again no main effect of trial and no interaction, p's>.25. For Participant Guides, lexical alignment was associated with Path Deviation, $r(25)$=-.55, p=.005; this relationship was not significant for RA Guides, $r(25)$=-.08, p=.70. Finally, alignment tended to increase across trials for the TD pairs, and decrease for ASD pairs.

Conclusions: Adolescents with ASD had greater difficulty describing navigational routes to a study-naïve RA, yielding routes that were less accurate. Decreased lexical alignment, i.e., a tendency to share vocabulary in describing routes, appears to contribute to communicative difficulties in ASD. These findings raise the possibility that explicit guidance to use shared vocabulary may be a useful intervention to support better communication.

414.040 *(Poster)* Lexical Semantic Abilities of Hebrew-Speaking Children with ASD

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Background: Previous studies yielded contradicting findings regarding whether the semantic component is intact in individuals with ASD. Most studies have assessed semantic abilities by using tests such as picture naming and semantic priming (Minshew&Goldstien, 1993; Kamio et al., 2007). In many cases, High-functioning children with autism performed at par to their age-level groups (Eigsti et al., 2011; Tager-Flusberg et al., 1990). However, other studies found the semantic-component to be impaired (Lord, Shulman &DiLavore, 2004; Paynter& Peterson, 2010).

Objectives: The aim of the current study is to test the semantic lexicon and the lexical semantic abilities of children with ASD using the widely accepted model of Lexical Retrieval (Nickels, 1997) and systematically assess each of its components.

Methods: Participants were 38 Hebrew-speaking children with ASD, 34 boys and 4 girls, ranging in age from 8;5 to 17;9 (mean age = 11;4, SD = 2;2).

Three background measures were obtained for each of the participants to serve as baseline measures; nonverbal IQ (Raven's progressive matrices), pragmatic abilities (CCC), and reading ability (TILTAN).

16 tasks were chosen for their ability to differentiate the different parts of the model. Tasks included conceptual-tasks (odd-one-out, picture-association), lexical retrieval tasks (picture-naming, word-definition), reading tasks (TILTAN screening test, written-word-picture matching) and sentence comprehension tasks (sentence-picture matching, sentence-comprehension). Group scores were analysed and compared to an age-matched group of typically developing children. Next, individual profiles were build based on each individual's performance on each of the 16 tasks with the aim of pin-pointing the locus of impairment, if one exists.

Results: As a group, the ASD group performed significantly below TD age-peers on 3 out of 5 tasks directly evaluating the semantic lexicon; the proportion of children scoring significantly below age expectations varied widely. Lexical-semantic scores, although age-correlated for most tasks, were generally not related to level of pragmatic deficit, or to NVIQ. Inspection of individual results gave rise to two different lexical semantic/language profiles: children with ASD with an impairment in the semantic lexicon (n = 12) or impairment in access to the semantic lexicon (n = 4) from reading, and children with ASD having an intact semantic lexicon (n = 22).

Conclusions: The majority of children with ASD in this group have intact lexical semantic abilities and if these are impaired they are part of a wider linguistic deficit. A small group of children with ASD was found to have a deficit in accessing the semantic lexicon through reading, a fact that has profound implications for teaching and intervention methods. Our results highlight the importance of testing a wide range of linguistic abilities in children with ASD as well as performing in-depth error analyses of their performance. Some participants were able to compensate for their deficits in tasks with pictures / written words and their deficits were evident only on very specific tasks and in some cases only when error analysis was made.

414.041 *(Poster)* Longitudinal Analyses of Expressive Language Development in Mandarin-Exposed Preschool Children with ASD

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Background: Longitudinal studies among preschool children with ASD learning Indo-European languages have highlighted the huge heterogeneity in their expressive language development (Tek et al. 2014); moreover, various factors such as early (pre)linguistic skills, joint attention, autism severity, etc. may predict their expressive language growth (Venassa et al. 2019). However, longitudinal studies in children learning typologically different language are needed to track early expressive language development and its influential factors in children with ASD across countries.

Objectives: This study attempts to delineate expressive language development in preschoolers with ASD exposed to Mandarin Chinese. Moreover, we investigate whether children's general language skills and autism severity may predict their expressive language development.

Methods: Using the *Putonghua Communicative Development Inventory: Words and Sentences* (PCDI) and the *Autism Behavior Checklist* (ABC), we assessed 61 preschoolers with ASD on their vocabulary, grammar and the decontextualized uses of language (i.e., the uses of language beyond the 'here and now' context), as well as their autism severity over one year's span. Parents completed these scales at two time points (children's mean ages were 47.26±11.59 months at time 1 and 59.39±11.58 months at time 2). To explore the group heterogeneity, we divided the whole sample into two groups based on their vocabulary production level at time 1: the Low Verbal group (LV, N=30, MA=42.10±9.79 months, *M*(vocabulary)=16.17±23.82 words, *M*(ABC)=66.82±24.07), and the High Verbal group (HV, N=31, MA=52.26±11.12 months, *M*(vocabulary)=335.00±161.62 words, *M*(ABC)=71.00±27.48.

Results: (1) Independent T-tests revealed that both the LV and HV groups showed significant increases in most of the 24 vocabulary items (LV: ps<0.05 for 20/24 comparisons; HV: ps<0.05 for 21/24 comparisons), and most of the 4 grammatical items, word combination, MLU, and sentence complexity (LV: ps<0.05 for 6/7 comparisons; HV: ps<0.05 for 5/7 comparisons). However, both groups showed no significant gains for most of the 5 items in the uses of decontextualized language (LV: ps<0.01 for 1/5 comparisons; HV: ps<0.05 for 1/5 comparisons). (2) Hierarchical regression analyses showed that for both groups, when setting age for control variable, the core language (vocabulary and grammar) didn't predict the growth of decontextualized language over time (ps>0.05), but the latter was a significant predictor for both the vocabulary and grammar development (ps<0.05). The ABC scores didn't predict the expressive language growth in either subgroup (ps>0.05).

Conclusions: In general, both the LV and HV subgroups of Mandarin-exposed children with ASD demonstrated similar patterns of an 'uneven' expressive language development, i.e., language growth was more apparent for core language skills (vocabulary, grammar), compared to the uses of decontextualized language. Furthermore, core language skills have limited effect in predicting children's growth of decontextualized language (Miniscalco et al. 2014). Instead, the latter may play a pivotal role in the subsequent development of core language skills in young children with ASD, warranting early intervention in increasing the uses of decontextualized language in children with ASD across countries (Leech et al. 2017; Su et al. 2018).

414.042 *(Poster)* Maternal Education Level Is Related to Expressive Language Abilities in Children with ASD

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Background: Several studies have demonstrated a significant relation between maternal education level and language abilities in typically-developing children (see Hoff, 2006 for review). This relation however has remained understudied in children with autism spectrum disorder (ASD). One study used retrospective parent-report data to explore this relation in a sample of French children with ASD (Grandgeorge et al., 2009); they found that mothers who completed more schooling reported that their children spoke their first words earlier than mothers who completed less schooling. Another study used a more objective, standardized measure of language and found that higher maternal education level predicted greater change in language abilities in Israeli children with ASD (Itzchak & Zachor, 2011). While findings from these studies suggest that maternal education level is related to language abilities in children with ASD, no studies have explored this relation in a racially diverse sample of American children with ASD. Furthermore, no studies have tested whether maternal education level is differentially related to expressive versus receptive language in children with ASD.

Objectives: The current study aimed to investigate the relation between maternal education level and child expressive and receptive language abilities in a racially diverse sample of children with ASD.

Methods: Secondary analyses were conducted using data from a multisite community-based intervention study (Project EARLY, NCT02359084). The final sample was comprised of 81 racially diverse children diagnosed with ASD, the majority of whom received public insurance (Table 1). At baseline, maternal education level was collected via parent-report. Two groups were formed based on maternal education level – children whose mothers obtained a high school education or below (*N*= 40; less than high school, high school degree, or GED), and children whose mothers obtained an education beyond high school (*N*= 41; some college, associate's degree, bachelor's degree, some graduate school, or graduate degree). 12-months after baseline, children (2.42–4.04 years) completed the expressive and receptive language subscales of the Mullen Scales of Early Learning (Mullen, 1995).

Results: Results of the Mann-Whitney U Tests showed that expressive language t-scores were higher for children whose mothers obtained an education beyond high school compared to children whose mothers obtained a high school education or below (Figure 1.a.; *U*=1030.00, *p*=.038). There were no significant differences in child receptive language t-scores between maternal education level groups (Figure 1.b.; *U*=1692.00,*p*=.903).

Conclusions: Results demonstrated that higher maternal education level is associated with better expressive language abilities, but not receptive language abilities, in children with ASD. Future studies should identify which variables within the child's proximal environment (e.g., quantity and quality of household language input; Hoff-Ginsberg, 1998) mediate the relation between maternal education level and expressive language abilities in children with ASD so that these variables can be targeted in intervention.

414.043 *(Poster)* Maternal Mediation Strategies during Interaction with Toddlers- a Comparison of Dyads with Autism Spectrum Disorder (ASD) and Dyads with Typical Development (TD)

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Background: During interactions with toddlers, mothers use various mediation strategies to construct mutual play and support learning. Such mediation skills play an important role in the development of toddlers' communicative skills, and tend to evolve as the toddler develops. Autism Spectrum Disorder (ASD) introduces challenges to the ongoing mother- toddler's dyadic interaction and natural strategies intuitively applied by mothers may be thus altered. Acknowledging the mothers' roles in the development of toddlers' communicative skills, a close inspection of such strategies is highly desirable.

Objectives:

1. To study the use of different maternal strategies during interaction with toddlers, at early lexical levels
2. To compare the strategies used by mothers in the two groups at similar lexical levels

Methods: 24 mother-toddler dyads participated in the study: In nine dyads, the toddlers had been previously diagnosed with ASD; In fifteen dyads, the toddlers were typically developing (TD). Toddlers in the two groups were matched by lexical levels at study entry. The mean age in the ASD group was 31.5 months and in the TD - 17 months. Each dyad was video recorded three times, at home, during naturalistic interaction. The first recording took place when toddlers reached a productive lexicon of 40-70 different words. Two additional recordings took place in intervals of two months.

Mothers' verbal mediation strategies were divided into five main categories: requests for information, descriptions, encouragements, shifting attention and directing toddler's behavior. The frequency of each strategy was calculated in order to characterize both within- group developmental changes and differences between the two groups.

Results: 1. Mothers from both groups used verbal encouragement in a similar fashion and frequency. The frequency of one specific type of encouragement, exact repetition of the child's production, significantly increased at a similar rate in both groups across the three visits ($f(2,44)=3.77$, $p< 0.05$).

2. Significant differences were found between the two groups of mothers regarding strategies associated with control of the interaction. Specifically, mothers of toddlers with ASD made more frequent attempts to redirect their child's attention ($F(1,22)= 74.56$, $p<0.01$) and used more prohibiting utterances ($F(1,22)= 8.14$, $p<0.01$).

3. Significant group differences were also found regarding three indices. Mothers of ASD toddlers had higher indices of both maternal overall talkativeness ($F(1,22)= 5.43$, $p<0.05$), the use of nonverbal means to support the child's action($F(1,22)= 9,51$, $p<0.01$) and the simultaneous use of different means of communication ($F(1,22)=19.8$, $p<0.01$).

4. Of all the maternal mediation strategies, requests for information were the most prevalent antecedents for the toddlers' productions. While common in the ASD mothers' group, shifting toddlers' attention seldom resulted in a toddler's verbal production.

Conclusions: Results highlight that in many respects, maternal mediation strategies reflect the lexical level of their child. However, our main finding is a distinct interaction style of ASD mother that is expressed in a rather elevated use of verbal and nonverbal mediation strategies in hope of maintaining continuous interaction that could not be otherwise achieved due to their toddlers' difficulties.

414.044 *(Poster)* Measuring Sensitivity to Audio-Visual Synchrony, a Potential Mechanism Underlying Language Impairments in ASD, Using Respiratory Sinus Arrhythmia (RSA)

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Background: Differences in visual attention in children with ASD are theorized to impact language development by altering the alignment between linguistic input and the visual environment (Venker, Bean, & Kover, 2018). One basis for this perspective is evidence of differential sensitivity to audio-visual synchrony. Previous work demonstrated that children with ASD fail to show a preference for synchronous relative to asynchronous audio-visual stimuli while watching a woman producing child-directed speech. Further, preference for synchrony was positively associated with language abilities. This work used a preferential looking paradigm and left unclear whether diminished attention to synchronous stimuli reflects a lack of *recognition* of synchrony, or simply a lack of preference. To clarify this, we measured heart rate variability in response to asynchrony.

Objectives: (1) To elucidate potential mechanisms underlying connections between sensitivity to audio-visual synchrony and language by evaluating whether children with ASD show different physiological responses to synchronous and asynchronous stimuli. (2) To explore whether these responses are stimulus (social vs. nonsocial) dependent and related to language ability.

Methods: In a 2 x 2 within-subject design, we acquired electrocardiogram (sampled at 1kHz) during four counter-balanced stimuli blocks of 75 seconds: audio-visual synchronous and asynchronous social (i.e., a woman speaking) and nonsocial (i.e., noise-making toys) stimuli. In the asynchronous condition, the video precedes the audio track by 1 second. The dependent measure is respiratory sinus arrhythmia (RSA), a measure of heart rate variability in the frequency range of respiration. Higher baseline RSA reflects better capacity for attention and engagement. Decreases in RSA during a task can be used as an index of attention to/engagement with stimuli. Effects of synchrony and stimulus type were assessed with analysis of variance. Relations between RSA, language ability (Preschool Language Scale), and ASD symptomatology (Autism Diagnostic Observation Schedule-2) were assessed using Pearson correlations.

Results: With 11 participants with ASD tested (M=4.12 years, SD=1.23), no significant differences in RSA have been identified based on synchrony or stimulus type. No significant correlations emerged for RSA and language ability. Preliminary data suggest a correlation between RSA difference scores for the synchronous and asynchronous social stimuli with restricted, repetitive behaviors on the ADOS-2. Larger decreases in RSA for asynchronous stimuli (i.e., greater sensitivity to asynchrony) is associated with lower rates of restricted, repetitive behaviors, $r(11) = -.75$, $p < .01$ (see Figure 1).

Conclusions: Our previous work showed that children with ASD differ from language-matched typically developing children in attention to audio-visual synchrony and that this attention pattern is related to language. That work supports the notion that atypical processing of audio-visual synchrony may be one mechanism underlying language impairments in ASD. The current results leave open the possibility that children with ASD lack a *recognition* of audio-visual synchrony. With implications for aspects of development and behavior beyond language, preliminary findings suggest a relation between insensitivity to asynchrony and restricted, repetitive behaviors. Data collection is ongoing. This work highlights ways in which the study of in-the-moment attention to auditory and visual stimuli can advance our understanding of development in ASD.

414.045 *(Poster)* Meta-Representation and Complex Syntax in Children with ASC and TD

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Background: Recent evidence supports the emergence, at around 4-5 years of age, of meta-representational cognitive capacities involved in reasoning both about false-beliefs (FB) and about the same objects under different descriptions ("intensionality"). Further evidence from children both with typical development (TD) and with autism spectrum conditions (ASC) supports a strong relation between the development of FB reasoning and embedded clause understanding. This suggests a potential common cognitive substrate between intensionality, FB, and embedded clauses.

Objectives: The objective of this study was to assess how complex syntax and meta-representational capacities involved in intensionality and false belief reasoning relate to one another in children with ASC.

Methods: 25 children with ASC (mean age 9;4) and 25 TD children (mean age 9;1) matched on on both chronological and verbal mental age (VMA) participated in the study. In a picture-matching task presented via touch-screen, participants were assessed on FB, intensionality and embedded clause performance (including relative clauses and three complement clause tasks, 'says that', 'sees that' and 'seems that', the latter manipulating the appearance-reality distinction).

Results: Results showed that the ASC groups performed significantly lower than matched TDs in embedding overall ($p \geq .0001$) and in particular the tasks assessing complement clauses ($p \geq .002$), with most difficulty on 'says that' ($p \geq .004$). Correlational analysis suggested that intensionality, complement clauses and FB all correlated with each other in the ASC group only ($p \leq .001$). In the TD group, no such correlations were identified.

Conclusions: These findings suggest a relation between certain meta-representational cognitive capacities and the maturation of the syntax of complementation among children with ASC.

414.046 *(Poster)* More Evidence That Frequency Counts Are Insufficient for Understanding Nonverbal Communication Differences in ASD: Autistic Adults Use Head Gestures at the Same Rate As Controls

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Background: Weaknesses in nonverbal communication are required for a diagnosis of ASD, yet remain poorly understood in verbally fluent speakers, especially adults. Many nonverbals are deployed during speech and provide critical information that supplements language. Nonverbal cues are also deployed during *listening;* speakers pick up on these cues and modify communication accordingly. Most research on nonverbal communication in ASD has employed narrative tasks, in which participants engage in a speaking, but not a listening, role, making it impossible to explore nonverbal features of listening in this population. *Head gestures* (e.g., affirmation, negation, uncertainty) are a common nonverbal cue used extensively during listening. In this study we used a naturalistic conversation task to study communicative head gestures in ASD, during both speaking and listening.

Objectives: To evaluate the frequency of head gestures produced by adults with and without autism during back-and-forth conversation, in both listener and speaker roles. We hypothesized that autistic adults would make a similar number of head gestures while speaking, consistent with most narrative research, but may provide fewer "backchannel" head gestures when listening.

Methods: 12 autistic adults and 12 age- and IQ-matched neurotypical adults (see Table) completed a collaborative referential communication task designed to elicit spontaneous back-and-forth conversation with a confederate in a controlled setting. One interlocutor was shown a grid of eight abstract figures and tasked with describing the figures to the other with the goal of ordering them correctly (see Figure). Participants completed this task under two conditions: (1) *Director* condition, in which participants had the completed grid, and (2) *Matcher* condition, in which confederates had the completed grid. Although both interlocutors spoke and listened in each condition, generally the director talked more and the matcher listened more. All head gestures produced by the participants were coded by the first author. Data on 18 additional participants will be available by INSAR2020.

Results: A mixed ANOVA was conducted with Group (autistic, neurotypical) as a between-subjects factor, Role (Director, Matcher) as a within-subjects factor, and head gesture count as the dependent variable. There was a significant main effect of Role, (p=0.01, η^2=.28), with head gestures far more common in the Director role. There was no main effect of Group (p=0.40, η^2=.03); the interaction between Role and Group was also not significant (p=0.92, η^2<.001).

Conclusions: All participants in this study used more head gestures when in a speaking role than in a listening role, consistent with other nonverbal communication behaviors. Adults in both groups used head gestures at a strikingly similar rate, consistent with a growing body of evidence demonstrating that the rate of spontaneously produced *hand* gestures is similar in ASD, even though autistic adolescents and adults may prioritize different communicative functions with their gestures, and may produce gestures that are harder to understand. Simple quantitative measures such as frequency may be insufficient to characterize nonverbal communication production in ASD; we plan to further explore our own dataset by examining: (1) the *function* of each head gesture, and (2) the *clarity* of function for each movement.

414.047 *(Poster)* Morphosyntax in Minority Adolescents and Young Adults with Autism

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Background: Despite the importance of language abilities and evidence that individuals with autism may also have language impairment (LI; e.g., Kjelgaard & Tager-Flusberg, 2001; Modyanova, Perovic, & Wexler, 2017; Roberts, Rice, & Tager-Flusberg, 2004), little is known about the morphosyntactic abilities of adolescents and young adults with autism. Even less is known about such abilities in racial/ethnic minority adolescents and young adults with autism. These gaps limit the ability to accurately diagnose and provide treatment suitable to diverse communities.

Objectives: Taking what is known on tense-marking and morphosyntax in children with autism, this study asked:

1. What is the accuracy of the sample on tense-marking elicitation tasks in a sample of racial/ethnic minority adolescents and young adults with autism and special education needs?
2. What error patterns are prevalent in the sample?

Methods: The New York City Board of Education & University of Kansas Institutional Review Boards approved this study. Participants were 10 male racial/ethnic minority adolescents and young adults with autism (N=10). All attended a specialized public school for students with autism, received their education in self-contained settings with small class sizes, qualified for free/reduced meals, and were exempt from state standardized testing due to their special education needs. Participants completed the phonological probe, 3s, and past tense probes of the Test of Early Grammatical Impairment (TEGI). As part of the broader research program, participants also completed the Clinical Evaluation of Language Fundamentals-3 ($M_{total\ language}$=52.89, SD=6.72) and the Wechsler Scales of Intelligence-Third Edition Digit Span (M=4.8, SD=3.23).

Following the TEGI Manual (Rice & Wexler, 2001), responses were counted as correct (i.e., finite), incorrect (i.e., nonfinite), unscorable (i.e., unelicited responses, such as progressive *-ing*), or no response. Error analysis further categorized incorrect and unscorable responses (Modyanova et al., 2017). If the examiner prompted and received multiple responses, all responses were included in this analysis.

Results: All participants passed the phonological probe and had an average screener score (i.e., an average of finite to nonfinite responses on the 3s and past-tense probes) of 58%, SD=36%. As Figure 1 displays, 50% of the sample had adult-like or near adult-like performance on the 3s probe & 40% on the past-tense probe. Table 1 shows the frequency and percentages of response types, as well as the number of participants who gave a given response type. Overall, about 50% of responses were finite, 20% either present or past progressive (i.e., auxiliary + *-ing*), and 10% nonfinite (i.e., a bare stem).

Conclusions: This study adds to what is known on morphosyntax in an understudied community in research. Specifically, here some individuals with autism who might be characterized as having low language based on standardized age-referenced measures had adult-like morphosyntactic abilities. Further, given that the most prevalent error was present progressive on the 3s probe and past progressive on the past-tense probe (while most responses were finite), it may be that administering standardized assessments – even highly structured ones such as the TEGI – to individuals with autism merits special considerations.

References available upon request.

414.048 *(Poster)* Naturalistic Joint Attention and Theory of Mind in Children with ASD and TD Peers

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Background: Individuals with autism spectrum disorder (ASD) often show differences in theory of mind (ToM; the ability to take the perspective of another person), an integral skill for interpersonal interactions. Joint attention (JA) or the ability to coordinate with a person during communication has also been found to be a meaningful precursor to ToM ability in both children with ASD (Mundy et al., 1986) and typically developing (TD) peers (Charman et al., 2000; Nelson et al., 2008) as understanding of attentional state may underlie an understanding of mental state (Baron-Cohen, 1989). Research on JA to date has primarily focused on testing specific skills in constrained situations designed specifically to elicit JA and testing ToM in younger children.

Objectives: Here we examine how parent-toddler engagement in JA during free-play, which captures how child and caregiver purposefully switch attention between each other and an object in more natural situations, relates to ToM performance 3 years later.

Methods: Forty-two parent-toddler dyads (ASD:n=20; TD:n=22) participated in three, thirty-minute, semi-structured play sessions separated by four months as part of a longitudinal study of early language. The groups were matched on receptive language (t(40)=.03,p=.97) at visit 1 (Mage ASD=32monts;Mage TD=20 months). Sessions were recorded and coded for joint attention type (IJA, in which the child initiates; RJA, in which the child responds to the parent's initiation; and passive attention (PA) in which parent and child are focused on the same object but the engagement lacks referential looks at each other). ToM was assessed approximately 3 years later (Mage ASD=6.4 years; Mage TD=5.5years); children were given both an unexpected change of contents and unexpected change of location task, which were summed for one composite score.

Results: The TD group's (89% correct) performance was significantly higher on ToM than the ASD group (48% correct) (t(40)=4.42,p<.001). When controlling for cognitive ability at Visit 1, JA performance at the initial visit did not relate to later ToM. RJA at Visit 2 was positively related to ToM for the ASD group (r=.484, p=.036) and just missed significance for the TD (r=.449,p=.054). IJA engagement at visit 3 was related to subsequent ToM for both groups (ASD: r=.504,p=.028;TD: r=.546, p=.016). When the entire sample was included in a regression of ToM performance on visit 1 IQ, visit 1 receptive language, visit 2 RJA, visit 3 IJA and group, early IQ did not predict a significant amount of variance (.2%), early language predicted 14 % of variance, RJA 18%, IJA an additional 15%, and group an additional 9% of variance.

Conclusions: When more naturalistic parent child encounters are analyzed, early JA performance relates to later ToM in both children with ASD and TD peers, indicating that JA is equally important for both groups in ToM development. Measuring ToM at this age left less variability in the TD group, many performed at ceiling, while the older ASD group still included children who performed at floor; however meaningful relationships still emerged. Early joint attention skills contribute to ToM performance above and beyond individual language ability.

414.049 *(Poster)* Observational and Reported Measures of Language and Pragmatics in Young People with Autism: A Comparison of Respondent Data and Gender Profiles.

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Background: Females who meet criteria for autism spectrum disorder (ASD) are at much greater risk than males of going undiagnosed (Dworzynski, et al. 2012), or being diagnosed with other conditions (Giarelli, et al. 2010). It is estimated that females represent a quarter of the total diagnosed population (Loomes, et al. 2017) but may be particularly underrepresented in higher IQ groups (70+; Nicholas, et al. 2008). A contributing factor in this discrepancy seems to be the poorly understood presentation of surface behaviours associated with a female phenotype of ASD (Kreiser and White, 2014). However, data in this area are complex, with differences between findings often appearing to be influenced by the person reporting on behaviours (clinicians, parents, teachers or the individual themselves), which may, in turn, be affected by the setting in which the child is being observed (e.g. at home or school; Mandy et al., 2012; Szatmari, et al., 1994).

Objectives: (1) Identify pragmatic, language and social behaviours of FwASD compared with MwASD and matched TDs as observed using a clinical checklist and as reported by parents, children and teachers.

(2) Compare clinical observation measures with parent- and child–report measures.

(3) Compare parent and teacher ratings of social behaviours.

(4) Compare functional measures with direct assessments.

Methods: Female children with autism spectrum disorder (FwASD) and performance intelligence quotient (PIQ) over 70 were compared with male children with ASD (MwASD) and typically developing (TD) controls (age 8-11 years) using a range of language and pragmatic measures. Functional ability was assessed using clinical observations and parent, teacher and self-reports. Results were compared between measures, and with direct assessments of language and pragmatics, in order to identify potential biases.

Results: This study found that FwASD performed better than MwASD but worse than TD controls on clinical observations of pragmatic ability. FwASD also performed worst overall on a parental measure of emotions. There were also a number of clear differences in the assessment results of children with ASD associated with the person reporting on the behaviours (clinicians, parents, teachers or the individual themselves). There were also discrepancies between results from observation measures and direct assessments. This was largely in line with the wider literature, but provides novel data, particularly on the assessment of language and communication, and potential biases impacting on the assessment of FwASD.

Conclusions: This research will contribute to our understanding of the female phenotype of ASD which could improve recognition, referral and accurate diagnosis of this group. By providing gender-normative data, we show the relative strengths and weakness experienced by FwASD in comparison to TD peers, which could lead to targeted therapy for this group. Additionally, this paper draws wider conclusions about the use of observational, report and direct assessment. It considers their relative use in developing a profile of abilities, and demonstrates potential biases. With all assessment methods showing some limitations, it is the recommendation of this paper that researchers and clinicians should provide holistic assessment; including a range of informants and be aware of potential biases.

414.050 *(Poster)* Parent-Reported Temperament and Child Vocalization Behaviors in 6- and 12-Month-Old Infants at High- and Low- Familial Risk of ASD

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Background: Autism Spectrum Disorder (ASD) is characterized by deficits in social communication and the presence of repetitive behaviors (American Psychiatric Association, 2013). Temperament plays a key role in cognition and learning (Rothbart and Putnam 2002), and has been found to differ between infants who develop ASD and those who do not (Paterson et al. 2019). Two major factors of temperament include surgency and negative affect. The former captures a tendency to approach novel people and situations, while the latter embodies constructs such as fear and sadness. These temperament constructs are captured in the parent-report Infant Behavior Questionnaire-Revised (IBQ-R). Naturalistic vocalization sampling holds promise as a method to achieve fine-grained phenotyping of infant behavior (Warren et al. 1996), but it is currently unknown whether brief infant vocalization samples (including delight and distress vocalizations) correlate with parent ratings of temperament (Ozonoff et al. 2010).

Objectives: In this study, we investigate the link between naturalistic samples of (1) distress vocalizing (crying) and (2) delight vocalizing (laughter) and parent-reported temperament subscores in high- and low-risk infants at 6 and 12 months of age.

Methods: Infant siblings of children with ASD (high-risk; HR) and without ASD (low-risk; LR) were administered the AOSI at 6 months and the AOSI and CSBS at 12 months (Table 1). At 24 months, participants underwent gold-standard testing to determine diagnostic category: high-risk with ASD (HR+), high-risk without ASD (HR-), or low risk. Assessments were audio/video recorded. Delight and distress vocalizations were timestamped and categorized by reliable undergraduate coders using ELAN (ELAN, 2018), counted, and normalized per 10 minutes of recording time. Parents completed the IBQ-R at all timepoints. Linear models predicted IBQ-R subscores from the interaction between diagnostic group and vocalization metrics, after accounting for site (lme4 in R, Bates, 2008).

Results: At 6 months, the relationship between distress vocalizing and fear scores was stronger in the LR group than the HR+ group (Estimate: -.07, SE: .20, t=2.85, p=.005; Table 2) and the HR- group (Estimate: -.05, SE: .03, t=-1.87, p=.06; Table 2). There were no significant differences in the relationship between distress vocalizing and fear scores for the HR+ and HR- groups, nor relationships between distress vocalizing and other negative affect subscales in any groups. At 12 months, the relationship between distress vocalizing and sadness scores was stronger in the HR+ group than the LR group (Estimate: .06, SE: .03, t=2.07, p=.04; Table 2). Mean and standard deviation No other group differences emerged in the relationship between distress vocalizing and negative affect subscores, and no group by delight interactions emerged in any surgency subscales at either time point.

Conclusions: In this exploratory study, we investigated relationships between brief vocalization samples (distress and delight) and parent reported temperament in a large sample of HR+, HR-, and LR infants. Differential group by vocalization relationships did not emerge for surgency subscores, while significant differences emerged for distress vocalizing. This suggests that parent report of temperament correlates modestly with naturalistic samples of vocalization behavior, primarily in the domain of negative affect.

414.051 *(Poster)* Partner Matters: Linguistic Accommodation in Children and Teens with ASD Vs. Typical Controls during Experimentally-Manipulated Conversations

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Background: Successful communication demands that speakers to do more than merely produce and perceive speech; they must also read a partner's social cues and respond by dynamically adjusting their own linguistic contributions. These adjustments during conversation – which often result in convergence on the complimentary processes that define "good" conversation (e.g., smooth turn-taking) – are known as linguistic accommodation (Gregory, Dagan, & Webster, 1997) or conversational entrainment (Pickering & Garrod, 2004). Sensitive and socially-responsive conversational behaviors play a significant role in successful communication, and research suggests that entrainment is associated with improved rapport, empathy, and perceived connection between social partners (Manson et al., 2013). Disruptions in this phenomenon may yield significant consequences. For example, difficulty reading and responding to a peer's social cues during conversation (and failure to adjust one's own contribution accordingly) will negatively impact an individual's ability to make and retain friends. A small body of research suggests that conversational entrainment is a challenge for individuals with autism spectrum disorder (ASD; Wynn et al., 2018), which may contribute to conversational breakdowns and social difficulties. Here, we examine language behavior in children with ASD and typically developing (TD) peers during experimentally manipulated conversations.

Objectives: Assess whether children with and without ASD modulate their conversational contributions (as measured by the number of words produced per minute) during 3-minute interactions with partners who act interested or bored.

Methods: Verbally fluent school-aged individuals with ASD (N=59) and TD (N=58; Table) completed the Contextual Assessment of Social Skills (CASS; Ratto et al., 2011) with two novel conversation partners naïve to diagnosis. The first person acted interested in the participant (Interested condition; talked more), while the second acted bored (Bored condition; talked less). Language was transcribed and words per minute (WPM) was calculated. Contributions of diagnostic group, age, sex, and full-scale IQ to WPM were assessed using a generalized linear mixed effects model with a Poisson distribution to account for repeated non-normally distributed count data. Tukey-corrected comparisons of estimated marginal means assessed the directionality of effects.

Results: There was a significant interaction between diagnosis and condition on WPM (estimate=.09, z=2.98, p=.003), after accounting for age and full-scale IQ. This interaction was driven by TD participants, who produced significantly more words during the Interested condition than the Bored condition (estimate=1.09, z=3.8, p<.001), demonstrating successful entrainment with their conversational partner (Figure). The ASD group maintained consistent language behavior across conditions (Table).

Conclusions: Subtle features of a conversation can influence whether social communication is successful, and this study highlighted a potential driver of communication challenges in ASD: reduced linguistic accommodation. While TD participants modulated their behavior in response to social cues emitted by their conversational partner, the ASD group did not. Reduced entrainment during conversations could contribute to significant social challenges experienced by individuals with ASD. Our findings have implications for understanding the effect of conversational partner behavior on social communication, and may be valuable for clinicians interested in improving conversational competence in verbally fluent individuals on the autism spectrum.

414.052 *(Poster)* Peer Language Input and Social Interaction in Monolingual and Bilingual Preschoolers with ASD

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Background: Autism spectrum disorder (ASD) is often associated with language delays. Although bilingualism is increasing in the United States, and is the norm worldwide, very little research has been done to understand bilingual development in children with ASD. Of the studies that have examined bilingual children with ASD, many find levels of language proficiency similar to monolingual children with ASD, despite a theoretical increased risk of delay. Critically, however, the field lacks a rigorous quantitative understanding of the language environments of bilingual learners, particularly those with ASD. Recent advances in automated measurement allow for efficient collection of objective measures of the simultaneous interactions and language use in inclusive preschool classrooms—an important language environment for many children with ASD.

Objectives: Here we utilize automated objective measures of language and movement to quantify the language experiences of monolingual and bilingual preschoolers in ASD inclusion classrooms, asking how peer input affects children's language development.

Methods: Thirty-nine 3-5 year olds, 12 with ASD (8 bilingual), 12 typically developing (TD; 6 bilingual), and 15 with developmental delays (DD; 4 bilingual) from 4 inclusion classrooms, participated. During observations every 2-4 weeks, children wore lightweight vests equipped with Language ENvironment Analysis (LENA) recorders to measure vocalizations and two Ubisense radio frequency identification tags to proximity/orientation. Ubisense measures of proximity/orientation were used to determine instances of social contact (children < 2 m apart and oriented towards one another) and synchronized with LENA data to assess when each child produced/received vocalizations to/from each of their peers. Using linear mixed effects regression models, we predicted each child's vocalizations while in social contact to each peer from their previous vocalizations to that peer (language output), that peer's previous vocalizations to them (language input), their diagnosis, their language background (bilingual, monolingual), and interactions between language background and peer input and between language background and diagnosis.

Results: As can be seen in Figure 1, we found a main effect of peer input such that children who received more language input from their peers at time t were more likely to produce language output to those same peers at time t+1, $X^2(1)=30.58$, $p<.00001$. We also found an interaction between language input and language background such that monolinguals had a greater effect of peer input on language output than bilinguals, $X^2(1)=22.23$, $p<.00001$. Finally, as can be seen in the figure, the difference between monolingual and bilingual children was driven by those with ASD and DD, as these groups showed a greater effect of language background on the relationship between language input and output.

Conclusions: Overall, the language input children received from their peers increases their subsequent language output to those peers—even while controlling for their own previous levels of talking. However, the effect of peer input was greater for monolingual than bilingual children, especially for children with ASD or DD, suggesting that social interaction and language exchange with peers is a potential target for intervention to support language development in these at-risk groups.

414.053 *(Poster)* Phonological Awareness and Language Development in Preschoolers with ASD with and without Hyperlexia

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Background: Preschoolers with autism spectrum disorder (ASD) are known to have a special interest in written material, with a portion of preschoolers with ASD possessing an early ability to read words, referred to as hyperlexia (HPL). It is unclear what skills underly this precocious reading ability. When comparing children with ASD to children with typical development (TD), studies have found mixed results in phonological awareness, verbal comprehension and reading profiles. To date, however, no study has compared these skills among TD, ASD with (+HPL) and without (-HPL) during the preschool period prior to formal reading instruction.

Objectives: To compare phonological awareness, verbal comprehension and reading profiles among preschoolers with ASD+HPL and ASD-HPL, to preschoolers with TD, as well as to examine the interrelations of these constructs within each group.

Methods: Preschoolers (N=30) aged 3-5 years with ASD+HPL (n=8), ASD-HPL (n=7) and TD (n=15) participated in the study. Children with ASD+HPL were defined by an exceptional strength in word reading, but impairments in cognitive, linguistic and reading comprehension abilities. All children completed Verbal Comprehension Index (VCI) subtests of the WPPSI-IV; the NEPSY-II Phonological Processing subtest, and the Letter-Word Identification and Passage Comprehension subtests of the Woodcock-Johnson IV Test of Achievement as measures of word reading and reading comprehension respectively.

Results: The ASD+HPL group outperformed the TD group (p=.001) and the ASD-HPL group (p=.002) on the word reading task, while the TD group outperformed the ASD+HPL group in VCI (p=.001). There were no significant differences in VCI between the TD and ASD-HPL groups (p=.48). Similarly, there were no significant differences among ASD+HPL, ASD-HPL and TD groups on phonological awareness or reading comprehension, although mean group performance of the ASD groups was below average on the NEPSY-II. Interestingly, the ASD+HPL group showed the larger discrepancy between word reading and overall language skills (phonological awareness and VCI). Phonological awareness and VCI were significantly correlated in the TD group (r=.73, p=.002) and in the ASD-HPL group (r=.79, p=.03), but not in the ASD+HPL group (r=.15, p=.72). Only the ASD-HPL group showed a significant correlation between VCI and word reading (r=.83, p<.05). Phonological awareness did not significantly correlate with word reading in the TD or ASD groups combined or in ASD+/-HPL subgroups.

Conclusions: Results suggest that TD and ASD-HPL groups are similar in their VCI, phonological awareness and reading profiles. ASD+HPL showed a different pattern. Despite the strongest reading skills, VCI and phonological awareness were weaker in the ASD+HPL group. These findings suggest that, for ASD+HPL, neither phonological awareness nor verbal comprehension skills are required for word reading, possibly implying a non-phonological route to word reading despite advanced word reading skills. These findings suggest a potentially unique underlying process used for reading in preschoolers with ASD, especially those with early word reading abilities. Interventions should use this strength in basic reading skills to improve language and reading comprehension in the ASD+HPL group from an early age.

414.054 *(Poster)* Phonological Awareness and Visual Spatial Abilities in School-Age Children with Autism

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Background: Phonological awareness is an essential precursor to reading acquisition and refers to the awareness of sound structures in language and the ability to manipulate (i.e., blend, segment, and delete) sounds at both the syllable and individual phoneme levels. Phonological awareness development may be vulnerable in children with autism spectrum disorder (ASD) given that many children with ASD demonstrate delays in language and communication. The current literature yields mixed findings showing that preschool children with ASD demonstrate difficulties with phonological awareness, while some studies indicate phonological awareness as a relative strength within this population. Children with ASD present with heterogenous language and cognitive profiles, yet, an important overlap between oral language skills and nonverbal cognitive abilities has been identified.

Objectives: The current study aimed to investigate the phonological awareness skills of school-age children with ASD compared to children with typical development (TD), while exploring the role of individual differences in IQ and ASD symptom severity on phonological awareness abilities.

Methods: Eighteen children with ASD (age= 6-12, *M*=9, *SD*=1.71, male *n*=16) and seventeen TD children (age= 6-11, *M*=9, *SD*=1.53, male *n*=8) participated in this study. Phonological awareness was measured using the *NEPSY-II Phonological Processing* subtest, ASD symptomology using the Social Responsiveness Scale-2 (SRS-2, and cognitive abilities, including verbal and visual spatial abilities, were measured using the Wechsler Abbreviated Scale of Intelligence - 2nd Edition (WASI-II).

Results: MANOVAs revealed that the ASD and TD groups did not differ in their score on the NEPSY-II Phonological processing subtest ($p > .05$) and the WASI-II ($p > .05$), demonstrating similar phonological awareness and cognitive abilities. Within the ASD group, a regression analysis revealed that visual spatial, but not verbal cognitive abilities, predicted phonological awareness scores ($p < .05$) and that autism symptoms did not predict scores in phonological awareness skills ($p > .05$). Regression coefficients indicated that within the ASD group, participants with a higher visual spatial score obtained a higher score in phonological awareness skills compared to those with a lower visual spatial score. Within the TD group, a regression analysis showed that visual spatial abilities, verbal abilities, and autism symptoms did not predict scores in phonological awareness skills ($p > .05$).

Conclusions: Results contribute to the literature in examining phonological awareness skills in school-age children with ASD, demonstrating that it is a relative strength within this population and is not related to autism symptom severity. Additionally, our findings support previous research showing a relationship between phonological awareness skills and nonverbal cognitive abilities in children with ASD. Given the increase in attention to the academic achievements within this population, findings add to our understanding of phonological awareness skills of children with ASD compared to aged-matched peers and can help inform instructional interventions aiming to increase reading success.

414.055 *(Poster)* Pragmatic Language Competence of School-Aged Children with Autism Who Achieve and Do Not Achieve Optimal Outcome in Peer Conversations

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Background: These years more and more children with autism spectrum disorders (ASD) are able to adapt into mainstream education and develop peer relationships. Some of them even obtain remarkable progress and achieve what is called optimal outcome (OO). Researches show that these school-aged high-functioning ASD (HFA) children may still present some residual deficits, pragmatic language competence being one of them. However, little is known about these subtle difference from a quantitative and detailed aspect. Most of the standard tests of pragmatic language are designed as parent/teacher report scales or checklists and structured evaluation. Since some pragmatic impairments are only present in real-life social interactions, we set up a natural environment and explore children's pragmatic language competence during peer conversations, which provides a new perspective in detecting and evaluating pragmatic language ability.

Objectives: This study aims to compare communication acts with social elements, conversational skills and autistic-specific speech acts of mandarin-speaking OO, HFA and TD children during peer talk.

Methods: 6 OO (mean age:9.69±1.88, IQ: 102.67±11.98), 16 HFA (mean age 9.17±1.45, IQ: 97.50±12.02) and 22 age-matched and IQ-matched TD children participated in this study. We used a strategic card game to induce peer talk between children with ASD(OO or HFA) and his/her TD peer（age difference less than 2 years). Then we coded and analyzed the 10 minute conversation using the CHILDES (Child Language Data Exchange System). We developed a new coding system to assess communication acts combined with social elements, which is based on 35 social-communicative skills: (①self-expressing: dissatisfied, show off, joy, etc.②self-peer social and emotional attunement: modest, perspective-taking, admiring, negotiating, etc.③executive function: turn-taking, disagree, agree, suggesting, etc.). The coding aspects of conversation skills include turn-taking, initiation, continuation (reply and expand), discontinuity and repair. Furthermore, we defined the special autistic-style speech into five types according to the ASD linguistic symptoms. The ANOVA and non-parameter test were used to test the significance of the difference.

Results: The results suggested that compared to OO group and TD peer, HFA children showed significantly less amount and types of communication acts (amount: OO>HFA, p=0.005, HFA<TD, p=0.001, HFA:23.75±10.87, OO:44.67±10.11, TD:40.82±13.72; types: OO>HFA, p=0.001,HFA<TD, p=0.035, HFA:9.75±3.61,OO:16.16±2.32,TD:12.91±3.16), and less amount of conversation continuation (OO>HFA, p=0.022, HFA<TD, p=0.030, HFA:31.00±14.16, OO: 31.00±14.16, TD:44.91±17.76). Compared to their own TD peer, HFA children showed less ratio and amount of expansion in his/her turn (ratio: HFA:0.24±0.09, TD:0.32±0.09, p=0.036; amount: HFA:15.06±7.97, TD:24.68±10.14, p=0.015), more autistic-style speech (sum: p=0.000, type: p=0.003) and more discontinuity(p=0.032). The difference in conversational initiation and repair was not significant.

Conclusions: The results of this study gave new evidence about the pragmatic language competence of high-functioning ASD children and those who achieve OO. HFA children have troubles in conversational continuation of a certain topic, clarifying messages and adding more related information in their own speech turns, while OO group perform better pragmatic competence by expressing and communicating with more social elements. These findings shed light on the future directions of intervention and support for school-aged children with ASD.

414.056 *(Poster)* Preschool Children with Autism Showed Impairment in Recognizing Emblems but Not Iconic Gestures

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Background: In comparison to their typically developing (TD) peers, children with autism spectrum disorder (ASD) have deficits in understanding and producing gestures (Colgan et al., 2006). However, findings on the types of gestures (e.g., iconic gestures, emblems) in deficit are inconsistent in the literature.

Objectives: The present study aimed to investigate the impairment in gestural production and recognition skills of different types of gestures in children with ASD compared to TD children.

Methods: Thirty-seven preschool children aged 4 to 6 years participated in the current study (TD n=15, ASD n=22). There was no significant difference between participants with ASD and those with typical development, in chronological age (U = 146, p = .567) and language developmental age (U = 120, p = .168). The participants' gestural skills were measured by gestural recognition and production tasks (So et al., 2017; So et al., 2016). Twenty iconic gestures (e.g., DRIVE) or emblems (e.g., GREETING), which are commonly used in daily life, were tested. For the gestural recognition task, we videotaped an experimenter producing the 20 target gestures. Each time, the child was shown a gesture and was asked to point to one of three written options that best identified its meaning or to orally name the gesture. In the gestural production task, the experimenter asked the child to produce the target gestures one at a time. A gesture was considered appropriate if it conveyed the target meaning. Generalized linear mixed effect model was conducted with language developmental age and group (ASD or TD) as fixed effects while child and gesture as random effects.

Results: Compared to the TD group, children with ASD showed delay in producing both emblems (p < .001) and iconic gestures (p = .019), as well as recognizing emblems (p = .012). However, impairment in recognizing iconic gestures was not found (p = .925). Results also showed that children with ASD recognized iconic gestures better than emblems (p = .030).

Conclusions: Iconicity may benefit gestural recognition in children with ASD. One common iconic strategy is a handling strategy, where the hands show holding or grasping an imagined object in action; another is an instrument strategy, where the hands represent the shape or a dimension of the object in a typical action. These strategies provide a perceived similarity between a gesture form and its real-world referent (Perniss, Thompson, & Vigliocco, 2010). Children with ASD may guess the meaning with the perceived similarity, which made them recognize the iconic gestures as well as their TD peers. However, the impairment in producing iconic gestures indicated that children with ASD may not be aware of these strategies when producing gestures. Therefore, explicit descriptions of the iconic strategies may be crucial in teaching gestural skills to children with ASD. Besides, since the iconic strategies are not available in other types of gestures including emblems, teaching these gestures in a real scene (e.g., role-play games) may help children with ASD build up the relationship between the form of a gesture and its meaning.

414.057 *(Poster)* Providing Visual Supports Via a Smartwatch to Improve Directive Following for Children with Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) with limited functional speech often demonstrate difficulties with directive-following (Schlosser et al., 2013). While there is limited research investigating receptive language for this population (Sevcik, 2006), visual supports augment directive following for many of these children (Schlosser et al., 2013). Delivering visual supports to a smartwatch may increase the naturalness of directive prompting. Preliminary case series design studies have suggested that directive following can be improved for children with ASD by providing visual supports on an Apple Watch™ held in front of the child in a "just-in-time" (JIT) manner (O'Brien et al., 2016; Schlosser et al., 2017). Given these promising feasibility studies, this investigation used an experimental design to explore the relationship between providing visual supports on a smartwatch and directive-following outcomes.

Objectives: The following questions were addressed: (1) Will the participant attend to, and follow, directives sent via text message to her smartwatch? and (2) is it is possible to gradually increase the distance between the mentor and the learner during prompt delivery?

Methods: A 9-year-old female with ASD with limited functional speech participated in this study. A single case, multiple probe, experimental design was used across three settings, over 16 days, in an elementary school. A mentor texted three written directives, per setting, to the participant's Apple Watch™ in a JIT manner. Introduction of the intervention was staggered across settings. The mentor systematically increased her distance from the participant.

Results: Based on visual analysis of graphed data, use of the smartwatch intervention improved the participant's directive following, and increased the mentor's distance from the learner, across all three settings. In later sessions, the participant also began to demonstrate "anticipatory responses" of upcoming directives. Video examples of the intervention will be shown.

Conclusions: Overall, this study suggests the effectiveness of using an Apple Watch™ to provide visual supports to a learner with ASD. This intervention allows for increased distance between the mentor and learner allowing for a more naturalistic academic environment. This intervention may have positive implications for perceived independence or actual independence through anticipatory response learning.

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414.058 *(Poster)* Qualitative and Quantitative Operational Differences in the Intersection of Bilingualism and ASD: A Systematic Review

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Background: Bilingualism's growing prevalence leads to an increasing clinical and practical need to understand how bilingualism manifests in cognitive and language outcomes in individuals with ASD. Limited research has shown findings on bilingualism's impact on ASD (e.g., Gonzalez-Barrero & Nadig, 2017; Petersen et al., 2012), but they have been constrained by small samples, inconsistent comparison groups, and heterogeneous operational definitions of bilingualism. To date, no review has synthesized the literature on the intersection of bilingualism and ASD both qualitatively and quantitatively.

Objectives: We systematically examined the literature's intersection of bilingualism and ASD, emphasizing their operationalization. Specifically:

1. How is bilingualism defined?
2. How is ASD described?
3. What research has examined the influence of bilingualism and ASD on each other?
4. Are language outcomes different in monolingual and bilingual children with ASD?

Methods: We examined six databases (e.g., ERIC, PsycINFO), yielding 319 articles (Figure 1). 173 articles from a pilot search were included, generating 290 unique articles. We screened titles, abstracts, and keywords and included 98 eligible studies based on three inclusion criteria:

1. Participants were stakeholders within the ASD field
2. One or more participant groups spoke two or more languages
3. Published in English, peer-reviewed, and empirical

55 papers were included; each were coded for 113 variables about terminology, "bilingualism", diagnosis, methodology, and goals. The first two authors double-coded 25% of the papers, with an inter-rater reliability of 93%. Having reported standardized language outcomes, seven studies were included in a meta-analysis.

Results:

1. Bilingualism was labeled 134 times across 50 unique labels. "Bilingualism" accounted for 28% of labeling, while 42% of labeling instances fell in the "Other" category (e.g., "limited English abilities"). Bilingual participants spoke between two (68%) and six (4%) languages. 35% of the studies had bilingual participants with a range of first languages (L1; e.g., English or French), followed by Spanish (22%) and English (15%). English was the most common second language (L2) at 50%, followed by a range of L2s (29%; e.g., Yoruba, Croatian). Testing language did not necessarily align with the participants' L1.
2. ASD was operationalized 119 times across 13 unique labels. "Autism" accounted for 35% of labeling, "ASD" for 28%, and "autistic" for 8%. 47% of the studies did not use any assessments to verify/diagnose participants and, surprisingly, 80% did not use the ADOS.
3. There were geographic differences as well: 64% were conducted in North America, 16% in Asia, and 9% in Europe. 49% were quantitative, 45% qualitative, and 5% mixed (Figure 2A). 51% of papers compared language and clinical groups and 49% did not include a comparison group (Figure 2B). 35% of studies aimed to study language skills, followed by perspectives (25%) and intervention practices (24%).
4. Using a meta-analytic method, we found bilingual and monolingual children with ASD did not differ in language skills.

Conclusions: There are substantial variations in labels of bilingualism and ASD, leading to inconsistent operationalization and obscuring the understanding of how bilingualism and ASD interact, posing a challenge to best support this growing population.

414.059 *(Poster)* Rate of Communication and Gesture Use in Toddlers with and without Autism Spectrum Disorder across Everyday Activities at Home

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Background: In a review of the evidence for intervention practices for children with autism spectrum disorder (ASD) under the age of three, Zwaigenbaum and colleagues (2015) emphasized the importance of building the capacity of caregivers to provide learning opportunities in the natural environment. Rate of communication, gesture use, and initiation of joint attention are important predictors of developmental outcomes in children with and without ASD. To date, the communicative acts of young children in the context of different activities in the home environment have not been examined.

Objectives: To examine rate of communication and relative frequency of communicative functions expressed by young children with and without ASD across everyday activities at home.

Methods: Participants were 211 toddlers diagnosed at age 3 with ASD (n=121), developmental delay (n=46), and typical development (n=44) recruited through screening in primary care from the archival database of the FIRST WORDS Project. Children completed a video-recorded home observation at a M_{age} of 20.01 months (SD=1.70). Parents were asked to interact with their child during a variety of activities, including play with toys, play with people, mealtime, caregiving, family chores, and book sharing. Activity types and child communicative acts were coded using Noldus Pro Observer XT.

Results: Children with TD communicated at higher rates during book sharing than other activities (Figure 1). Children with ASD communicated at higher rates during play with people, when they were not required to shift their attention between objects and others. Children with ASD used a significantly higher rate of deictic gestures during book sharing compared to overall deictic gesture use (M=1.15, SD=1.46) with a small effect size (d=0.24). They produced a higher rate of representational gestures during snack time (M=.30 SD=.85) and play with people (M=.21 SD=.42), again with small effect sizes (d= 0.26 and 0.21, respectively). Across groups, relatively low rates of communication were observed during family chores and gross motor play with "props."

Communicative Functions: High relative frequencies of acts for joint attention were observed during book sharing, as children tapped or labeled pictures (Figure 2). Acts for behavior regulation were common during mealtime and caregiving (e.g., requesting and protesting). High relative frequencies of acts for social interaction occurred during play with people, when social exchanges were being shared between the adult and child and objects were not present.

Conclusions: On average, families spent the majority of their home observations engaged in play with toys (35-40%); however, children communicated across activities. Book sharing appeared to foster both deictic gesture use and joint attention. These findings support the notion that early intervention can, and should, incorporate more than just toy play. Strategies to increase active engagement can be used to scaffold communication during daily, necessary activities like caregiving, chores, and mealtime so that parents can implement intervention throughout the day. Finally, when conducting ASD screening or a communication evaluation in the home, it may be important to examine rate of communication during activities that do and do not require the child to engage in triadic coordination of attention.

414.060 *(Poster)* Relations between Factivity Semantics of Mental Terms and the Five-Step Theory-of-Mind Scale in Cantonese-Speaking Children with and without Autism Spectrum Disorders

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Background: While considerable research has examined false belief (FB) understanding in children with autism spectrum disorders (ASD), little is known about their other theory-of-mind (ToM) skills. Wellman and Liu (2004) have devised a ToM battery to examine the developmental steps of five ToM skills, including diverse desires (DD), knowledge access (KA), diverse beliefs (DB), contents FB (CFB), and hidden emotion (HE). Based on the finding that strong non-factive mental terms predicted FB understanding in typically developing (TD) children (Cheung et al., 2009), we hypothesize that different mental terms will predict different ToM skills in Cantonese-speaking children with and without ASD. Specifically, we expect that (a) strong non-factive mental terms such as *ji5wai4* ("falsely think") will predict CFB understanding; (b) factive mental terms such as *zi1dou6* ("know") will predict KA; and (c) mental terms that denote emotions, such as *hou2hoi1sam1* ("happy"), will predict HE.

Objectives: To examine whether knowledge of the factivity semantics of six mental terms, including three factive ones (*hou2hoi1sam1* ("happy"), *zi1dou6* ("know"), and *ng4gei3dak1* ("forget")) and three strong non-factive ones (*ji5wai4* ("falsely think"), *ng6wui6* ("mistakenly think"), and *waan6soeng2* ("imagine")), predict the five ToM skills in Wellman and Liu (2004) in Cantonese-speaking children with and without ASD.

Methods: 40 Cantonese-speaking children with ASD (mean age = 6.91, *SD* = 1.47) and 60 TD children matched on language ability (mean age = 6.22, *SD* = 0.94) participated in this study. A Cantonese version of Wellman and Liu's (2004) five ToM tasks was used to assess participants' understanding of the five ToM skills. Knowledge of the factivity semantics of mental terms was evaluated on the basis of participants' ability to judge the truth/falsity of the complement clauses following factive and strong non-factive mental terms. Participants' language ability and nonverbal intelligence were measured using the Test of Hong Kong Cantonese Grammar (T'sou et al., 2006) and the Primary Test of Nonverbal Intelligence (Ehrler & McGhee, 2008), respectively. All participants' scores for language ability and nonverbal intelligence were within the normal range.

Results: Hierarchical multiple regressions were conducted to examine the unique contribution of the factivity semantics of mental terms to the five ToM skills. After the effects of age, language ability, and nonverbal intelligence were controlled for, the results showed that autistic children's understanding of *zi1dou6* ("know") significantly predicted DD and KA, and their understanding of the three strong non-factive mental terms significantly predicted CFB. In TD children, *ng4gei3dak1* ("forget") was found to predict DD and CFB, and *hou2hoi1sam1* ("happy") was found to predict HE.

Conclusions: The present study partially confirmed our hypotheses: (a) *zi1dou6* ("know") significantly predicted KA; (b) the three strong non-factive mental terms significantly predicted CFB in children with ASD; and (c) *hou2hoi1sam1* ("happy") significantly predicted HE in TD children. However, contrary to our hypothesis, *ng4gei3dak1* ("forget") significantly predicted CFB in TD children. These findings suggest that children with ASD rely on knowledge of strong non-factive mental terms for CFB understanding, whereas TD children rely on knowledge of the factive mental term *ng4gei3dak1* ("forget") for CFB understanding.

414.061 *(Poster)* Relationship between Parental Education and Communication Levels for Children at Risk for Autism Spectrum Disorder

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Background: Previous research consistently found a link between socioeconomic status (SES) and autism spectrum disorder (ASD; Bhasin & Schendel, 2007; Durkin et al., 2017). Parental education is one factor that is closely related to SES that may play a role in the diagnosis and presentation of ASD. Past research has mainly focused on maternal education and showed that more than 16 years of maternal education was related to an increased risk for ASD by more than twofold (Bhasin & Schendel, 2007). However, social communication has shown to be lower among those with lower maternal education in children with and without ASD (Rosenberg et al., 2018).

Objectives: This study aims to add to this body of research and to determine whether parental education is associated with communication level for children at risk for and diagnosed with ASD. Based on the above findings it is hypothesized that both maternal and paternal education will be positively correlated with the Communication domain of the *Vineland Adaptive Behavior Scale, Second or Third edition, Parent/Caregiver Rating Form* (*Vineland-II, 3*).

Methods: Participants included 239 children who completed a comprehensive developmental assessment at a community-based developmental assessment clinic over the span of three years. Out of the 239 participants, 158 participants were diagnosed with ASD (66.1%) after completing a comprehensive developmental assessment. 75.7% of the participants were male and the mean age was approximately 68.54 months (SD = 43.68). The sample consisted of 30.5% White children, 27.2% Latinx children, 19.2% Black children, 11.3% Biracial children, 2.5% Asian children, 2.1% other, and there was about 7.1% missing information on ethnicity. Twenty participants were excluded from the maternal education correlation due to missing information while 47 participants were excluded from the paternal education correlation. The participants completed a developmental assessment that included the *Vineland-II, 3*as part of the testing battery (Sparrow, Cicchetti, & Balla, 2005; Sparrow, Cicchetti, & Saulnier, 2016).

Results: There was a significant positive correlation between maternal education and the Vineland's Communication domain (r = .228, p = .001). However, paternal education and the Vineland's Communication domain were not significantly correlated (r = .384, p = .064).

Conclusions: The hypothesis was partially supported because these results revealed that higher maternal education is linked to better communication for children at risk for or diagnosed with ASD. These results support previous findings and may be explained by the idea that mothers with higher education use more expressive communication and gestures with their children, which may increase the child's understanding and use of communication.

414.062 *(Poster)* Sensory Processing Behaviors Relate to Listening Comprehension and Oral Expression in ASD

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Background: Issues related to sensory processing are a defining feature of autism spectrum disorder (ASD). Sensory processing issues occur in several modalities including vision, audition, and touch, and can impact how a child modulates and interprets incoming sensory information from the environment. Additionally, language and communication issues are core diagnostic features in ASD. Difficulties related to language and communication can include restricted expressive and receptive language, limited comprehension of verbal and non-verbal cues, and reduced vocabulary. Importantly, communication and language development are reliant upon successful sensory perception. Despite this, little attention has been devoted to examining whether increased issues in sensory function relate to reduced comprehension and expression in ASD.

Objectives: We aimed to test whether sensory issues relate to reduced listening comprehension and oral expression in autistic children.

Methods: Participants (N=442) included autistic (*n*=280, *mean age*=11.05±4.19) and typically-developed children (TD; *n*=162, *mean age*=11.41±4.55). The Oral and Written Language Scales (OWLS-II) was administered to children to assess listening comprehension and oral expression. Parents completed a well-established questionnaire assessing sensory processing (Short Sensory Profile; SSP). Linear regressions were performed for the autistic and TD children to assess if the seven sensory domains on the SSP (*Tactile, Taste/Smell, Movement, Sensory Seeking, Auditory Filtering, Low Energy*, and *Visual/Auditory*) predicted listening comprehension and oral expression.

Results: The SSP significantly predicted listening comprehension in autistic ($F(7,255)=4.31$, $p<.001$), but not TD children ($F(7,153)=.29$, $p=.959$). With autistic children, the subscales *Movement, Sensory Seeking, Auditory Filtering,* and *Low Energy* were all individually predictive. Increased *Movement* and *Sensory Seeking* subscales were related to increased language scores for autistic children whereas *Auditory Filtering* and *Low Energy* were related to *decreased* language scores. The SSP also significantly predicted oral expression in autistic children $F(7,246)=2.72$, $p=.010$, with the subscales *Tactile, Movement,* and *Sensory Seeking* being individually predictive. Interestingly, the SSP also predicted oral expression in TD children $F(7,153)=2.19$, $p=.038$, but only the *Auditory Filtering* subscale was individually predictive (see Table for statistics).

Conclusions: Our findings indicate that atypical sensory processing significantly relates to the comprehension and use of language in autistic children. In particular, *Auditory Filtering* and *Low Energy* were negatively related to listening comprehension, but not oral expression in autistic children. Surprisingly, the two subscales reflecting increased sensory input (*Sensory Seeking* and *Movement*), were positively related to listening comprehension *and* oral expression in autistic children. This pattern indicates that sensory processing has a unique impact on autistic children that is not apparent in TD children. To our knowledge, this is the first data to show that sensory behaviors related to increased language abilities in autistic children are reflective of the quantity of incoming sensory information as oppose to the manner in which it is processed, and that sensory behaviors related to decreased listening comprehension, in particular, are reflective of decreased sensory engagement in autistic children. Overall, our findings demonstrate the importance of sensory processing in language outcomes in autistic children as well as the importance of sensory processing in language abilities more broadly across development.

414.063 *(Poster)* Service Utilization of Minimally Verbal Individuals with Autism

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Background: While outcomes are improving, about 20-30% of people with autism remain minimally verbal (Tager-Flusberg & Kasari, 2013), defined as using single words or less (Thurm et al., 2015). Families of minimally verbal individuals typically face high care-related costs, as their children have higher rates of co-occurring health conditions, including gastrointestinal disorders, neurological conditions, feeding difficulties, and sleep disorders (Carr & Owen-DeSchryver, 2007), as well as challenging behaviors (Goodwin et al., 2018) compared to individuals with ASD and functional language. The minimally verbal end of the spectrum is traditionally understudied in autism research and underserved clinically (Siegel, 2018), and an important area of investigation is how families access services and supports for their children (Becerra et al., 2017).

Objectives: To understand the medical, intervention service, financial support, and family systems needs of families of minimally verbal individuals with autism.

Methods: An online survey was developed and disseminated to identify services families currently are receiving, their perceived efficacy, and the services they would like to receive but are currently unable to access. Parents/caregivers also were asked about barriers to obtaining services. Participants were recruited from the Simons Powering Autism Research for Knowledge (SPARK) genetics study.

Results: A total of 608 caregivers completed the survey. The individuals they reported on ranged in age from 4 to 52 (M = 10.78), with 83 age 18 and up, and were predominantly male (80%) and white (71%), with 99% of individuals having been professionally diagnosed with ASD. Only 21% of respondents felt there were no treatment services or supports needed for their child at this time. Medical services identified as most needed by families were: biomedical (23%), dietary intervention (22%), and genetics (17%). Most needed interventions were social skills training (41%), in-home supports (33%), applied behavior analysis (32%), and leisure opportunities (25%). The most frequently rated barriers to obtaining desired services included insufficient financial resources (58%), resources unavailable within the community (56%), being unable to find resources (47%), and a waitlist that is too long (42%).

Conclusions: Results confirmed that families of minimally verbal children are not accessing a variety of services they feel are needed. Provider shortage and service cost were persistent barriers, highlighting the need for policies and resource allocation that improve financial supports for families, as well as expand training, recruitment, and retention of professionals and support workers.

414.064 *(Poster)* Speech Prosody Predicts Social Competence in Children without but Not Those with ASD

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Background: In communication, speakers vary their speech prosody to convey changing emotional states. Abnormal speech prosody, such as atypical intonation, rate, and rhythm of speech are common characteristics seen with individuals diagnosed with Autism Spectrum Disorder (ASD). These atypicalities can be indicative of the child's ASD severity and are associated with how others perceive their social competence, which may consequently impede typical social development. More recently, it has also been shown that these speech characteristics can influence how others communicate with individuals with ASD.

Objectives: The objective of the current study was to: (1) examine whether a child's social competence may be predicted from their prosodic speech features and (2) to explore how prosodic properties of parent's speech may be indicative of their child's autism characteristics and/or social competence.

Methods: Twenty children with and twenty without ASD participated in this study, along with their parents. Participants were matched by diagnostic group, and did not significantly differ in age ($t(38)$=-.53, p=.60) or IQ ($t(38)$=1.53, p=.14). Participants were excluded if they had an IQ<70; one TD child was excluded as their IQ data was more than 2 SD from the group. Parents completed the Multidimensional Social Competence Scale (MSCS) to measure their child's social competence. Children and parents were asked to build a Lego object. Mean fundamental frequency (F0), pitch range, pitch variability, and spontaneous speech were extracted from recordings of the dialogue between the parent and child as they completed this task.

Results: A hierarchical regression indicated that age and sex did not predict MSCS scores for children with or without ASD. When the children's mean F0, pitch range, pitch variability, and spontaneous speech scores were added to the model, these speech characteristics increased the significance of the model for the children without (R^2=.777, F(6,12)=6.981, p=.002), but not the children with, ASD (R^2=.025, p=.999). A significant proportion of the variance in the MSCS scores of the children without ASD was accounted for by mean F0 (p<.05), and pitch range (p<.01).

To assess the relationship between parent's speech characteristics and their child's social competence, a hierarchical regression was conducted to see whether, the parent's speech characteristics could predict their child's social competence (after controlling for the parent's age). Age alone was not a significant predictor, but when the speech characteristics were added to the model, significant variance in MSCS scores of children with, but not without, ASD was accounted for (R^2=.653, F(5,14)=5.267, p=.006). Specifically, the amount of spontaneous speech produced by the parents accounted for significant variance in their child's social competence (p<.05).

Conclusions: The results indicate that among children without ASD, there is a relationship between the development of speech characteristics and social competence. This pattern was not found for autistic children suggesting that the development of their speech communication skills is separate from their social skill development. The speech of parents of children with, but not without, ASD was found to predict their child's social competence; this may reflect an attempt by these parents to scaffold their child's speech communication.

414.065 *(Poster)* Spontaneous Linguistic Alignment Is Reduced and Less Flexible in Children with ASD

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Background: Social impairment in ASD has been associated with an impaired ability and propensity to imitate others. However, the extent and form of impairment in imitation in ASD is still unclear. Here we focus on linguistic alignment: the tendency to re-use an interlocutor's words ("mommy, give me the *giraffe*", "is that a *giraffe*?"), and syntax ("the giraffe *has fallen*", "yes and the elephant *has gone* to help her"). Previous studies indicated typical alignment in (low support needs) participants with ASD involved highly structured, task-oriented conversations. Given the centrality of alignment in establishing common ground and rapport in social interactions, we need to assess whether alignment is typical also in everyday unscripted conversations.

Objectives: We investigated i) the developmental trajectory of linguistic alignment in children with ASD and typically developing children during spontaneous parent-child interactions; ii) whether the trajectory is affected by the clinical and cognitive features of the child.

Methods: We analyzed spontaneous speech in 67 parent-child dyads from a longitudinal corpus (30 minutes of play activities, 6 visits over 2 years). We included 32 children diagnosed with ASD and 35 linguistically matched TD children (mean age at recruitment respectively 32.76 and 20.27 months). Alignment was calculated using the ALIGN Python library (Duran et al., 2019). We first contrasted child alignment in actual conversations with that in surrogate pairs formed by a parent and a child from two different dyads. We used Bayesian multilevel zero-and-one-inflated beta regression models. This accounts for the propensity of children to align at all (rate), the number of linguistic forms aligned on average when the children actually align (level[a]), and exact repetitions, as a function of diagnostic group, visit, Vineland Socialization (VS), Mullen Expressive Language (MEL) and Visual Reception (MVR).

Results: See table for details. Children in both groups consistently align their lexical and syntactic choices to their parents beyond the surrogate-pair baseline. The number of utterances with any form of alignment increases with age in both groups, albeit less so for children with ASD. Further, the actual number of linguistic forms aligned in those utterances decreases with age and more so in the TD children. This indicates that as they grow, children might engage more in their parents' linguistic production by reusing their words and syntax, but they do so more flexibly and employ them in slightly different constructions (thus reducing the level of alignment).

Verbal skills were positively related to alignment rate in both groups, but negatively to alignment level (for both groups on syntactic levels and only the ASD group for lexical levels). Socialization skills were positively related to lexical alignment rate for both groups, and to the increase in syntactic alignment rates for both groups. They were also strongly negatively related to syntactic alignment levels. No relation was found with MVR.

Conclusions: While the ability to align might be intact, we observe fewer and more rigid instances of spontaneous alignment in ASD modulated by both verbal and socialization skills.

414.066 *(Poster)* Subgroup Identification of Speakers with and without ASD Using Network Models of Acoustic Features of Prosody and Voice

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Background: Untrained peers can recognize an atypical quality to the speech of some people with ASD (Grossman, 2015; Redford et al., 2018). Although certain acoustic features such as pitch range (Nadig & Shaw, 2012) have been shown to be important groupwise factors for distinguishing between ASD and TD speech, no clear pattern of features associated with the speech of people with ASD has yet been shown, and the speech of people with ASD has been described confusingly as e.g. both "monotonous" and "variable," "stilted" and "exaggerated" (Fusaroli et al., 2017). This raises the intriguing possibility that while autistic speech may sound atypical, this atypicality may manifest in different ways in different individuals. Because speech quality is defined by a complex set of interrelated acoustic variables, we used network models to explore the multivariate space describing the speech qualities to which raters respond.

Objectives: Study goals were (1) to identify potential sub-groups of typical and atypical speakers, using acoustic features of prosody and voice, and (2) to describe the vocal and prosodic qualities characteristic of these subgroups.

Methods: We analyzed speech data (8 scripted sentences per participant) from 15 adolescents diagnosed with ASD (mean age = 14.4 years, SD = 1.48) with IQ scores in the typical range, and 15 adolescents with typical development (TD; mean age = 14.1 years, SD = 1.91); groups did not differ on chronological age or full-scale IQ. Participants in both the ASD and the NT groups demonstrated average to high average performance on standardized language measures (see Mayo, 2015, for details). These recording were categorized by 15 naive raters as "typical," "somewhat unusual," or "definitely atypical." Acoustic features extracted from the participants' speech were used to build a network of speakers, using positive and negative partial correlations between acoustic variables to define the strength and direction of the connections. A community-detection algorithm (Reichardt & Bornholt, 2006) was used to identify acoustic profiles of speakers.

Results: When speakers were modeled as nodes in a network, they clustered roughly in correspondence to their classification as "typical" or "atypical" by naive raters. The community detection algorithm identified four acoustic profiles among the speakers. One profile contained primarily speakers characterized as "typical," while the other three showed distinct patterns of acoustic quantities. Atypical speakers were distinguished from typical speakers by slower speech rate, but atypical speakers were also distinguished from each other primarily by different patterns and degrees of breathiness and nasality.

Conclusions: These results suggest that while the acoustic patterns of typical speakers tend to resemble one another, there may exist identifiable subgroups of atypical speakers. Although the community detection algorithm was free to identify up to ten different groups, it identified only four meaningfully different clusters of speakers, suggesting that similarities between atypical speakers within each subgroup were stronger than their differences. These data point toward the possibility of moving beyond broad descriptions such as "monotonous" toward a more nuanced understanding of the different types of atypical prosody and voice quality in ASD.

414.067 *(Poster)* Talking More and Pausing Less: Girls with ASD Behave Differently during Brief Natural Conversations

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Background: Autism spectrum disorder (ASD) is primarily diagnosed in boys (4:1; Baio et al., 2018), with greater male:female ratios in higher IQ ranges (10:1; Lord & Schopler, 1985). However, a recent meta-analysis suggests that ASD girls have been underdiagnosed and thus excluded from many studies (Loomes et al., 2017), rendering it urgent to understand this subgroup. Previous studies demonstrate atypical conversational behaviors in children with ASD relative to typically developing (TD) peers (Capps, Kehres, & Sigman, 1998), but few studies have included sufficient numbers of girls to assess sex differences, and even fewer have explicitly compared autistic girls to typical girls. This study begins to fill that gap by analyzing speech/pause duration in a large sample of boys and girls with and without ASD.

Objectives: Measure effects of sex and diagnosis on quantitatively derived speech/pause patterns in girls and boys with and without ASD during natural conversations.

Methods: Ninety-two ASD (n=45, 16 girls, mean age=11.46) or TD (n=47, 24 girls, mean age=10.06) children, matched on IQ and sex ratio but not on age (p=0.02; included as a covariate in all analyses; Table), completed 5-minute "get-to-know-you" conversations with a young adult confederate (n=25, 22 females). Trained annotators transcribed and time-stamped audio recordings. An in-house GMM-HMM based Speech Activity Detector automatically time- segmented audio files into speech/silence segments. We automatically diarized speakers using Python, and manually reviewed diarization. Silence segments were coded as within-turn or between-turn silence. Between-turn silences were further coded as Confederate-to-Participant or Participant-to-Confederate, depending on the direction of the turn change. The number and duration of segments with overlapping speech did not differ by group, and were excluded from analyses. We measured duration and rate (per minute) of speech/silence segments and total speech time for each participant. Features were compared by group and related to clinical measures to understand individual differences in ASD participants. Total duration of conversations did not vary by group (p=0.63), but was covaried in all analyses.

Results: ASD girls spoke the longest (vs. TD girls: p=0.017; vs. ASD boys: p=0.014; vs. TD boys: p=0.012; Fig.1A) and produced more speech segments than other subgroups (vs. ASD boys: p=0.014; vs. TD girls: p=0.018; vs. TD boys: p=0.011; Fig.1B). ASD girls' mean speech segment duration was longer than TD girls (p=0.031; Fig.1C), and ASD girls produced more within-turn pauses than ASD boys (p=0.042) and TD boys (p=0.018; Fig.1D). ASD girls' between-turn (Confederate-to-Participant) silence (i.e., latency to respond) was shorter than ASD boys (p=0.01; Fig1.E) and less frequent than TD girls (p=0.012) and ASD boys (p<0.001; Fig.1F). Frequent within-turn pauses predicted higher adaptive behavior scores and improved social responsiveness scores for ASD girls – but not boys (Table 1).

Conclusions: ASD girls speak differently than ASD boys, but may differ from TD girls and boys as well. Conversational behaviors that conflict with a male-referenced conceptualization of ASD (e.g., greater volubility and faster conversational responding in girls) may interact with clinical biases to place girls at particular risk of under-diagnosis, thus reducing access to ASD-specific supports.

414.068 *(Poster)* Temporal Associations between Child Joint Attention and Mother Attention for Children with Autism during Naturalistic Social Interactions

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Background: During early development, an infant's maintenance of joint attention depends on their partner's skillful support (Adamson & Russell, 1999). Joint attention development is of particular importance for children with autism spectrum disorder (ASD), as they often demonstrate deficits in joint attention skills compared to their peers. Understanding the contingent relations between parental behaviors and their child's social communication behaviors during a social exchange may provide a clearer picture of contextual elements and behaviors of the social partner that may support joint attention in children with ASD.

Objectives: The purpose of the present study is to assess whether joint attention behaviors of children with ASD and their mother's social attention are temporally related during a social interaction.

Methods: Participants included 44 children with ASD (35 males; *Mage*= 49.33, *SD*= 10.01 months) and their mothers (*Mage*= 36.62, *SD* = 4.10 years). Two groups were created for subsequent analyses. The minimally-verbal group (n = 20) consisted of children who were administered ADOS-2 module 1, and the verbal group (n = 21) consisted of children who were administered either ADOS-2 module 2 or module 3. An adapted version of the Early Social Communication Scales (Mundy et al. 2003) was administered to capture children's initiations of joint attention (IJA; ICC = 0.74-0.89), and response to their mother's bids for joint attention (RJA, ICC = 0.72-1.0). Mother attention was measured using *dyadic orienting* (Leekam et al., 2006). An independent observer coded dyadic orienting as instances in which the child successfully made a *visual* (ICC = .85), *auditory* (ICC = .97), or *multisensory* (ICC = .87) bid for their mother's attention. Mother and child behaviors were coded in 15-second intervals. Contingency analysis identified lag-1 associations between child joint attention and subsequent mother dyadic orienting. A Yule's Q (odds ratio) was calculated, indicating the strength of contingency between child and parent behaviors (Bakeman & Gottman, 1997).

Results: Findings revealed that following intervals in which the child initiated joint attention, mothers were more attentive to their child's attentional bids in subsequent intervals (t (31) = 3.77, p < .001). Additionally, for intervals in which mothers attended to their child's bid for attention, children were more likely to initiate joint attention in the subsequent interval (t (28) = 3.96, p < .001). While child IJA and subsequent mother attention were contingently related, this relation was moderated by children's expressive (F (1, 24) = 4.25, p = .050) and receptive (F (1, 24) = 7.83, p = .009) language, and interacted differently for the verbal group compared to the minimally verbal group, such that language ability promoted the contingent relation for the minimally verbal group, but discouraged the contingent relation for the verbal group.

Conclusions: Mother attention promoted subsequent child IJA, and child IJA promoted subsequent mother attention. Children's language ability emerged as an important moderator of the contingency between child IJA and mother attention. Mothers may hold expectations or assumptions about their child's communicative abilities that inform how they attend or respond to them socially.

414.069 *(Poster)* Test-Retest Reliability of Linguistic Variables Derived from Short Semi-Structured Conversations in Individuals with and without ASD

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Background: Social communication is a core challenge in autism spectrum disorder (ASD), but has proven difficult to reliably measure, especially in natural contexts that generalize well to everyday function. The Contextual Assessment of Social Skills (CASS; Ratto, Turner-Brown, Rupp, Mesibov, & Penn, 2011) is a short, semi-structured conversation used to measure social skills in individuals with ASD. Analyzing linguistic behavior during the course of a short conversation can shed light on a person's vocal-motor phenotype, personality, volubility, as well as their internal thoughts, feelings, and interests (Tausczik & Pennebaker, 2010). Even something as simple as how talkative a person is when meeting someone new can serve as a marker of social and conversational skill (Ratto, et al., 2011). Despite the potential for using natural language processing to analyze conversational behavior as a fine-grained phenotypic outcome measure in social communication treatment research, few conversation tasks have established (1) test-retest reliability between administrations and (2) applicability across a range of ages and cognitive ability levels.

Objectives: In this study, we assess the test-retest reliability of linguistic behaviors produced during short, semi-structured conversations from individuals of different ages and cognitive ability levels.

Methods: Thirty-two participants aged 6-24 with ASD and of typical development (TD, Table 1) participated in two sets of two 3-minute CASS conversations with four novel confederates. The first confederate in each set acted interested in the participant (Interested condition), while the second acted bored (Bored condition). Trained undergraduate raters orthographically transcribed audio recordings of both sets of conversations. R packages for text-mining, LIWC (Tausczik & Pennebaker, 2010), and in-house scripts were used to extract participant word count and percentage of time spent talking from the transcribed conversations. Test-retest reliability of separate linguistic variables was compared by condition, between administrations, using two-way absolute agreement intraclass correlations (irr in R, Gamer et al., 2019).

Results: Intraclass correlations revealed good (Interested condition; ASD ICC=0.73, TD ICC=0.6, Fig. 1) and excellent (Bored condition; ASD ICC=0.88, TD ICC=0.78, Fig. 1) correlations between conversation administrations in participant word count (Cicchetti, 1994). Talking percentage indicated a similar pattern (Interested condition: ASD ICC=0.63, TD ICC=0.73; Bored: ASD ICC=0.83, TD ICC=0.80), demonstrating the CASS conversation's ability to capture consistent information between administrations among individuals across a wide range of ages and with significantly different cognitive levels.

Conclusions: A snapshot of an individual's social communication phenotype in a natural setting can provide useful information for screening, diagnosis, prediction, and treatment planning. Using word count and talking percentage, we determined that in both the Interested and Bored conditions, the CASS demonstrates good and excellent test-retest reliability, respectively. This was true for both the ASD and TD groups. Importantly, test-retest reliability remained high despite significant variance in the cognitive levels and ages of both ASD and TD participants. Data collection for this project is ongoing. We anticipate that our sample will double by April of 2020, which will allow us to analyze a larger range of linguistic variables and assess potential moderators of test-retest reliability (e.g., sex, IQ, and symptom severity).

414.070 *(Poster)* Testing the Reliability of the Autism Classification System of Functioning: Social Communication – Integrated for Children and Youth Ages 2 to 18 Years

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Background: The Autism Classification System of Functioning: Social Communication (ACSF:SC) is a 5-level classification system that operationalizes 'levels' of social communication functioning in ASD, providing a common language and basis to stratify children according to ability within a clinical setting, and in research. The ACSF:SC can be used by parents and professionals use the same levels to complete two ratings based on a child's observed social communication – the child's best capacity and their typical performance. It was first developed for preschool children with ASD (ages 3 to <6 years) among whom its psychometric properties have been established. Recently, the ACSF:SC has been revised through content validity testing to both toddler (ages 2 to <3 years) and school-aged children (6-21 years) creating the ACSF:SC-Integrated. With this expanded age-range, reliability testing is a necessary next step to be tested with parents and professionals to ensure consistency in reporting for the population of children/youth with ASD.

Objectives: To test the intra- and inter-rater reliability of the ACSF:SC-Integrated in children and youth with ASD ages 2 to 18 years.

Methods: Using recruitment methods ranging from direct in-clinic contact to online outreach, we approached families of 227 children/youth with ASD (across 3 Ontario sites, 2 Alberta sites, and families engaged in previous ACSF:SC studies). One parent and two professionals completed the ACSF:SC -Integrated for each child with ASD twice, approximately 4-6 weeks apart. Intra- and interrater reliability of the ACSF:SC-Integrated was assessed using weighted Cohen's kappa (κ_w) with quadratic weights.

Results: At the time of first classification using ACSF:SC-Integrated by parents, 78 children/youth were classified. Children characteristics included 62 males, mean age 6.5±3.5 years, and mean age range 2.1-15.6 years, respectively. For age breakdown of sample, 12 aged 2 to <3 (10 males, age 2.5±0.2 years), 29 aged 3 to <6, 36 (21 male, age 4.3±0.9 years), 35 aged 6 to 16 (31 males, age 9.6±2.6 years). Professionals had a range of backgrounds, including teachers/educational assistants (n=7), early childhood educators (n=2), ABA therapists (n=5), Speech-Language Pathologists (n=5), physicians (n=2), occupational therapists (n=1), and others (n=7). Intra-rater agreement results were as follows for best capacity and typical performance, respectively: for parents (n=49) κ_w= 0.66 (95% CI=.40-.92) and (n=50) κ_w= 0.76(95% CI=.52-1.00; for professional ratings (n=12) κ_w= 0.97 (95% CI=.92-1.00) and (n=11) κ_w= 0.92 (95% CI=.82-1.00). The inter-rater agreement between parents and clinicians were (n=28) κ_w= 0.64 (95% CI=.37-.92) and κ_w= 0.74 (95% CI=.58-.90), for best capacity and typical performance, respectively. Inter-rater reliability between the first and second professional will be analyzed when the sample-size increases as data continues to be collected, which will be updated for the conference presentation, in addition to existing analyses presented here.

Conclusions: Findings demonstrate reasonable consistency in rater agreement when parents and/or professional are completing the ACSF:SC-Integrated for children ages 2 to 16 years old. ACSF:SC-Integrated has similar or better intra and inter-rater agreement results than the previous ACSF:SC preschool version. Intra-rater agreements for parents and professionals were similar and at times exceeded agreement expectations.

414.071 *(Poster)* The Effects of Augmentative and Alternative Communication Interventions on Speech Production in Autism Spectrum Disorder: A Systematic Review and Meta-Analysis

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Background: Approximately 25-35% of individuals with autism spectrum disorder (ASD) present with little or no functional speech and are candidates for augmentative and alternative communication (AAC). Despite documented effectiveness of AAC interventions, the autism field continues to face fears from stakeholders that the adoption or the continued use of AAC modalities may hinder the acquisition of natural speech. If left unanswered, this may lead families to postpone, or worse, reject AAC modalities altogether leaving their children less likely to reach their full potential.

Objectives: This project uses meta-analytic methods to aggregate and evaluate intervention literature with respect to:

1. What are the effects of AAC interventions on speech production?
2. Are included AAC interventions effective in terms of AAC outcomes?
3. Do some types of AAC interventions (e.g., PECS, manual signs, electronic devices, multimodal AAC) yield more effective speech outcomes?
4. Is there a relation between the effectiveness of AAC outcomes and speech?
5. Are the gains in speech greater when the speech measure is related to the vocabulary of the AAC modality as opposed to generalized speech measures?
6. Do published studies yield more effective speech compared to unpublished work?
7. Are pre-intervention vocal imitation skills a predictor of speech gains?
8. Are the gains in speech greater with speech output from devices/applications relative to without speech output (e.g., communication boards)?

Methods: A multi-faceted search strategy will include: (a) several general-purpose databases; (b) publisher databases (e.g., ScienceDirect, Sci-Hub, Scopus); (c) six trial registers for unpublished trials; (d) reference lists of included studies; (e) forward citation searches of included studies; and (f) contacting authors of included studies. To aid data extraction we will prepare a coding form and manual to code each study in terms of: (a) Participant characteristics; (b) AAC approach; (c) treatment intensity; (d) intervention design; (e) speech production design; (f) generalization design; (g) maintenance design; (h) type of speech; (i) speech measurement technique; (j) IOA, % of sessions, observer status; (k) treatment integrity, measure, % of sessions, and observer status; (l) outcomes (speech & AAC outcomes); (m) magnitude of effects: implementation of latest effect size metrics for individual study analysis as well as aggregation of group and single-case designs; and (n) risk-of-bias assessment using the PEDro scale for group experimental designs, the Single-Case Experimental Design Scale, and the EVIDAAC Single-Subject Scale. Reliability of study inclusion and coding will be established.

Results: This project will update and extend an earlier review by Schlosser and Wendt (2008). At the time, nine SCED studies (27 participants) and two group studies (98 participants) were included, providing evidence that AAC interventions do not impede speech production. More detailed analyses found that observed gains varied across individuals and were rather modest.

Conclusions: Conclusions of the previous review will be revised consistent with the updated data set and analyses; refined intervention protocols and innovations in AAC technologies over the last decade may have led to improved outcomes. Advances in clinical AAC research may also allow to identify potential predictors of speech acquisition. Presenters will draw implications for clinical practice and future research.

414.072 *(Poster)* The Emotional Valences of Negative Passive Sentences in Japanese By Adults with ASD Tendencies

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Background: As Lartseva, Dijkstra, and Buitelaar (2015) point out, although people with ASD are able to correctly classify emotional language stimuli as emotionally positive or negative, there is still a need to investigate ASD people's difficulty in processing subtle meanings of emotional language.

In the Japanese language, there are two types of passive, namely "direct passive" sentences with clearly stated subjects and "indirect passive" sentences with implied subjects.

In order to expand the scope of this research field, this study investigates ASD people's capacity to judge subtle emotional valences of passive sentences in Japanese.

Objectives: The purpose of this study is to verify the hypothesis that ASD people tend to have difficulties in understanding the subtle negative connotations of indirect passive sentences with implied subjects. By studying such difficulties of people with ASD tendencies, we can gain insights into the characteristics of ASD people's interpretation of linguistic stimuli.

Methods: Twelve adults with ASD tendencies judged the emotional valences of fifteen direct and fifteen indirect passive sentences, both types depicting various degrees of negative emotional valences . The subjects responded by indicating the degree of emotional valences on a continuum of a line ranging from negative to positive, a measurement instrument called a Visual Analogue Scale (VAS). The distances (millimetres) of their slash marks were measured from the zero point in the middle of a line between the negative and the positive extremes on each end. Their response data are compared with those of a Control group of a hundred and six adults (university students) without ASD tendencies. The ages of the adults with ASD tendencies ranged from 18 to 25, and those of adults without ASD tendencies ranged from 19 to 22.

Results: Both of the Control group and the ASD group showed a significant difference between indirect and direct passive sentences（$P < .001$, $d = 0.98$; $P = 0.003$, $d = 0.93$).

For the direct and indirect passive sentences there were no differences between the ASD group and the Control group. However, whereas the Control group judged ALL the indirect passive sentences as having negative emotional valences, the judgments of the adults with ASD tendencies fluctuated and some of them even judged some indirect passive sentences as having neutral or positive emotional valences.

Conclusions: Based upon the above results, it can be said that some people with ASD tendencies have difficulties in interpreting the subtle meanings of indirect passive sentences which lack clear subjects. The implication of this study relates to the need for caretakers and teachers to be aware of such difficulties that people with ASD face in daily communication in the Japanese language, and pay due considerations to support their well-being in the society.

414.073 *(Poster)* The IQ Discrepancy Differentiates the Language Delay in ASD Children

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Background: IQ discrepancy (IQD) refers to the discrepancy between verbal and nonverbal intellectual abilities, indicating an atypical pattern of verbal-performance IQ differences (i.e., the distance between measured verbal [VIQ] and performance intelligence [PIQ] quotients). IQD appears to be related to several aspects of child development, but no studies have examined the association between IQD and language delay in children with autism spectrum disorders (ASD).

Objectives: The aims of the study were to establish whether 1) a group difference existed in the language delay among ASD children with different levels of IQD; 2) an association existed between IQD and language delay.

Methods: A total of 507 children with ASD were divided into three groups according to the size of the IQD: EVEN IQ (n=469; IQD within 1 SD), discrepantly higher VIQ (n=64; VIQ > PIQ above 1SD [≥ 15 points]), and discrepantly higher PIQ (n=74; PIQ > VIQ above 1SD [≥ 15 points]). Children with ASD were assessed with the Language Disorder Scale of Preschoolers (LDS) and Wechsler Preschool and Primary Scale of Intelligence™ – Fourth Edition (WPPSI™-IV) respectively to measure their language disability and determine their IQD. The LDS contains three subtests: overall language ability, listening comprehension, and oral expression. Each subtest could differentiate three groups: normal, borderline, and delayed. Chi-square tests were used to examine the relationships between IQD and language delay.

Results: The results indicated significant differences among the three subgroups ($p < 0.05$) in the LDS. The results of the LDS show that 313 children had language delay in overall language ability (61.7%); 224 children, in listening comprehension (44.2%); and 278 children, in oral expression (54.8%). The FIQ, VIQ, PIQ, and IQD in the WPPSI-IV were 76.20 (SD = 11.02), 77.61 (SD = 13.88), 78.28 (SD = 15.28), and 10.69 (SD = 7.99) respectively, all of which were below the FIQ of 100 in the psychometric curve. Chi-square tests showed that IQD was related to children's overall language ability, listening comprehension, and oral expression ($X^2 = 17.68$, df = 4, $p = .003$; $X^2 = 19.88$, df = 4, $p = .001$; $X^2 = 16.03$, df = 4, $p = .002$). Children with even IQD showed better language ability than did children with discrepantly higher VIQ or PIQ. Moreover, children with discrepantly higher VIQ were associated with better language ability than were children with discrepantly higher PIQ, and vice versa.

Conclusions: The results of this study showed that IQD was significantly associated with language delay in children with ASD. The results of this study could encourage clinicians, educators, and therapists to consider IQD when measuring children's language function and to analyze the patterns of language disability in preschool children with ASD. Possible language problems of children with ASD may be detected early based on routine evaluation of cognitive profiles. Furthermore, the language delay could be explained in terms of IQD. Professionals should pay attention to children's language problems when they have IQD.

414.074 *(Poster)* The Importance of Speech Sounds for Learning New Words

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Background: Children with autism and minimal verbal skills differ according to the amount and types of speech sounds (phonemes) they produce. However, little attention has been given to how these differences may relate to progress in learning to speak (Biller & Johnson, 2019; (Brady et al., 2015)

Objectives: The purpose of this study is to examine how speech sound production relates to language measures including word productions measured concurrently, and 6 months later.

Methods: 26 Children (18 males and 8 females) between the ages of 60 and 100 months with autism and minimal verbal skills participated. The following measures were collected from each child at time 1: number of different consonants produced during a recorded sample at school; number of speech sounds and oral motor gestures imitated during an assessment; and phonemic scores derived from elicited speech attempts (Chenausky, Norton, Tager-Flusberg, & Schlaug, 2018; L. Williams, Pitt, Fleming, Becker, & Brady, 2018). The phonemic scoring provided differential weighting for accuracy of each phoneme in comparison to target production. The following word production measures were obtained at time 1 and 6 months later at time 2: # different words produced during production probes, scores from the Expressive Vocabulary Test (K. T. Williams, 2007), and Communication Complexity Scores (CCS Brady et al., 2018). CCS scores describe expressive communication during a naturalistic probe, with higher scores assigned to word productions. We ran simple correlations to determine relationships between speech sound production measures and word production measures.

Results: Significant moderate-large correlations were found between speech sound measures and the word production outcomes, as shown in Table 1.

Table 1. Correlations between speech sound and word production variables

	oral/verbal imitation	*# different consonants*	*Phonemic Scores*	*EVT Raw Score 1*	*EVT Raw Score 2*	*CCS Optimal*
oral/verbal	1.000					

imitation						
Total # of consonants	0.519	1.000				
Phonemic Scores	0.553	0.516	1.000			
EVT Raw Score 1	0.629	0.345	0.741	1.000		
EVT Raw Score 2	0.486	0.568	0.735	0.733	1.000	
CCS Optimal	0.334	0.428	0.405	0.443	0.516	1.000
Total # of Words	0.448	0.490	0.657	0.426	0.656	0.396

Of note, word production outcomes (EVT, and Total # words) were more strongly correlated to phonemic scores than oral/verbal imitation or number of different consonants.

Conclusions: These results indicate a strong relationship between children's speech sound production skills and their concurrent and future word productions. The phonemic scoring system provided a weighted score in which productions were given points for how closely they approximated target productions. Approximations of consonants and vowels were described with this scoring system. Our results provide further support for carefully assessing and treating speech sound productions as part of an overall communication program for children with autism.

414.075 *(Poster)* The Interrelationship of Speech Motor Control, Language and Prosody in Autism

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Background: Research supports that differences exist in the acoustic-perceptual features of prosody in autism. The underlying mechanisms that contribute to prosodic differences are not well understood. Several hypotheses exist to explain prosodic impairment in autism, ranging from a lack of one's ability to 'tune in' to the speech environment and 'tune up' speech behaviors (Shriberg et al., 2011) to differences in language (Lyons, Simmons, & Paul, 2014), auditory processing (Bonneh, 2011), executive functioning (Filipe, 2018), and speech motor control (Velleman, Andrianopoulos, et al., 2010). It is important to investigate sensorimotor and cognitive linguistic processes and the impact they have on receptive and expressive prosody. The outcomes of such research can lead to a better understanding regarding the nature of prosodic differences in some individuals with autism, how to effectively assess prosody, and the development of evidence-based interventions.

Objectives: This research addressed the following questions: 1) Do individuals with autism perform with significantly less accuracy on structured receptive and expressive prosody tasks in comparison to Typically Developing (TD) controls; 2) Is performance on Alternate Motion Rate (AMR) and Sequential Motor Rate (SMR) tasks positively correlated with expressive prosody scores?; and 3) Are standardized receptive vocabulary scores positively correlated with expressive and receptive prosody scores?

Methods: A between-group study was conducted to investigate prosodic ability, as well as the degree of relationship between prosody, speech motor control, and language abilities in individuals with autism (n=17; 11 males, 6 females) in comparison to TD controls (n=17) matched for age, gender, and language. Participants were monolingual speakers of English, between 7;10 to 19;0 years of age. Experimental tasks included standardized receptive and expressive vocabulary testing, structured expressive and receptive prosody tasks, AMRs and SMRs. Testing was completed in a sound-treated, double-walled chamber with an ambient noise level of 25 dBA. Performance on the prosody tasks resulted in a composite receptive/expressive prosody score per participant. The AMR/SMR tasks were audio recorded using the Tascam multi-track digital recorder for each participant to determine the number of syllables produced per second, per task, using the Multi-Dimensional Voice Program. Between-group differences were studied using t-tests and/or Welch-Aspen t-test to control for unequal variances between groups. Pearson's correlation analyses were conducted to examine the degree of relationship between prosody, speech motor control and language.

Results: The individuals with autism performed with significantly less accuracy on receptive (p=.000) and expressive (p=.000) prosody tests compared to controls. Correlation coefficients between expressive prosody and AMR/SMR tasks are *very weak* to *weak* as follows: p^(r=.116); t^(r=.115); k^(r=.237); and p^t^k^(r=.04). There was a *moderately strong* correlation between receptive vocabulary and expressive prosody (r=.597) and a *strong* correlation between receptive vocabulary and receptive prosody (r=.7).

Conclusions: The outcomes show that some individuals with autism have impaired receptive and expressive prosody. Consistent with previous literature, the results demonstrate a strong connection between language and prosody. A weak positive relationship was revealed between speech motor control and prosody. Implications for future research will be discussed.

414.076 *(Poster)* The Relationship between Speech Prosody and Conversational Effectiveness in Youth with and without ASD

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Background: Deficits in speech prosody in individuals with autism spectrum disorders (ASD) are one of the hallmarks of the disorder and are often one of the earliest symptoms (Traeger-Flusberg et al., 2005). Prosodic impairment in individuals with ASD is reported to persist even if other areas of language improve (Peppé & McCann, 2003). Although verbal children and adolescents with high-functioning autism score well on prosodic tasks that are related to the grammatical structure of utterances (Paul et al., 2005; Peppé et al., 2011), their overall prosody is still perceived as odd by listeners (Filipe et al., 2014). Deficits in word and sentence level prosody in individuals with ASD have been the focus of prosody research in this population. However, the impact of prosody deficits on discourse and conversational level phenomena are as of yet not well understood. The current study contributes to the limited corpus of research investigating the relationship between prosodic abilities and conversational success in youth with and without ASD.

Objectives: The objective of the current study was to investigate the relationship between prosodic ability and conversational effectiveness in children and adolescents with and without ASD. It was hypothesized that those performing well on receptive and expressive prosody tasks would be more successful communicators at the conversational level.

Methods: A total of 28 children and adolescents between the ages of 9 and 15 years - 14 participants diagnosed with ASD and 14 age, gender, and non-verbal IQ matched neuro-typical peers - completed the current study. Each group consisted of 11 male and three female participants. All participants completed IQ and language testing, and the participants in the ASD group were also administered the ADOS-2. The prosodic abilities of all participants were assessed using the Profiling Elements of Speech Prosody in Communication (PEPS-C) (Peppé & McCann, 2003), and conversational effectiveness was assessed using the Diapix task (Baker & Hazan, 2011) – a goal oriented conversational task during which conversation partners engage in a conversation in order to find differences in a set of pictures. Conversational effectiveness was measured as the number of differences found per each minute of conversation. Results were analyzed using linear regression modeling.

Results: As expected, prosody skill as measured by PEPS-C scores were significantly different between the two groups with the neuro-typical peers scoring on average 16.4 points more than the ASD group ($F(1,26)=5.69$, $p=0.02$). The main predictor for conversational success was the time that conversation partners were engaged in the task ($\beta = -0.2$, $t=-12.544$, $p< 0.001$) with those who found the largest number of differences per minute also taking less time overall to complete the conversation. This was true for both groups. However, neither the total PEPS-C score nor the expressive or receptive prosody sub-scores were correlated with conversational success.

Conclusions: The results of this study suggest that prosodic ability does not impact how effective children and adolescents – regardless of ASD diagnosis - are in goal-oriented conversation.

414.077 *(Poster)* The Role of Imageability in Early Word Learning of Children with Autism Spectrum Disorder

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Background: Throughout typical development, children rely on perceptual, social, and linguistic cues to learn words (Hollich et al., 2000). Early words are often perceptually salient and highly imageable, with nouns dominating children's early lexicons (Gentner, 1982; Fenson et al., 1994). Imageability quantifies the perceptual salience of a word by rating the ease in which it evokes a mental image and is a strong predictor for word acquisition in TD children (McDonough et al., 2011). Children with autism spectrum disorder (ASD) often have delayed language acquisition compared to their typically developing (TD) peers, characterized by intact lexical mechanisms but differences in linguistic processing (Charman et al., 2003; Arunachalam and Luyster, 2015). Individuals with ASD have difficulty learning words with multiple, ambiguous conceptual representations and demonstrate an atypical reliance on perceptually-based processing for words with low imageability (Schafer et al., 2013; Kana et al., 2006, Gaffrey et al., 2007). This study contributes preliminary data on the lexicosemantic features that facilitate early noun and verb learning in children with ASD.

Objectives: The purpose of this study was to investigate the extent to which imageability predicts early noun and verb acquisition in children with ASD.

Methods: Secondary data analyses were conducted using data obtained from the NIH supported National Database for Autism Research (NDAR) (NIMH Data Archive Collection ID #2368) and a previous longitudinal study (Lord, Luyster, Guthrie & Pickles, 2012). The productive vocabularies of 157 children with ASD (13-107 months of age) were measured using the MacArthur Bates Communicative Development Inventory (MB-CDI; Fenson et al., 2007). Most children contributed multiple data points, yielding 379 data points from the 157 children. To prevent item repetition, only the MB-CDI Words and Sentences Form was used. One hundred twenty-three items (78 nouns, 45 verbs) were included in our analysis based upon the overlap of MB-CDI words and published imageability ratings from Masterson & Druks (1998).

Results: Preliminary results indicate that the average imageability of words produced was significantly negatively correlated with total words produced ($r = -.732$, $p < .01$), suggesting that the first words acquired were highly imageable. This pattern held across word class; however, imageability was more strongly correlated with total nouns than total verbs. The average imageability of nouns had a strong negative correlation with total nouns produced ($r = -.949$, $p < .01$), while average imageability of verbs was moderately correlated with total verbs produced ($r = -.367$, $p < .01$).

Conclusions: Consistent with literature on TD children, these results demonstrate that the first words – both nouns and verbs – of children with ASD are ones that are highly imageable. As children with ASD become more proficient word learners, they appear to depend less on imageability. These findings support that children with ASD rely on similar word-learning strategies as their TD peers, and point to the importance of multimodal, visual input (e.g., photographs, videos, animations, etc.) for establishing mental images during early word learning for children with ASD (Schlosser et al., 2012).

414.078 *(Poster)* The Roles of Pragmatic Language and Theory of Mind in the Adaptive Communication Skills of Children with and without Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) exhibit marked social communication impairments (APA, 2013). Research suggests these deficits often lead to delays in adaptive functioning, such as adaptive communication (AC; Bolte & Poustka, 2002). These adaptive outcomes have also been related to later social skills deficits and ASD symptom severity (Billstedt et al., 2007). It is important to study factors that predict low AC outcomes in order to develop targeted interventions. Several factors such as pragmatics and theory of mind (ToM) have been shown to predict later adaptability (Bennett et al., 2013). These constructs are most often examined in samples of older children (Bennett et al., 2013; Whyte & Nelson, 2015). They have yet to be examined in a sample of younger children using a typically developing (TD) control group.

Objectives: The aim of this study was to examine the direct and indirect effects of pragmatic language and ToM in the AC of young children with and without ASD.

Methods: The sample consisted of 13 children with ASD and 24 children with TD ages 3:0 to 6:5. AC was measured by the *BASC-2*. Pragmatic language was assessed by the *CASL*. ToM was measured through a laboratory task battery. Verbal abilities were measured by the *DAS-II* Verbal Cluster. Children needed to have average or greater Verbal Cluster scores in order to participate in study.

Results: A serial mediation analysis was conducted using the SPSS macro PROCESS to examine the direct and indirect effects of pragmatics and ToM on the association between status (i.e., ASD vs TD) and AC. Covariates included gender, age, and verbal abilities. Results indicated significant direct effects of status on AC [$F(1, 35) = 28.61$, $p < .001$], status on pragmatics [$F(1, 35) = 8.17$, $p = .001$], and pragmatics on ToM [$F(1, 35) = 7.03$, $p = .01$]. Results did not support the hypotheses that the relation between status and AC would be mediated by pragmatics alone, ToM alone, or pragmatics predicting ToM. Post-hoc analyses were conducted to examine levels of clinical importance for the measures that showed significant group differences (i.e., pragmatic language and AC). Analyses revealed that only children with ASD had at-risk or clinically significant pragmatic and/or AC skills.

Conclusions: Initial findings supported my hypotheses that children with ASD would exhibit lower AC and pragmatics than children with TD. Results did not support my hypothesis that pragmatics and ToM would mediate the relation between status and AC. Exploratory analyses showed that only children with ASD exhibited pragmatics and AC scores that fell into the range of clinical importance. Specifically, almost two-thirds of the children with ASD exhibited clinically important levels of AC, pragmatics, or both. These results suggest that children with ASD who demonstrate average or greater structural language scores (e.g., *DAS-II* inclusion criteria) may still exhibit significant AC and pragmatics challenges. These results suggest children with ASD as young as three years may benefit from treatment targeting pragmatics and AC. Previous literature shows this may improve overall adaptive functioning (Bennett et al., 2013).

414.079 *(Poster)* The Social Orienting Continuum and Response Scale (SOC-RS) with Bilingual Preschool Children with ASD

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Background: The development of communication, or lack thereof, is integral to diagnosing children with Autism Spectrum Disorders (ASD), (American Psychiatric Association, 2013). Families of ASD children have received advice discouraging exposure to multiple languages (Kremer-Sadlik, 2005). The relationship between language development in ASD children and exposure to multiple languages has been investigated in recent years (Hambly & Fombonne, 2012). These studies suggest that language in children with ASD is not adversely affected by exposure to multiple languages. Furthermore, for typically developing children, bilingualism has practical and economic gains, as well as several cognitive advantages (Kuhl, 2016).

Objectives: We examined the Social Orienting Continuum and Response Scale (SOC-RS; Mosconi et al., 2008) to assess the communicative development of preschoolers with ASD to further our understanding of the relationship between bilingual language exposure and social-communication.

Methods: Children with ASD (N=53), aged 37 to 59 months, from bilingual and monolingual families were selected. At Time 1 (T1), 25 bilingual and 28 monolingual ASD children were included. At Time 3 (T3), 16 bilingual children and 24 monolingual ASD children had data available. The study included the ADOS-2 (Lord et al., 2012), nonverbal cognition (Mullen Scales of Early Learning; Mullen, 1995), and expressive and receptive language (Preschool Language Scale IV; Zimmerman et al., 2002) measures. Measures were administered in English. Coding of the SOC-RS was done from video analysis; including 23 behavioral and 3 state codes. SOC-RS was developed by Mosconi et al. (2008) for additional coding of social communication abilities during the ADOS; our team updated the coding manual and added codes related to language.

Results: ANOVA's were used for analysis. The ASD bilingual (Bi) and monolingual (Mono) children revealed no significant differences on all 23 SOC-RS behavioral codes. There were no significant differences between the two groups on the SOC-RS *language, joint attention response,* and *orienting to name* codes. The ASD-Bi children differed from the ASD-Mono children on several items: (A) ASD-Bi produced more *echolalia* at both T1 (M Bi=2.86 SD=2.8; M Mono=1.6, SD=2.6) and T3 (M Bi=3.88 SD=4.3; M Mono=2.33; SD =4.7), (ps=.100 to .298); (B) The ASD-Bi children produced slightly more *joint attention eye gaze* at both T1 (M Bi=.28 SD=.614; M Mono=.25, SD=.585) and T3 (M Bi=2.13 SD=1.8;M Mono=2.08, SD=2.0), (ps=.334 to.934), and *joint attention point* at T3 (M Bi=.80 SD=1.14; M Mono=.48, SD=1.0), (ps=.765 to .372); (C) The ASD-Bi scored higher on *orienting to name experimenter* at both T1 (M Bi=1.20, SD=2.1; M Mono=.57, SD=.742) and T3 (M Bi=.87, SD=.640; M Mono=.72, SD=.843), (ps=.157 to.565).

Conclusions: Our findings suggest that bilingualism does not negatively impact early social communicative behaviors such as joint attention and language in young children with ASD and may, result in more joint attention behaviors and language. The results provide additional support for maintaining bilingualism in children with ASD. We note that all measures were conducted in English and that children had at least 50% environmental exposure to English, thus inclusion of children with broader language exposure and administration of measures in multiple languages are needed.

414.080 *(Poster)* The Utility of Automated Vocalisation Indices Collected in a Clinical Setting for Preschool Children on the Autism Spectrum.

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Background: There is a growing understanding of the need to capture abilities of children with autism using multiple instruments (Kasari et al., 2013; Neville et al., 2017; Plesa Skwerer et al., 2016). Automated vocalisation indices (AVI), such as the Language ENvironment Analysis (LENA®) software, can provide a low burden tool for capturing child language, which may provide additional insight into their language profiles. Designed for use with children aged between 2 and 48 months, LENA® produces several metrics, including key child vocalisations (CVs), conversational turns (CTs), with novel measures such as vocalisation ratios (VRs: comparison of speech vs. non-speech vocalisations) and reciprocal conversational turns (RCTs: a more social measure of language which examines a three-part conversational contingency) also able to extracted. While LENA® was developed to capture whole day recordings of children in naturalistic settings, we need to determine the validity of LENA metrics in clinical practice settings where children are often seen (Harbison et al. 2018).

Objectives: In the context of children with autism receiving group-based early intervention, we sought to explore the validity of AVI (i.e., CV, RCT, and VR) collected during short 1:1 clinical interactions in relation to other commonly-used standardised language measures.

Methods: LENA recordings were collected for 53 children (*M*=26 months, *SD*=6.9 at time of first recording; 35 boys, 18 girls) enrolled in a group-based Early Start Denver Model (G-ESDM) intervention program, between 2015 and 2018. Language samples were captured during a 1:1 unstructured play-based interaction (*M*=53.53 min, *SD*=15.86 mins) with an adult at the beginning of the intervention year. These interactions provided naturalistic opportunities for the child to spontaneously vocalise and take turns in conversation. Data were extracted and processed using specialised software in preparation for analysis. Autism symptomatology, developmental abilities and adaptive behaviours were collected using the Autism Diagnostic Observation Schedule (ADOS), Mullen Scales of Early Learning (MSEL), and Vineland Adaptive Behaviour Scales (parent interview; VABS) respectively, also administered pre-intervention.

Results: Analyses revealed moderate positive correlations between average CVs and age equivalence scores in receptive and expressive subscales of the VABS (r=.338, p=.014; r=.357, p=.009), and a moderate negative association with overall language scores on the ADOS (r_s=-.433, p=.001). VRs were moderately positively associated with both verbal and non-verbal DQ (r=.356, p=.010; r=.320, p=.005), and age equivalence scores in receptive and expressive subscales of the VABS (r=.344, p=.013; r=.381, p=.005), with a moderate negative association with language scores on the ADOS (r_s=-.315, p=.024). Moderate positive correlations were found between average RCTs and age equivalence scores in receptive, and relationship subscales of the VABS (r=.348, p=.012; r=.333, p=.016), with a moderate negative association with language scores on the ADOS (r_s=-.395, p=.004).

Conclusions: The findings provide preliminary evidence that novel LENA AVIs collected during brief individual play-based interactions with a clinician may be a valid and useful measure of children's naturalistic language abilities that may not be captured by standardised assessments such as the MSEL. Additional data on a larger cohort of children will be available by INSAR 2020.

414.081 *(Poster)* Using Mlu to Evaluate the Reliability of ADOS Transcription

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Background: Despite the recommendation of publishing transcription protocol and annotator reliability for data generated from a speech corpus, most research does not include that information. Re-transcribing and directly comparing transcripts requires a very costly and labor intensive undertaking. Instead of using word-by-word re-transcription, Mean Length of Utterance in Morphemes (MLUM) can be easily calculated from transcripts and used as a reliability measure for intra- and inter-transcriber comparisons.

Objectives: Develop a computational method to determine transcriber consistency across a large speech corpus, beginning with an initial assessment of intra-annotator reliability.

Methods: Participants were recruited for an fMRI study at OHSU. Inclusion criteria were: age 7 to 17, IQ ≥ 70, having fluent/phrase speech, being native English speakers. The main data used in this study consist of the Autism Diagnostic Observation Schedule (ADOS-2) Module 3 that was administered at baseline. All administrations were recorded and transcribed according to transcription guidelines based on conventions used by Systematic Analysis of Language Transcripts (SALT) software. Transcripts for three tasks were selected: *Emotions*, Social Difficulties and *Annoyance*, and *Friends* and Marriage Conversations. Each activity for each child was split into two parts by selecting even and odd lines. MLUM was then calculated for each part. Intra-annotator agreement was evaluated using the intraclass correlation (ICC) calculated for two-way mixed effects models, single measurement, absolute agreement type.

Results: The sample comprised 57 children with ASD (mean age:11.3 years; 78.9% male; mean IQ: 101.7) and 60 controls without ASD (mean age:11.4 years; 56.7% male; mean IQ: 111.9). Across tasks and groups, means MLUMs ranged from 5.6 to 6.7 and mean number of utterances ranged from 43.2 to 72.8. ICC between the even and odd MLUM was 0.714 for *Emotions* (95% CI: 0.613 < ICC < 0.792), 0.624 for *Annoyance* (95% CI: 0.5 < ICC < 0.723), and 0.708 for *Friends* (95% CI: 0.604 < ICC < 0.788), indicative of moderate to good levels of reliability (see Figure). Paired-t-tests between the MLUM halves were all non significant, indicating very good within task intra-rater agreement between the two randomly generated MLUM estimates. When examined by ASD status, ICC did not differ significantly between the two groups although reliability in ASD was higher than for controls on the three tasks. Using age and IQ median splits (11.3 years and 110, respectively), we further established that age had no discernable effect on ICC across tasks, and that there was a trend for lower reliability on two tasks among subjects with higher IQ. However, all ICCs across age and IQ groups remained in the moderate (>.50) range.

Conclusions: Calculating MLUM for two random halves within each activity, while not ideal, provides an efficient and valid measure of intra-annotator reliability. Comparing this across an entire transcription team offers a substitute when full inter-annotator reliability is not feasible. We emphasize that all research conducted on speech corpora should present associated reliability data.

414.082 *(Poster)* Validation of a Behavioral Pitch-Discrimination Paradigm for Young Children with ASD

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Background: Research has consistently demonstrated that children with autism spectrum disorder (ASD) show enhanced auditory perception (e.g., Boets et al., 2014; Remington & Fairnie, 2017), perhaps reflecting Enhanced Perceptual Processing in the auditory domain (Mottron, et al., 2012). In older children, differences in perception may contribute to delayed language development (Eigsti & Fein, 2013), but behavioral measures of auditory discrimination are not appropriate for young children or those with developmental delays (Abramson & Lloyd, 2016; Schwartz et al, 2018).

Objectives: We introduce a validated behavioral pitch discrimination task, based on mouse models (Truong et al., 2015), which requires minimal verbal ability and which is appropriate for use in children ages 3-6 with developmental delays. In adults, we demonstrate the relationship between performance on (1) this novel task and (2) a well-studied pitch discrimination paradigm previously used with adults and adolescents. Second, we demonstrate the utility of this task for young children in a sample of typically developing children. These steps are critical precursors to testing the hypothesis that auditory acuity (e.g., particularly strong perceptual skills) predicts language delays in ASD.

Methods: In the two-alternative forced-choice (2AFC) pitch discrimination paradigm, participants heard pairs of 100ms pure tones and made a same/different judgment. Tone pairs differed by 3% (Easy), 2%, 1% (Hard), or 0% (Identical) of overall frequency. In the novel, child-friendly paradigm, participants listened to a pure tone of variable duration, followed by a 150ms cue tone which differed in frequency as in the 2AFC task. The participant's task was to respond to a subsequent visual target as quickly as possible. Pitch discrimination was operationalized as the RT difference to cued versus uncued trials. Data from 27 college students were collected to validate the novel methodology. Thirty typically-developing children (mean age=5.9) completed the children-friendly pitch-discrimination task.

Results: Table 1 displays correlations of adult accuracy (d') on the 2AFC paradigm and ΔRT on the child-friendly paradigm at each difficulty level. Performance across the two tasks was significantly correlated when tones differed by 3% (r=.41, p=.03) and 2% (r= .48, p=.01), but not by 1%, (r=.25, p=.19); d' values indicate that most participants were at chance at the 1% condition, consistent with prior findings in a typical group. For children, log(ΔRT) differed significantly across conditions, $F(2,58)=5.47$, $p<0.01$, suggesting sensitivity of this RT measure to the difficulty of the perceptual task; see Figure 1. Preliminary examination of results indicated marked performance variability across participants. In 12 participants with available language history, there was a trend-level relationship between task performance and first word milestones (r=-.50, p=.09).

Conclusions: Results suggest that this novel pitch discrimination task displays a moderately strong relationship with performance on a more traditional 2AFC task. Furthermore, results with young children displayed the expected pattern of results. This task minimizes cognitive requirements (e.g., auditory working memory, conceptual knowledge) which have impeded the behavioral characterization of pitch discrimination abilities in young children with ASD. Data collection assessing the relationship between language milestones and pitch discrimination in preschoolers with ASD is on-going.

414.083 *(Poster)* Visual Salience Increases Attention to Relevant Information in a Familiar Word Processing Task

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Background: Children with autism spectrum disorder (ASD) demonstrate differences in visual attention across both social and non-social domains. These attentional differences create situations in which the visual input children see is not directly related to the auditory input they hear—a phenomenon known as auditory-visual misalignment. Because it involves a mis-match of the auditory and visual statistics that are relevant for language learning, auditory-visual misalignment is hypothesized to contribute to vocabulary delays in children with ASD.

Objectives: The current study investigated whether increasing the salience of visual stimuli reduced the amount of auditory-visual misalignment experienced by children with ASD. Specifically, we tested whether making an image wiggle on the screen during an experimental word processing task would increase children's attention to relevant information.

Methods: The initial sample included 15 children with ASD; five were excluded from the analyses due to excessive missing data. The remaining 10 children were between 2 and 4 years of age (M = 39 months, SD = 10). ASD diagnoses were determined through parent report, the ADOS-2, and expert clinical judgment. On average, participants displayed considerable delays in language and cognitive skills and a high level of autism-related symptoms (ADOS-2 Comparison Score: M = 8.2, SD = 1, range = 6-10). Children took part in a looking-while-listening task that presented pairs of familiar images on a screen (e.g., a cookie and a dog), along with spoken language describing one of the images (e.g., *Where's the cookie?*). In the first 10 trials (the Static condition), neither image moved. In the second 10 trials (the Moving condition), the named image wiggled on the screen at the end of the trial.

Results: Accuracy was quantified as the amount of looking to the target (i.e., named) image, divided by the amount of looking to both images. Just after the target image was named (300-2000 ms after target noun onset), children's accuracy was .60 in the Static condition and .57 in the Moving condition, indicating recognition of the named image. Accuracy during this period (when images in both conditions were static) did not significantly differ between the two conditions. From 2400-4000 ms after noun onset—when the target image wiggled in the Moving condition—accuracy was significantly higher in the Moving condition (M = .81, SD = .18) than in the Static condition (M = .57, SD = .19; $p < .01$).

Conclusions: These findings provide evidence that increasing visual salience (i.e., making something more visually appealing) can reduce auditory-visual misalignment in children with ASD. In this way, manipulating visual salience may be a useful tool to maximize the likelihood that children with ASD are looking at the aspects of their environment that are most relevant for learning—in other words, the "right thing at the right time." These findings have implications for increasing auditory-visual alignment in both screen-based activities and everyday social interactions in ways that increase learning opportunities and facilitate vocabulary development in children with ASD.

414.084 *(Poster)* What Really Matters? Characterizing “the Presence of Useful Speech” in 5-Year-Olds with ASD

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Background: Eisenberg (1956) reported that “the presence of useful speech” at age 5 predicts later outcomes in individuals with Autism Spectrum Disorder (ASD). Numerous studies have since replicated this finding, but each provided a different, often vague definition of the predictive factor “useful speech” and reported varying results (see Table 1). Thus, the meaning of “useful speech” remains ambiguous, preventing the generation of clear conclusions about the importance of specific spoken language features in ASD.

Objectives: This exploratory study investigates which aspects of expressive language at age 5 best correlate with adult cognitive and language-related outcomes in individuals with ASD.

Methods: Data for this study come from a longitudinal dataset, as described in Lord et al. (2006). To date, videos of 20 5-year-olds with ASD completing the Pre-Linguistic Autism Diagnostic Observation Schedule (PL-ADOS; DiLavore, Lord, & Rutter, 1995) or the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) have been transcribed and coded for features of morphosyntax (mean length of utterance [MLU] in morphemes), lexical diversity (noun diversity, verb diversity) and pragmatics (number of communicative functions). Adult outcome measures include verbal IQ, nonverbal IQ, Peabody Picture Vocabulary Test Fourth Edition (PPVT-4; Dunn & Dunn, 2007) standard scores, ADOS algorithm communication and social totals, and Vineland Adaptive Behavior Scales II (VABS-II; Sparrow, Ciccheti, & Balla, 2005) Communication domain standard scores.

Results: Partial correlations controlling for age 5 nonverbal IQ were run between age 5 language features and adult outcome scores. Our age 5 measure of morphosyntax—MLU in morphemes—was significantly correlated with adult VABS-II communication scores (r=.62, p=.023), verbal IQ (r=.68, p=.01), and PPVT-4 standard scores (r=.65, p=.017), but not with adult nonverbal IQ or ADOS algorithm scores. A similar pattern was observed for one age 5 measure of lexical diversity, verb diversity, which was significantly correlated with adult VABS-II communication scores (r=.56, p=.046), verbal IQ (r=.64, p=.018), and PPVT-4 standard scores (r=.62, p=.023), but not with adult nonverbal IQ or ADOS algorithm scores. The other measure of vocabulary (noun diversity) and the measure of pragmatics (number of communicative functions) at age 5 were not significantly correlated with any adult measures.

Conclusions: These preliminary findings demonstrate that MLU in morphemes and verb diversity at age 5 were significantly associated with performance on adult language and communication measures in individuals with ASD. Noun diversity was not significantly correlated with performance on adult language measures, suggesting that the long-term significance of early vocabulary may depend partly on word type. Our measure of childhood pragmatics was not associated with adult language and communication outcomes.

414.085 *(Poster)* What's a Chinchilla? Question Asking in Children with ASD

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Background: In typical development, the tendency to ask questions emerges and peaks in the preschool and early school-age years. This skill is an important strategy for cognitive, linguistic and social development, as well as academic achievement. Although research suggested that children with Autistic Spectrum Disorder (ASD) may learn best from language that follows their attention and interests, little is known about the ways in which children with ASD use questions in their daily lives.

Objectives: We aimed to ascertain the frequency and content of question-asking in a semi-structured task (based on Greif et al., 2006) presenting images of objects and animals. This task emulates the activities that young children are often presented in classroom and home settings (e.g., book reading, “circle time” presentations, etc.).

Methods: English-speaking children with ASD 4.0-6.11 years old completed standardised diagnostic, IQ & language testing, and finally a semi-structured question-eliciting task on an iPad with images of unfamiliar animals and objects. Children were presented with an array of images and invited to ask questions; the examiner answered each question. Children were encouraged to ask as many questions they liked; the task was complete when the child had no further questions (Greif et al., 2006). Each session was transcribed, and the questions were coded by trained examiners according to question form, function and content.

Results: To date, we have completed data collection with 15 participants. The average age of the participants was 5.5 years old (SD=11 months); the group had average NVIQ (M=99.25; SD=30.04) and expressive language scores (CELF P2 Expressive Language Score M=99.25; SD=18.46). Our analyses are descriptive and compare our preliminary findings to data reported by Greif et al. (2006), who studied typically developing children slightly younger than our sample (the mean age in Greif et al. was 4.6 years old).

In terms of frequency, Greif et al. (2006) reported that, in their TD sample, children asked (on average) 26.1 questions during the task. Contrastingly, in our sample, children asked -- on average -- 7.93 questions (SD=7.65) during the task.

In terms of content, Greif et al. (2006) reported that their TD sample primarily asked questions about the names, function/behavior and categories of objects/animals. Similarly, in our results: out of a total of 119 questions asked by the children, 58 focused on names, and 36 queried function/behavior. However, only 5 addressed category membership.

Conclusions: Compared to typically developing children and using an identical task, children with ASD asked strikingly fewer questions. This discrepancy does not seem to be due to cognitive or language skills, which were both average. Nevertheless, the kinds of questions asked were similar, focusing on the names and traits of objects/animals. Interestingly, the children with ASD did not query category membership with the same regularity that the TD children did. Given the importance of question-asking for cognitive, linguistic, social and academic success, our findings suggest that supporting this skill in children with ASD is an important strategy for parents, caregivers and teachers.

414.086 *(Poster)* Why Are Parents Better Than Researchers at Eliciting Speech from Minimally and Low-Verbal Children and Adolescents with ASD?

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Background: Natural language samples (NLS) are an excellent source of information about the expressive language abilities of minimally and low-verbal (MLV) individuals with ASD, who often cannot go through standardized assessment procedures (Tager-Flusberg & Kasari, 2013). Yet, there are no agreed upon guidelines about the best way to elicit NLS from this population. One important avenue for investigation is the role of conversational partner, considering past research showing that children speak more with their parents than with trained examiners (in preschoolers Kover et al., 2014; in MLV Barokova & Tager-Flusberg, 2018 - SRCD). Yet, no study has examined potential differences between parent and examiner speech, and how they relate to child/adolescent speech.

Objectives: I. To compare the speech of parents to that of examiners. **II.** To examine associations between adult and child/adolescent speech.

Methods: Twenty-two (4 females) children and adolescents with ASD between the ages of 6;6 and 19;7 (M = 12;6) were included in this study. Standardized measures of language, communication, and nonverbal IQ were used: VABS, SCQ, and Leiter (Table1). Examiners in the lab and parents in their home collected a NLS following the same protocol (described in Barokova & Tager-Flusberg, 2017). Both parents and examiners had good administration fidelity. The parent- and examiner-NLS were transcribed following standard procedures (Miller et al., 2011). We have already reported that in these samples, MLV children and adolescents, on average, produced more utterances per minute and used a higher number of different words (NDW) when with their parents than with examiners. To compare parent vs. examiner speech across the language domains, we extracted adults' mean length of utterance (MLU) to assess syntax, NDW for lexical diversity, and number of statements, exclamations, and questions per minute for examine pragmatic function of utterances.

Results: I. No differences were found between parent and examiner MLU and NDW (all results in Table 1). On average, parents produced more statements per minute and asked more questions than examiners. In contrast, examiners made significantly more exclamations per minute than parents. **II.** No significant associations were found between participant frequency of utterances and any of the parent or examiner language measures. Participants' NDW was significantly correlated with examiners' MLU ($rs(20)= .590$, $p<.01$), but was not correlated with any of the parent language measures. Participants' frequency of utterances during parent and examiner samples was significantly correlated($rs(20)= .794$, $p<.01$), and so were their NDW ($rs(20)= .877$, $p<.01$).

Conclusions: Parent and examiner language did not differ in structural aspects, but differed in the number of utterances by pragmatic function. Despite these differences in the domain of pragmatics, adult speech was not related to child/adolescent speech. Nevertheless, MLV participants' language measures were significantly correlated across parent- and examiner-collected samples. This suggests that parents elicit more speech from their children not because of a unique characteristic of their speech, but perhaps due to familiarity or some non-verbal aspect of their communication. Although the role of familiarity has been assumed in the language sampling literature, it has not been shown empirically.

414.087 *(Poster)* "the Moral of the Story Is Don't Anger an Entire Hive of Bees": Narrative in ASD and First-Degree Relatives

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Background: Narration (i.e., storytelling) is a primary form of social communication, used to relate events and experiences in socially and psychologically meaningful ways. Narrative production is a well-documented challenge for individuals with ASD, with subtle differences also manifesting among their first-degree relatives, who often display subtle personality and social-communicative traits mirroring the core features of ASD (i.e., the broad autism phenotype, BAP). Prior work has also indicated atypical visual attentional patterns in individuals with ASD and their parents, and relationships between narrative abilities and visual attention (Lee et al., 2019).

Objectives: To disentangle known heterogeneity in the social-communicative profiles of ASD by implementing a detailed hand-coding system to sensitively quantify features of narrative and associated visual attention during narration impacted in ASD, and first-degree relatives who may display subclinical social communicative differences that index genetic liability to ASD.

Methods: Participants included 55 individuals with ASD and 49 controls, as well 161 parents of individual with ASD (ASD parents) and 61 parent controls. Participants narrated a wordless picture book presented on an eye tracker. Narratives were coded for key aspects of narrative ability including evaluation of characters' internal states (e.g., thoughts, emotions) and descriptions of key story scenes. Proportions of fixations and fixation duration towards social and nonsocial elements in the picture book were analyzed in relationship to narrative quality within groups.

Results: Individuals with ASD more often missed key story elements in their narratives ($p<.05$) and used fewer internal state terms than controls ($p<.05$). No significant differences emerged between parent groups. In individuals with ASD, visual attention to animate and inanimate aspects of the stimuli did not correlate with narrative scores, but they did in controls. In contrast, greater visual attention to animate features of narrative scenes was associated with greater usage of affective state terms and lower overall narrative quality in ASD parents.

Conclusions: Differences on key narrative parameters were detected in ASD but not in parents, underscoring the subtlety of subclinical BAP traits. Importantly, visual attention related to narrative parameters in all groups, highlighting the utility of eye tracking as a more sensitive measure to capture subclinical traits related to ASD. Specifically, proband controls and both parent groups provided richer narratives when attending more to inanimate elements of the picture book, suggesting that unlike individuals with ASD, these groups did not need to rely on illustrated social information to provide social details in their stories.

Communication and Language / Neuroimaging

ORAL SESSION — COMMUNICATION AND LANGUAGE / NEUROIMAGING
308 - Social and Language Learning; and Sex Differences

308.001 *(Oral)* Examining a Sequential Mediation Model Among Preschoolers with ASD: Playing, Engaging and Communicating

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Background: Early intervention can improve core social communication challenges including joint engagement (JE) and initiations of joint attention (IJA, Kasari et al., 2006). Gains in IJA have been linked to better language outcomes (Kasari et al, 2008). Increases in JE are hypothesized to be the mechanism by which children make gains in IJA and which lead to downstream improved language skills (Shih et al., 2017). In the JASPER early intervention approach, JE is improved through targeting play development. In this study the role of play diversity is examined as a potential sequential mechanism with JE in improving IJA (Figure-2).

Objectives: In this secondary analysis, we examine: 1-the mediating effect of play diversity on JE in the context of a JASPER trial (Figure-1), and 2- explore the sequential mediation effect of play diversity with JE on IJA (Figure-2).

Methods: Participants. 66 children were 50.26 months old (M = 50.26; SD = 6.38) and 89 % were male. Children ranged in developmental level at study entry (range 11.00–57.67 months; M = 35.41 months: MSEL mental age) and were of diverse ethnic backgrounds (69 % ethnic minorities) (Chang et al., 2016).

Intervention. Classrooms were randomized to immediate JASPER or waitlist (WL). JASPER teachers implemented JASPER 30 minutes a day with their students for 3 months, while teachers in the WL continued with school curriculum as usual for 3 months.

Measures. Ten-minute teacher-child interactions were videotaped at entry, exit, and follow up and coded by independent blinded assessors for the duration of children's joint engagement and initiations of joint attention.

Structured Play Assessment (Lifter and Bloom, 1989). The number of unique spontaneous play types and their frequency were coded based on 16 levels of functional and symbolic play. Total play diversity is the sum of unique spontaneous play types across levels.

Results: Mediation analyses (Preacher & Hayes, 2008) was used to explore the potential mediating effect of play diversity on JE and sequential mediation effect with JE on IJA in a JASPER intervention.

There was a significant treatment difference in total play diversity, joint attention, and joint engagement where children in the JASPER intervention made significantly more improvements compared to WL children (Chang et al., 2016). Total play diversity was significantly associated with JE (p=0.002). and IJA (p=0.047) even after adjusting for the treatment effect suggesting that play diversity may be a mechanism of change for increasing JE and IJA (Figure-1,2). However, after adjusting for JE (i.e. downstream skill) and treatment, play diversity is no longer significantly associated with IJA (p=0.325; Figure-2). Consequently, play diversity mediated the effect of treatment on IJA and may be an upstream development skill prior to JE.

Lastly, IJA was significantly associated with expressive (p=0.01) and receptive language (p=0.025).

Conclusions: These results suggest that play diversity is a potential path by which increases in young children's JE influences the development of IJA. These findings highlight the need to maximize both play skills and JE in order to foster development in more distal core challenges such as IJA and language.

308.002 *(Oral)* Community Implementation of the Social ABCs Parent-Mediated Toddler Intervention: Domains and Drivers of Treatment Response

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Background: Advances in the dissemination of parent-mediated intervention for toddlers with autism spectrum disorder (ASD) require evidence of effectiveness beyond randomized control designs conducted in tightly controlled laboratory settings.

Objectives: To evaluate the effectiveness of a parent-mediated intervention for toddlers with confirmed or suspected ASD in a large community implementation. The Social ABCs^{TM} parent-mediated intervention (supported by published RCT evidence) was one of four models funded through a government demonstration initiative in Ontario, Canada (2016-2019). We build on preliminary data presented orally at INSAR 2019, now with a complete data set and novel analyses of outcomes and predictors.

Methods: The Social ABCs^{TM} developers trained 6 front-line staff ("coaches") to deliver the intervention through a regional service-provider in Hamilton Ontario (pop. 500,000; 24% born outside Canada). Coaches attained fidelity, and 136 families completed the 12-week 1:1 coaching program (with follow-up at week 24). Participants included 98 boys (72%) and 38 girls (28%); mean age 25.36 months (range = 14-34 months). Coached parents included 118 mothers, 11 fathers, and 7 grandmothers; 35% had full-time employment and 22% reported having English as a subsequent language (ESL). Thirty-seven toddlers (27%) were in full-time daycare. Measures included video-coded indices (parent implementation fidelity and toddler responsivity to parent language opportunities) and standardized measures at baseline and 6 months later: Vineland Adaptive Behavior Scales (VABS-II), Mullen Scales of Early Learning (MSEL), and Autism Diagnostic Observation Schedule-2 (ADOS-2).

Results: Repeated measures ANOVA revealed significant increases in parent fidelity ($F_{(1,78)} = 1344.58$, $p < .001$) and toddler responsivity ($F_{(1,63)} = 113.89$, $p < .001$) from week 1 to 12. Parent week-12 fidelity exceeded our target of 75% ($M = 79.60$) and significantly predicted toddler responsivity ($p = .024$). ADOS-2 revealed significant decreases in symptoms in the Social Affect domain ($M = 12.97$ vs. 10.91; $t = 4.51$, $p < .001$), but not the Restricted/ Repetitive Behavior domain ($p = .56$). MSEL age equivalents (AE) for both Receptive and Expressive Language improved significantly (p's < .001), and MSEL standard t-scores also increased significantly for Receptive ($p = .001$) but not Expressive Language ($p = .52$), which remained stable over time. Standard scores for VABS-II Communication (but no other domain) increased significantly ($p < .001$). Toddlers' receptive and expressive language levels at baseline significantly predicted week-12 responsivity (p's < .02), but did not predict *change* in responsivity (p's > .50). No demographic variables (sex, parent coached, ESL status, daycare attendance) predicted parent fidelity or toddler outcomes.

Conclusions: Findings demonstrate the feasibility and effectiveness of the Social ABCs™ within a large community implementation. Parents exceeded our fidelity target and toddlers made significant gains on video-coded and standardized measures. Indeed, on some measures, toddlers made gains at a greater rate than expected by development alone, as indexed by standard score increases. Findings support the effectiveness of brief parent-mediated intervention for a wide range of families and their toddlers with emerging or confirmed ASD within a community service-delivery model.

308.003 *(Oral)* Trajectories and Timing of English Proficiency Among English Language Learners with ASD in Schools

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Background: In 2015, approximately 4.8 million students – 9.5% - were identified as English language learners (ELL) in the U.S. Early work has revealed disproportionate representation of ELLs in the autism designation, however studies have yet to evaluate trajectories and timing of English proficiency and service use among students with autism spectrum disorder (ASD) in schools.

Objectives: The present study aimed to examine differences in the development of English proficiency and service use by educational placement among students with ASD by (1) identifying changes in English language proficiency by classroom placement, (2) examining the probability of continued ELL classification by classroom placement and (3) identifying the top services received by students classified as ELL.

Methods: The current study utilized annual longitudinal special education administrative record data including students served under a primary eligibility of autism from the academic years 2011-2012 through 2016-2017. Primary placement (>50%) for each student was classified as *general education* (GE) or in a dedicated *special day class* (SDC). The percentage of students who transitioned from ELL to English proficient was computed for GE and SDC. For students who transitioned to English proficient, mean age of classification change was computed. Kaplan Meier curves were generated to determine the probability of students remaining classified as ELL across time (measured by student age) for GE and SDC, respectively. Finally, top three services used by students in GE and SDC classes were tabulated.

Results: Of the students with ASD in GE, 25.9% (N=1624; 86% male, 86% Hispanic/LatinX, M_{age}=8.96, $M_{observations}$=3.7) were classified as ELL at the time of their first observation. Of the students with ASD in SDC, 43.7% (N=684; 86% male, 91% Hispanic/LatinX, M_{age}=10.14, $M_{observations}$=3.65) were classified as ELL at first observation. Only 31% of students classified as ELL in GE at their first available observation were English proficient by the time of their last observation. The mean age at which students in GE transitioned to English proficient was approximately 11.8 years old. Only 15% of students classified as ELL in SDC at their first available observation were English proficient by the time of their last observation. The mean age at which students in SDC were no longer classified as ELL was approximately 13.2 years old. Kaplan Meier curves (Figures 1a and 1b) revealed that the probability of classification as ELL decreased as students aged, plateauing at ~70% probability of continued classification as ELL around age 8 through age 18 for GE and at ~80% probability of ELL classification for SDC around age 9. Finally, for both students in GE and SDC classes, Language and Speech, Counseling and Guidance, and Occupational Therapy were the most frequent services received.

Conclusions: The present study revealed the striking number of students with ASD classified as ELL who are served in a large urban school district. A minority of ELLs with ASD gain English proficiency by middle childhood, a finding most notable for students in SDC placements. Future work is required to identify methods to best support ELLs with ASD in schools.

308.004 *(Oral)* Neuro-Biological Sex Differences in the Autistic Brain: A Systematic Review

K. Mo[1,2], *T. Sadoway*[3], *S. Bonato*[2], *S. Ameis*[1,2], *E. Anagnostou*[1,4], *J. P. Lerch*[1,5,6], *M. J. Taylor*[1,6] *and M. C. Lai*[1,2], *(1)University of Toronto, Toronto, ON, Canada, (2)Centre for Addiction and Mental Health, Toronto, ON, Canada, (3)Pediatric Laboratory Medicine, The Hospital for Sick Children, Toronto, ON, Canada, (4)Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada, (5)Wellcome Centre for Integrative Neuroimaging, University of Oxford, Oxford, United Kingdom, (6)The Hospital for Sick Children, Toronto, ON, Canada*

Background: Our current understanding of autism is largely based on clinical practice and studies involving males given (1) the male predominance in prevalence and (2) females are often under-recognized and diagnosed cases frequently present with co-occurring epilepsy and low intelligence quotient and likely excluded from studies. As a result, there is a significant "male lens" in this field and females with autism are often poorly understood. To date, the effects of sex in brain development in autism has not been well-defined.

Objectives: To undertake a systematic review to 1) provide an overview of the literature that examines sex differences in the brain of individuals with autism and 2) summarize key brain areas with reported sex differences in autism.

Methods: Inclusion criteria: peer-reviewed studies of the brain involving samples of participants with an autism diagnosis that exclude case series. Databases (including EMBASE, Medline, PsycINFO, and Web of Science) were searched using relevant subject headings and keywords for concepts of 'sex' OR 'gender' AND 'autism' AND 'brain'. The risk of bias assessment tool (Hoy et al. 2012) was used to evaluate internal and external validity by two independent raters.

Results: The search generated a total of 10,095 articles (including grey literature, n=92). After removing duplicates (n=3,140), 6,863 unique articles were reviewed for relevance. 2,051 articles were screened by title and abstract and categorized by subject to give an overview of the current research landscape. After screening (n=1,188 removed), 863 articles were assessed for eligibility by full-text review. 66 neuroimaging studies that included analysis of sex and/or gender variables were retained for qualitative synthesis. Included papers varied in methodology and neuroimaging modalities (e.g., diffusion MRI, resting-state/task fMRI, structural MRI) and analysis of sex and/or gender variables. A total of 25 studies reported a significant result from analysis of sex-by-diagnosis interactions and/or sex-stratified analysis. Due to high heterogeneity in study design and participant demographics, very few studies were available for comparison and there was no clear consensus for specific areas of the brain with sex-modulating effects. One notable finding was the right inferior fronto-occipital fasciculus where two studies reported sex-by-diagnosis interaction effects; however, the direction of findings differed as one reported greater fractional anisotropy (FA) in teenage males with autism and the other reported lower FA in adult males with autism. In addition, there was a lack of studies that examined the effect of gender and lack of clear differentiation between sex and gender in these studies.

Conclusions: This systematic review demonstrates a significant research gap in sex-modulating effects in the autistic brain. The few available studies do not point to any well-supported brain regions with consistent sex-modulating effects. Studies so far may be underpowered to detect sex-by-diagnosis interaction effects and this information suggests a greater need for future investigations of sex-based heterogeneity with larger sample sizes. Future studies should also measure and investigate the effects of gender. Understanding the effect of biological sex in the risk of autism is an imperative first step to extend beyond the male lens in this field.

Diagnostic, Behavioral, Sensory and Intellectual Screening and Assessment

PANEL SESSION — DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT

205 - Finally Capturing the Whole Picture: An Update on ICF Research in Autism

Panel Chair: Sven Bolte, *Center of Neurodevelopmental Disorders (KIND), Centre for Psychiatry Research; Department of Women's and Children's Health, Karolinska Institutet, & Stockholm Health Care Services, Region Stockholm, Stockholm, Sweden*

Discussant: Sonya Girdler, *School of Occupational Therapy, Social Work and Speech Pathology, Curtin University, Perth, WA, Australia*

Traditionally, autism spectrum disorder (ASD) is assessed almost exclusively from the clinical symptomatology perspective. Still, for autistic individuals, their families and large parts of society, the impact on functioning is both more significant and accessible Unfortunately, the diagnostic manuals provide no qualification as to how this impact should be assessed in more detail. The International Classification of Functioning (ICF) provides a bio-psycho-social framework for conceptualising functioning and health. The ICF takes a holistic perspective of disability, aligning with contemporary views of the functioning of autistic individuals, as resulting from an interaction of autistic symptomatology, participation within major life areas and many environmental facilitators and barriers. The ICF also provides a framework which focuses our attention on not only disability, but also the strengths and abilities of autistic individuals as a personal factor. This panel will present international research from Sweden, Australia and South Africa, which have utilised the ICF and the ICF core sets for ASD to further improve our understanding of functioning capturing the whole picture.

205.001 *(Panel)* The Whole Functional Picture of Autism: Development and Future Plans for the ICF Core Sets

***S. Bolte**, Center of Neurodevelopmental Disorders (KIND), Centre for Psychiatry Research; Department of Women's and Children's Health, Karolinska Institutet, & Stockholm Health Care Services, Region Stockholm, Stockholm, Sweden*

Background: Autism spectrum conditions are associated with diverse social, educational, and occupational challenges. To date, no standardized, internationally accepted tools exist to assess autism–related functioning. The World Health Organization's International Classification of Functioning, Disability and Health can serve as foundation for developing such tools.

Objectives: This lecture will review the development of the recently published ICF core sets for autism (Bölte et al., 2019; *Autism*), based on four international preparatory studies, and current efforts to validate the core sets, and derive psychometrically sound assessment tools from the sets for research, clinical, educational and vocational practice.

Methods: The core sets are based on four preparatory studies, a systematic review, an expert survey, a qualitative study, and a clinical study, involving several hundred researchers, clinicians and stakeholders from multiple disciplines and all WHO regions. The core sets have been validated (Schiariti et al., 2018; *Dev Med Child Neurol*; Black et al., 2019; *Aut Res*). Currently, the core sets for autism are further validated in different contexts (e.g. employment), translated into hands-on computer-based psychometric instruments using a Delphi method, iterative approach involving clinical, educational and vocational organizations in Sweden and in different WHO regions to establish reliability and validity.

Results: The ICF core sets for autism contain 111 second-level ICF categories in the comprehensive ore sets, and 60 in the common brief core set comprised 60 categories, while the age-appropriate core sets included 73 categories in the preschool version (0- to 5-year-old children), 81 in the school-age version (6- to 16-year-old children and adolescents), and 79 in the older adolescent and adult version (⩾17-year-old individuals). The majority of categories in the core sets describe participation and the environment. The core sets show good diagnostic validity against ADHD and cerebral palsy, and a high coverage (90%) for issues around employment of autistic people. Derived scales will use a pool of items to operationalize the core set categories, applying the ICF Research Branch numeric scale, and artificially intelligent solutions for use on mobile devices.

Conclusions: Past and current ICF core set research demonstrates the core set's potential to meaningfully complement categorical clinical information from DSM-5 and ICD-11 to achieve a thorough assessment of impairment and environmental barriers, on one hand, and facilitators and individual strengths, on the other. The latter will improve treatment planning, reimbursement systems, and communication among professionals and stakeholders.

205.002 *(Panel)* Development and Piloting of ICF Core Set Based Assessment of Functioning Tools for Young People Diagnosed with Autism or Other Neurodevelopmental Conditions

S. J. Girdler[1], *E. D'Arcy*[2], *M. Hayden-Evans*[3], *A. Chamberlain*[4], *B. T. Milbourn*[1], *A. O. Whitehouse*[5], *S. Bolte*[6], *V. Eapen*[7], *J. Wray*[8] *and K. Evans*[9], *(1)School of Occupational Therapy, Social Work and Speech Pathology, Curtin University, Perth, WA, Australia, (2)Cooperative Research Centre for Living with Autism (Autism CRC), Brisbane, Australia, (3)School of Occupational Therapy, Speech Pathology and Social Work, Curtin University, Perth, WA, Australia, (4)Autism Research Team, Telethon Kids Institute, Perth, Australia, WA, Australia, (5)Telethon Kids Institute, University of Western Australia, Perth, WA, Australia, (6)Center of Neurodevelopmental Disorders (KIND), Centre for Psychiatry Research; Department of Women's and Children's Health, Karolinska Institutet, & Stockholm Health Care Services, Region Stockholm, Stockholm, Sweden, (7)Cooperative Research Centre for Living with Autism (Autism CRC), Long Pocket, Brisbane, Australia, (8)State Child Development Service, Western Australia Department of Health, Perth, Western Australia, Australia, (9)Telethon Kids Institute, University of Western Australia, Perth, Western Australia, Australia*

Background: Children and adults on the autism spectrum experience a range of activity limitations and participation restrictions, impacting on daily life and long term role outcomes. International guidelines recommend that functioning be evaluated as part of a diagnostic evaluation, and both the DSM-5 and ICD-11 include functioning related diagnostic criteria for autism spectrum disorder (ASD). The 'Australian National Guideline for the Assessment and Diagnosis of ASD' advocates a strengths-focused and comprehensive assessment of functioning and support needs for all individuals referred for an assessment of ASD concerns. This Australian guideline suggests the International Classification of Functioning, Disability and Health (ICF) as a conceptual framework for an assessment of functioning, along with the use of standardised assessments that cover a broad range of domains, with a suggestion for researchers to develop and validate a fit-for-purpose tool based on the ICF Core Sets for ASD.

Objectives: This program of research aimed to develop and validate assessment of functioning tools based on the ICF Core Sets for ASD that are suitable for individuals on the autism spectrum across the lifespan and available in clinician-administered, self-report and proxy-report versions.

Methods: Prototype assessment of functioning tools were developed in clinician-administered, self-report and proxy-report versions with input from researchers, clinicians and the autism community (n>37). These prototype tools include simplified definitions, examples and symbolic images for each of the ICF Core Sets for ASD items. The clinician-administered version was piloted with at least 75 parents/caregivers of young autistic individuals up to 20 years of age (alongside the PEDI-CAT and Vineland, two established standardised tools). Feedback on the clinician-administered version was also obtained from parents/caregivers (n>30) on acceptability and clinicians (n>30) on clinical utility. The self-report and proxy-report versions will be piloted with autistic adolescents/adults and parents/caregivers of autistic individuals of all ages (expected n>50) between January – March 2020 and feedback will be sought regarding acceptability.

Results: Preliminary psychometrics properties of the clinician-administered version suggest that most activity and participation domains have good to excellent internal consistency, along with excellent inter-rater reliability at the item level. Parent/caregivers and clinicians provided early feedback that the clinician-administered version was holistic and strengths-focused, although time-consuming, and a full set of psychometric properties and normative data for a manualised final version would be necessary prior to wide spread adoption. Further investigation of the psychometric properties and usability of the clinician-administered, self-report and proxy-report versions will be available at the INSAR meeting.

Conclusions: These prototype assessment of functioning tools represent an important first step in operationalising the ICF Core Sets for ASD, which will provide a suite of comprehensive assessment of functioning tools that are feasible and acceptable to the autism and clinical communities.

205.003 *(Panel)* Formalising an Assessment of Functioning Process for Individuals Undergoing an Autism Diagnostic Evaluation and/or Service Planning in Australia

K. Evans[1], *A. Chamberlain*[2], *S. J. Girdler*[3], *B. T. Milbourn*[3], *E. D'Arcy*[4], *M. Hayden-Evans*[5], *S. Bolte*[6], *V. Eapen*[7], *J. Wray*[8] *and A. O. Whitehouse*[9], *(1)Telethon Kids Institute, University of Western Australia, Perth, Western Australia, Australia, (2)Autism Research Team, Telethon Kids Institute, Perth, Australia, WA, Australia, (3)School of Occupational Therapy, Social Work and Speech Pathology, Curtin University, Perth, WA, Australia, (4)Cooperative Research Centre for Living with Autism (Autism CRC), Brisbane, Australia, (5)School of Occupational Therapy, Speech Pathology and Social Work, Curtin University, Perth, WA, Australia, (6)Center of Neurodevelopmental Disorders (KIND), Centre for Psychiatry Research; Department of Women's and Children's Health, Karolinska Institutet, & Stockholm Health Care Services, Region Stockholm, Stockholm, Sweden, (7)Cooperative Research Centre for Living with Autism (Autism CRC), Long Pocket, Brisbane, Australia, (8)State Child Development Service, Western Australia Department of Health, Perth, Western Australia, Australia, (9)Telethon Kids Institute, University of Western Australia, Perth, WA, Australia*

Background: An international review of autism diagnostic guidelines revealed functioning as an important topic to evaluate during a diagnostic evaluation, however varied emphasis was placed on an assessment of functioning as a necessary component. The 'Australian National Guideline for the Assessment and Diagnosis of Autism Spectrum Disorder' (ASD) articulates an assessment of functioning as the first step when an individual is referred for an assessment of ASD concerns. This assessment of functioning:

- may be undertaken by a range of medical/allied health professionals with relevant training and expertise in specified areas;

- should cover a broad range of domains of functioning, activity and character related strengths, environmental barriers and facilitators, and both observed and expressed support needs;
- should involve information collection within natural contexts through multiple methods (e.g. interviews, observations, standardised assessment tools; and,
- outcomes should include specific support needs and connection with appropriate services.

The Australian guideline concludes with a recommendation for researchers to investigate the psychometric properties of existing tools that assess functioning.

Objectives: This program of research aimed to investigate the psychometric properties and usability of existing standardised assessment of functioning tools, specifically the Vineland-3 and PEDI-CAT (ASD).

Methods: All items from the Vineland-3 and PEDI-CAT (ASD) were linked to the International Classification of Functioning, Disability and Health – Children and Youth (ICF-CY) using established rules. Feedback from clinicians (n>30) regarding the clinical utility of the Vineland-3 and PEDI-CAT tools was obtained through focus groups. Clinical assessments were conducted with approximately 170 parents/caregivers of young people diagnosed with neurodevelopmental conditions (primarily autism) at multiple time points. Parents/caregivers completed computer-based administrations of the Vineland-3 Parent/Caregiver Form and PEDI-CAT (ASD and Original). A sub-sample (n>81) completed a comprehensive assessment of functioning in the home setting with an occupational therapist, involving a clinician-administered Vineland-3 Interview and ICF Core Set tool. Finally, parents/caregivers provided feedback (n>35) on the tools. Data were analysed using a quantitative and qualitative approaches.

Results: Linking results revealed that both the Vineland-3 and PEDI-CAT (ASD) focus on a restricted range of activity and participation items of the ICF-CY, and do not adequately cover all items with the ICF Core Sets for ASD. Clinician feedback indicated that neither the Vineland-3 and PEDI-CAT (ASD) is suitable to be used in isolation to assess functioning. Preliminary analysis of the psychometric properties of these tools suggested that both the Vineland-3 and PEDI-CAT (ASD) have acceptable test-retest reliability and moderate concurrent validity with each other, whilst the Vineland-3 Interview has good to excellent inter-rater reliability (based on a single administration) and mixed alternate forms reliability with the Parent/Caregiver Form. Parent/caregiver acceptability results indicated that there are strengths and weaknesses of both assessment tools. Final findings on the psychometric properties and usability of the Vineland-3 and PEDI-CAT (ASD) will be available at the INSAR meeting.

Conclusions: Existing tools, when used in isolation, are not sufficiently holistic for a comprehensive assessment of functioning. Tools based on the ICF Core Sets for ASD Documentation Form should be developed and evaluated for future translation into clinical practice.

205.004 *(Panel)* Understanding ASD in Context: A Cross-Cultural Comparison of Family Perceptions of Functioning in Sweden and South-Africa

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Background: Autism Spectrum Disorder (ASD) affects individuals from all continents, cultures and socio-economic backgrounds. Functional outcomes can be highly variable across diverse populations. The World Health Organization International Classification of Functioning, Disability and Health (ICF) is used to describe functioning and recent efforts have been made to develop ICF core sets for ASD. The core set development process included a qualitative study that examined caregiver perspectives from divergent countries (Canada, Sweden, India, Saudi Arabia and South Africa). This provided the unique opportunity to examine the association between contextual factors and functioning in children with ASD from diverse socio-economic settings by directly comparing parent/caregiver perspectives.

Objectives: First, to understand the global landscape of parental perceptions of functioning in their children with ASD, and to identify the predominant ICF themes raised by parents in existing literature. Second, to perform a systematic and direct comparison of functional themes raised by parents/caregivers in a Low/Middle-Income Country (South Africa) and a High-Income Country (Sweden) during the ICF ASD Core Set Development process.

Methods: To meet aim one, we performed a scoping review. Two researchers conducted a comprehensive search of peer-reviewed studies and key findings were linked to ICF first or second-level categories. Next we performed secondary analysis of data from focus groups and semi-structured interviews analysed for the ICF ASD core set study. Using frequency and content analysis we compared South African (n=22) and Swedish (n=13) participants.

Results: Thirty-three studies were included in the scoping review, and most were conducted in High-income Countries (HIC, n = 25/33, 76%) with only six studies in Low/Middle-income Countries (LMIC, n = 6/33, 18%). Two studies compared perspectives from LMIC and HIC (n = 2/33, 6%). Functional themes from HIC included a range across the ICF bio-psychosocial framework with body functions, activities & participation, environmental factors and personal factors all represented. Functional themes from LMIC were predominantly focused on environmental factors, but included some categories from body functions and activities & participation.

Complete frequency agreement was seen in 4 ICF categories in Sweden and South Africa - carrying out daily routines, dressing, complex interpersonal interactions and immediate family. Obvious differences in frequency of reporting were observed in one environmental factors category, six body functions categories, and three activities & participation categories. Only three ICF categories differed in content between South Africa and Sweden.

Conclusions: Although existing literature focused more on environmental factors in LMIC compared to HIC, environmental factors were not reported more frequently in South Africa (LMIC) than Sweden (HIC) in the direct comparison of qualitative data. In fact, parent/caregiver perspectives more frequently differed regarding body functions and activities & participation. The content of perceptions was mostly similar.

Given the universality of findings, our results support the global usefulness of the recently developed ICF core sets for ASD. We recommend that more comparative studies on ASD and functioning should be conducted, and that similar comparisons in other disorders where core sets have been developed, such as ADHD, may also be of value.

PANEL SESSION — **DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT**

206 - New Measures in Autism: Progress Toward Optimal Endpoints

Panel Chair: Antonio Hardan, *Psychiatry & Behavioral Sciences, Stanford University, Stanford, CA*

Discussant: Thomas Frazier, *Autism Speaks, New York, NY*

Significant progress has been made in the development and validation of instruments for measuring autism spectrum disorder (ASD) symptoms. However, despite strengths, current measures have limited (i) content coverage, often missing key symptoms that can have significant clinical impact and are therefore an important treatment target, (ii) ability to capture co-occurring symptoms whose presentation might be specific to ASD, therefore underestimating important areas of clinical need, (iii) ability to track symptom change, and (iv) alignment with the current dimensional frameworks including the Research Domains Criteria (RDoC). The proposed panel brings together state of the art empirical work aimed at addressing noted measurement limitations. Proposed investigations span a range of approaches including (i) parent rated measure of typical and atypical anxiety in ASD, (ii) quantitative measure of social motivation and other key social domains aligned with RDoC, (iii) multi-step conceptual and big-data analytic approach towards the development of new measure of repetitive behaviors, and (iv) brief observation measure for capturing change in core ASD symptoms. Given that research efforts are needed to ensure that practitioners and policy-makers have robust data on ASD instruments, the proposed panel is particularly timely and holds promise for positively impacting both research and clinical practice.

206.001 *(Panel)* Extending the Usefulness of the Brief Observation of Social Communication Change (BOSCC)

A. Holbrook[1], *K. Byrne*[1], *R. L. Grzadzinski*[2], *S. H. Kim*[3] *and C. Lord*[1], *(1)University of California, Los Angeles, Los Angeles, CA, (2)University of North Carolina Chapel Hill, Chapel Hill, NC, (3)Psychiatry, Center for Autism and the Developing Brain, White Plains, NY*

Background: There are several limitations to current practices of measuring treatment response for individuals with Autism Spectrum Disorder (ASD), including but not limited to: reliance on caregiver/clinician reports, limited number of flexible and standardized measures for use across studies, and the application of measures that were not designed for or sensitive enough to measure change over brief periods of time. The BOSCC was developed to provide a standardized and efficient method of measuring subtle changes in social communication in individuals with ASD. The BOSCC administration and BOSCC coding system have been used to validly and reliably measure social communication change in minimally verbal children (Grzadzinski et al., 2016; Kim et al., 2018), addressing the need for appropriate treatment measures in this population. However, due to the wide heterogeneity in language abilities within ASD, there remains a need for a measure that can be used for individuals across a range of language levels. The BOSCC has been expanded to include a module that can be used with individuals with phrase speech.

Objectives: 1) Use preliminary data to explore if the BOSCC measures change in social communication behaviors over time in children with phrase speech. 2) Compute basic psychometrics for the BOSCC phrase speech module.

Methods: Participants included 13 children with ASD (M_{age}= 4.15 years, *SD*=1.47 years). Six children were enrolled in a targeted intervention program while the remaining seven children received treatment as usual (TAU).

The BOSCC is a 12-minute videotaped play interaction between an individual and a play partner blind to treatment status. It was designed to be easy to administer and was implemented with research assistants who had received minimal instruction.

The BOSCC coding consists of two 6-minute segments, each watched twice and coded. Codes are averaged across the segments. The BOSCC coding system uses decision trees to increase ease of use. The BOSCC phrase speech module was developed by modifying 15 of the original items and adding two new items to reflect social communication behaviors of individuals with phrase speech. Behaviors are coded on a 6-point scale ranging from 0 (atypical behavior not present) to 5 (atypical behavior present and significantly impairs functioning). Inter-rater reliability was calculated using percent agreement within 1 point on overall totals.

Two paired-samples t-tests were conducted to determine change in BOSCC scores across time within each treatment group.

Results: Significant changes were observed in BOSCC Total Scores over the course of intervention (pre:*M*=30.5, *SD*=6.2 vs. post:*M*=26.2, *SD*=6.3); *t*(5)=2.70, *p*=0.04, Cohen's D=0.68. No significant changes were observed in BOSCC Total Scores over time for TAU (pre:*M*=26.3, *SD*=8.9 vs. post:*M*=24.6, *SD*=11.8); *t*(6)=0.67, *p*=0.53. Preliminary inter-rater reliability was high (percent agreement=94%; ICC=.99).

Conclusions: Preliminary data suggests that the BOSCC phrase speech module is sensitive to and reliably measures small changes in social communication in children with ASD with phrase speech. The high inter-rater reliability indicates coding ease and precision in using a modified decision tree system. Data collection is ongoing and more data with a larger sample will be available for analyses by May 2020.

206.002 *(Panel)* Reliability and Validity of the New Parent-Rated Anxiety Scale in Youth with Autism Spectrum Disorder

L. Scahill, *Marcus Autism Center, Atlanta, GA*

Background: Anxiety is common in youth with autism spectrum disorder (ASD). Anxiety symptoms vary from mild to severe in this population. Due to language and cognitive challenges in youth with ASD, measures of anxiety used in the general pediatric population may not be suitable for youth with ASD.

Objectives: This presentation reports on the development, reliability and validity of a new parent-rated measure of anxiety in youth with ASD.

Methods: Seventy-two candidate scale items were derived from a series of focus groups with parents of youth with ASD. Parents of 990 youth with ASD (age 5-17; 80.8% male) completed the 75-item survey (scored 0-3) online. Factor analysis and item response theory (IRT) analyses reduced the number of items resulting in a single factor with 25 items. A separate sample of children with a least mild anxiety (N=116; age 5-17; 79.3% male) participated in a comprehensive in-person clinical assessment to evaluate validity and reliability of the 25-item Parent-rated Anxiety Scale for ASD (PRAS-ASD).

Results: In the online sample, the mean PRAS-ASD score was 29.04 ± 14.9 **(**range 0 to 75; coefficient alpha = 0.93). The IRT results indicated excellent reliability across a wide range of scores with low standard errors. In the clinical sample (N=116), the PRAS-ASD mean was 31.0 $\pm$15.6 (range 1-65). Pearson correlations with parent ratings of repetitive behavior and disruptive behavior ranged 0.33 to 0.66 supporting divergent validity of the PRAS-ASD. The correlation with a parent-rated measure of anxiety used in the general pediatric population of 0.83 supports convergent validity. Forty participants (32 boys, 8 girls; mean age of 11.9 $\pm$ 3.4) returned at Time 2 (mean =12.2 days) and Time 3 (mean = 24.2 days). Intraclass correlation showed test-retest reliabilities of 0.88 and 0.86 at Time 2 and Time 3, respectively.

Conclusions: Not all children with ASD are anxiety. Anxiety ranges from little or no anxiety mild to severe. The 25-item PRAS-ASD is a reliable and valid scale for measuring anxiety in youth with ASD.

206.003 *(Panel)* The Stanford Social Dimensions Scale: A New Instrument to Assess Social Domains in Autism

J. M. Phillips[1]*, M. Uljarevic*[2]*, R. K. Schuck*[3]*, S. Schapp*[4]*, E. S. Loyola*[5]*, E. E. Salzman*[6]*, R. Libove*[7]*, T. W. Frazier*[8] *and A. Y. Hardan*[1]*, (1)Psychiatry & Behavioral Sciences, Stanford University, Stanford, CA, (2)Department of Psychiatry and Behavioral Sciences, School of Medicine, Stanford University, Stanford, CA, (3)Psychiatry and Behavioral Sciences, San Jose State University, Palo Alto, CA, (4)Psychiatry, Kaiser, Redwood City, CA, (5)Palo Alto University, Palo Alto, CA, (6)Psychiatry, UCSF, San Francisco, CA, (7)Psychiatry and Behavioral Sciences, Stanford University, Stanford, CA, (8)Autism Speaks, New York, NY*

Background: Social motivation theory has been suggested to provide a potentially useful framework for understanding the emergence of social impairments in autism spectrum disorder (ASD). In addition, a number of early interventions including the Early Start Denver Model and Pivotal Response Treatment target social motivation. Social motivaiton is also an importnat component of the Research Domain Criteria's (RDoC) Affiliation and Attachment construct. Much like the heterogeneity observed in cognitive abilities of children with ASD, there is similar variability in the degree of social motivation seen across the autism spectrum. Differing levels of social motivation may have important implications for treatment selection and expected outcomes. However, despite the prominence of this construct in treatment, there are few available tools specifically designed to capture individual differences in social motivation and related aspects of social behavior, particularly in a manner that can be useful for tracking change across time.

Objectives: To validate a newly developed quantitative instrument—the Stanford Social Dimensions Scale (SSDS)—designed to capture individual differences in distinct components of social motivation and other key dimensions of social functioning aligned wiht the RDoC framework and to explore its utility for differentiating social subtypes among a sample of individuals with ASD.

Methods: The validation sample consisted of 175 parents of autistic individuals (35 females; *M*age= 7.19 years, *SD*age= 3.96) who completed the SSDS, the Social Responsiveness Scale (SRS-2) and the Child Behavior Checklist (CBCL). The replication sample consisted of 624 parents of children who were either typically developing (TD) or had a reported neurodevelopmental or psychiatric condition (437 TD; *M*age= 11.49 years, *SD*age= 4.48); these parents completed the SSDS and the SRS-2.

Results: Exploratory Structural Equation Modeling indicated that a five-factor model provided best fit to the data across both the initial ASD sample (comparative fit index [CFI]= .940, Tucker Lewis Index [TLI]= .919, root mean square error of approximation [RMSEA]= .048, standardized root mean square residual [SRMR]= .038) and the replication sample (CFI= 946, TLI= .930, RMSEA= .044, SRMR= .026). The five factors that emerged were described as Social Motivation, Social Affiliation, Expressive Social Communication, Social Recognition, and Unusual Approach. All subscales had good to excellent consistency (Composite Reliability scores of ≥ .72), showed good convergent and divergent validity, as evidenced by the pattern of correlations with relevant SRS-2 and CBCL domains, and strong discriminant validity, with the ASD sample showing significantly higher impairment than the non-ASD clinical sample, which, in turn, had significantly higher impairments than the typically developing sample. Within the ASD sample, Latent Profile Analysis yielded five profiles showing distinct patterns of strengths and weaknesses across different SSDS scales. Profiles were further differentiated in terms of cognitive ability, ASD and internalizing symptom severity.

Conclusions: Our findings provide validation of a new scale designed to comprehensively capture individual differences in social motivation and other key social dimensions in ASD. Results further suggest the potential utility of this scale in identifying subgroups of individuals with ASD who share particular constellations of strengths and weaknesses across key social dimensions.

206.004 *(Panel)* A Big Data Approach Toward the Development of a New Quantitative Measure of Restricted and Repetitive Behaviors

M. Uljarevic[1]*, B. Jo*[2]*, T. W. Frazier*[3]*, R. Libove*[4] *and A. Y. Hardan*[5]*, (1)Department of Psychiatry and Behavioral Sciences, School of Medicine, Stanford University, Stanford, CA, (2)Department of Psychiatry and Behavioral Sciences, Stanford University, Stanford, CA, Stanford, CA, (3)Autism Speaks, New York, NY, (4)Psychiatry and Behavioral Sciences, Stanford University, Stanford, CA, (5)Psychiatry & Behavioral Sciences, Stanford University, Stanford, CA*

Background: Despite their clinical significance, etiology behind the restricted and repetitive behaviors (RRB) domain is poorly understood and effective treatments are currently lacking. Inconsistencies in the organization, division, and measurement have pervaded RRB research to date, presenting a major obstacle for a better understanding of the underlying mechanisms thus stifling the development of effective individually tailored treatments. Most pressingly, existing RRB measures have major limitations, including: (i) poor ability to systematically and comprehensively capture all relevant RRB domains, (ii) limited psychometric properties, (iii) lack of sensitivity to subtle symptom expressions and ability to capture change.

Objectives: To conduct (i) a systematic review of RRB factor analytic studies to date, and (ii) a series of factor analyses across existing RRB measures using multiple high-quality data sets. This conceptual and empirical process will derive a comprehensive RRB taxonomy and inform the development of a new quantitative RRB measure—the Comprehensive Assessment of Restricted and Repetitive Behaviors (CARRB).

Methods: For systematic review Medline, PsychInfo and Scopus databases were searched for published articles available through October 2019. A series of complex exploratory and confirmatory factor analyses were conducted in large, well-characterized existing data sets (N > 40,000) including ASD and other neurodevelopmental disorders to enable identification of core RRB domains generalizable across existing measures and to identify under-represented RRB domains.

Results: Systematic search identified 33 factor analytic studies evaluating 8 scales. Almost half of the studies (n=16) focused on the Autism Diagnostic Interview-Revised, eight on the Repetitive Behavior Scale-Revised, four on the Repetitive Behavior Questionnaire-2; other instruments were evaluated in only one or two studies. While Repetitive Motor Behaviors (RMB), Insistence on Sameness (IS) and Circumscribed Interests (CI) factors emerged most frequently, factors such as compulsions and sensory sensitivity also emerged albeit inconsistently. The majority of studies utilized modest sample sizes, limited statistical methods, and relied on single measures that varied widely in terms of comprehensiveness. None of the studies explored the content agreement across scales. The item content of the factors was inconsistent, even when the same measure was used. Integration across a range of large data sets (including the Autism Genetic Research Exchange, the National Database for Autism Research and the Simons Simplex Collection) and the application of the exploratory structural equation modelling and multi-trait multi-method approaches confirmed the existence of RMB and IS factors (although the content varied widely across measures). The CI factor was under-sampled and under-specified (five or less items irrespective of the scale). Item level analyses identified the existence of unusual sensory interests, sensory sensitivity, compulsions and tics represented by ≤ 4 items each. Derived RRB domains served as the basis for developing the pilot version of the CARRB.

Conclusions: A combination of systematic review of the current literature and the application of advanced latent variable approaches enabled fine-grained differentiation between distinct RRB domains and identification of domains not adequately captured by the existing measures. This knowledge is essential for the development of a new RRB measure designed to provide comprehensive assessment of the identified RRB domains.

PANEL SESSION — DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT

207 - Screening for Autism Spectrum Disorders in the ASD PEDS Network: Building Capacity, Engaging Communities, and Improving Detection

Panel Chair: Alice Carter, *Department of Psychology, University of Massachusetts Boston, Boston, MA*

Discussant: Sarabeth broder-Fingert, *Boston Medical Center, Boston, MA*

This session will highlight results from the projects that comprise the NIMH ASD PEDS Network. Each of the NIMH ASD PEDS Network projects were designed to address health disparities in rates of and age at detection of ASD. The projects are diverse with respect to the screening approaches that were adopted. Specifically, there is variability across the contexts of screening (i.e., pediatrics versus Part C Early Intervention), engagement of community partners, screening tools employed, formats of screening (questionnaire, interview, observation), and study design (e.g., randomized clinical trial of the added value of family navigation, quasi-experimental design using difference in difference analyses to compare intervention sites to contrast sites using administrative data). Most of the studies in the network included both quantitative outcomes related to screening results as well as qualitative data regarding parent and provider experiences with screening. Each project will present their screening model and present key findings and lessons learned. Taken together, these studies suggest that routine early screening in universal and targeted settings can reduce age at detection, enhance rates of early detection, and may be most beneficial for families from historically marginalized statuses (e.g., racial and ethnic minorities). The discussion will focus on cross-study implementation science.

207.001 *(Panel)* Evaluation of the Screen-Refer-Treat Model for Increasing Early Detection and Intervention for Toddlers with ASD across Community Systems of Care: A One-Year Follow-up

W. L. Stone[1], *L. V. Ibanez*[2], *K. J. Steinman*[3], *S. Dorsey*[4], *A. Vander Stoep*[5], *K. Myers*[6] *and C. Zhou*[7], *(1)Psychology, University of Washington, Seattle, WA, (2)UW READi Lab, Seattle, WA, (3)Neurology, University of Washington and Seattle Children's Hospital, Seattle, WA, (4)Department of Psychology, University of Washington, Seattle, WA, (5)Department of Psychiatry and Behavioral Sciences, Department of Epidemiology, University of Washington, Seattle, WA, (6)Department of Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA, (7)Department of Pediatrics, Seattle Children's Research Institute, University of Washington, Seattle, WA*

Background: Despite the availability of evidence-based interventions for toddlers and young children with ASD, many obstacles limit access to these treatments. Primary care providers (PCPs) often lack knowledge about the early signs of ASD and/or fail to use validated screening tools as recommended by the American Academy of Pediatrics. The publicly funded Part C Early Intervention (EI) system, which offers treatment for families of toddlers with developmental delays and is available in all U.S. states, operates under a generalist model, with few providers having specialized ASD training. This paucity of specialized ASD intervention services in their community creates a further disincentive for PCPs to identify children with ASD.

Objectives: The Screen-Refer-Treat (SRT) project aims to overcome these challenges and improve early access to ASD-specialized services by implementing a multisystem heath care intervention to increase capacity in both primary care and early intervention sectors within the same community. Specific goals are to: (1) increase PCPs' use of universal ASD *screening* at 18-month well-child visits and *referral* of positive screens to EI programs, and (2) increase EI providers' use of an evidence-based *treatment* when ASD is suspected.

Methods: The SRT model was conducted in four underserved counties in one U.S. state; 10 PCP practices (n=53 PCPs) and 9 EI programs (n=80 EI providers) were enrolled. To increase PCPs' universal use of ASD screening at 18 months, practices received an online version of the Modified Checklist for Autism in Toddlers Revised/with Follow-up (M-CHAT-R/F; Robins et al., 2014), which reduces their time burden by automatically presenting follow-up interview questions when appropriate. A 2-hour workshop on ASD recognition and care was also provided. EI providers received two 1-day trainings on an evidence-based interactive screener (Screening Tool for Autism in Toddlers [STAT]; Stone et al., 2004) and an evidence-based ASD intervention, Reciprocal Imitation Training [RIT], that is easily implemented and can be taught to parents (Ingersoll & Schreibman, 2006). Counties were randomly assigned to the timing of their training using a stepped-wedge cluster design. Provider outcomes included ratings of feasibility and adoption of the tools, as well as changes in self-efficacy regarding ASD care post-SRT training. Separate cohorts of parents were enrolled before and after the SRT training and completed measures of parenting stress, efficacy, satisfaction with health care, and child social communication.

Results: Results obtained one year post-SRT training indicate high feasibility and use of the online M-CHAT-R/F, the STAT, and RIT. Paired samples *t*-tests indicated significant increases from pre- to post-SRT in: (1) PCP and EI provider self-efficacy in providing ASD care and treatment; and (2) PCP use of routine ASD screening at 18 months. An independent samples *t*-test indicated increased satisfaction with health care for the post-SRT parent cohort relative to the pre-SRT cohort. All *p* values range from < .01 to < .05.

Conclusions: The SRT model was effective in changing the practices of community-based providers to increase early ASD screening and specialized intervention for toddlers with, or suspected of having, ASD. Additional data analyses comparing the parent cohorts are ongoing.

207.002 *(Panel)* Addressing Health Disparities in Early Detection of ASD: Screening in Part C Early Intervention

A. S. Carter[1], *R. C. Sheldrick*[2], *A. Eisenhower*[3], *T. Mackie*[4], *F. Martinez-Pedraza*[5], *N. A. Hoch*[6] *and S. M. Brunt*[7], *(1)Department of Psychology, University of Massachusetts Boston, Boston, MA, (2)Boston University School of Public Health, Boston, MA, (3)University of Massachusetts Boston, Boston, MA, (4)Institute for Health, Health Care Policy and Aging Research, School of Public Health, Rutgers Univer, New Brunswick, NJ, (5)Center for Children and Families, Florida International University, Miami, FL, (6)Clark University, Worcester, MA, (7)Psychology Department, University of Massachusetts Boston, Boston, MA*

Background: Children screened in pediatrics and suspected of having ASD are often referred to Part C Early Intervention (EI) services without an ASD evaluation referral. Thus, after a positive ASD screener, developmental concerns (e.g., language delays) may be acknowledged without referral to ASD specific services. Access barriers may further limit receipt of evaluation following referral. These barriers are associated with health disparities in children's receipt of early diagnosis, affecting access to ASD specific evaluation and intervention. We partnered with community-based EI agencies to implement multi-stage ASD screening and referrals to university-based diagnostic evaluation to increase access to early detection of ASD among all children, minimizing health disparities in rates of diagnosis.

Objectives: To determine if a community-based, EI-administered multi-stage screening protocol and referral to university-based diagnostic evaluation increases rates of ASD diagnosis and minimizes health disparities in rates of ASD diagnosis. To contextualize findings in parent experiences.

Methods: A mixed methods approach was adopted. Quantitative analyses involved tracking 4943 children (mean age: 22.0 months; 62.9% boys, 73.3% children of color, 34.9% non-English-primary language, 64.5% publicly-insured) who were eligible for screening through the multi-stage screening and diagnostic protocol. Stage 1 screening included the Brief Infant-Toddler Social Emotional Assessment and Parent Observations of Social Interactions, Second stage screening involved the Screening Tool for Autism in Toddlers. A positive screener or parent or provider concern triggered eligibility for the next stage/referral for evaluation. State-level administrative demographic and diagnostic data from the Department of Public Health were used to conduct difference-in-difference analyses comparing rates of diagnosis in screening intervention sites relative to contrast sites that showed similar trajectories of diagnostic rates in the baseline, pre-intervention period. Finally, qualitative analyses of 65 longitudinal interviews with 22 parents provide insight into parent experiences of the multi-stage screening process.

Results: Participation and follow-through were high (64.9% and 65.3% at first-and second-stage screening, 84.6% at diagnostic evaluation), with 83.7% of children participating in a diagnostic evaluation receiving an ASD diagnosis, Difference-in-difference analyses document that rates of diagnosis improved significantly at each intervention site relative to comparison sites (See Figure). Analyses will be elaborated in relation to health disparities. Logistic regressions identified the following predictors of ASD diagnosis relative to the full screen eligible sample: children receiving diagnoses were older [Exp(*B*)=1.03, *p*=.004, 95% C.I.=1.01-1.05], more likely to be boys [Exp(*B*)=0.40, *p* < .001, 95% C.I.=0.31-0.52], and more likely to be children of color than all other eligible children [Exp(*B*)=1.39, *p*=.026, 95% C.I.=1.04-1.86]. No differences in language [Exp(*B*)=0.96, *p*=.71, 95% C.I.=0.75-1.21] or insurance [Exp(*B*)=1.20, *p*=0.16, 95% C.I.=0.93-1.54] were observed. Parents reported the written and observational screening tools facilitated understanding their child's behaviors within an ASD interpretive framework in unique and synergistic ways, facilitating shared decision-making with the EI provider.

Conclusions: Our EI-implemented multi-stage screening model increased rates of ASD diagnosis and appears to address health disparities in receipt of ASD diagnosis. Expanding screening to EI settings offers opportunities to aid parents in understanding their children's ASD symptoms and facilitate shared decision-making and access to ASD specific interventions.

207.003 *(Panel)* The Get SET Early Model As a Mechanism for the Very Early Detection of ASD: Examination of Influencing Factors Including Parent Concern, Sex, and Age

K. Pierce[1], *V. Gazestani*[2], *E. Bacon*[3], *A. Cheng*[3], *C. Barnes*[4], *S. Nalabolu*[3], *E. Courchesne*[1], *L. Lopez*[3], *S. J. Arias*[3] *and C. Pham*[3], *(1)Autism Center of Excellence, Neurosciences, University of California, San Diego, La Jolla, CA, (2)Neurosciences, Univeristy of California, San Diego, La Jolla, CA, (3)Neurosciences, University of California, San Diego, La Jolla, CA, (4)University of California, San Diego, La Jolla, CA*

Background: Studies have shown that very early engagement in treatment (by age 2 years) is associated with a range of positive changes including increases in social orienting, language ability, and overall IQ for toddlers with ASD[1-3]. Why then, is ASD not consistently identified and treated early? Several factors including generally low rates of referral for an evaluation on the part of pediatricians even when a toddler has failed a screen[4], variability in the level of parent concern, even when autism is present, age at which screening occurs, and sex likely play a role.

Objectives: Here we examine the efficacy of our 12-component *Get SET Early* model (S=Screen, E=Evaluate, and T=Treat) as a mechanism to detect ASD in the general population at young ages within the context of a repeat screen approach using the CSBS DP IT Checklist[5]. **Figure 1.** Our goals are to: (1) determine median age of ASD detection and treatment referral stratified by age at screen; (2) determine the total number of ASD cases as well other delays detected and; (3) examine pediatrician referral rates based on age at screen, gender, and presence or absence of parent concern.

Methods: Two hundred and three pediatricians participated. Parents filled out the CSBS at 12, 18 and/or 24 month well baby check ups and also denoted whether or not they were concerned about their child's development. Pediatricians denoted whether or not they were referring a toddler for an evaluation following screening. Logistic regression was used to examine factors relating to pediatrician referral, with sex, age at screen, and presence or absence of parent concern as variables.

Results: Pediatricians administered 59,411 CSBS screens at 12, 18 and/or 24 month well baby check-ups. Seven hundred and sixty-nine toddlers were referred to the *Get SET Early* model based on failure of the CSBS or parent concern and completed one or more diagnostic evaluations by licensed psychologists. Overall median age at 1st screen was 17.07 months; first evaluation 19.3 months, and most recent (last) evaluation 29.24 months. Toddlers that were screened at 12 months received their first diagnostic evaluation and were referred for treatment by 15.6 months, which is several years earlier than the national average of 56 months[6]. **Figure 2.** Diagnostic outcomes were: 355 ASD, 414 other delays (e.g., DD) and 73 false positives. Pediatricians were more likely to refer a toddler for an evaluation if the child was male, and at older rather than younger ages. They were also twice as likely to refer if a parent also had concerns. **Figure 3.**

Conclusions: With an overall median age of ASD detection and treatment referral of 19 months, with some children receiving an evaluation and referral for treatment as young as 12 months, the Get SET Early model is an effective mechanism for the early detection of ASD. When making referrals for an in-depth evaluation, pediatricians were highly influenced by whether or not a parent was concerned, suggesting that querying of parent concern should be incorporated into screening as standard practice.

207.004 *(Panel)* Novel Strategies to Support Early Identification and Engagement in Autism Services: Family Navigation and the Autism Navigator

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Background: Engaging historically underserved children in autism diagnostic and treatment services requires strategies that address structural and family-level barriers. Two such strategies are Family Navigation (FN) and the Autism Navigator. FN is a care management strategy designed to reduce disparities in care through individually-tailored care coordination. Our multisite randomized trial of FN versus usual care (n=250) found that FN significantly impacted time to diagnostic ascertainment among families of young children at risk for ASD. The benefit was most pronounced among Hispanic families (Hazard ratio (HR) non-Hispanic children: 1.36 (1.20, 1.54); HR Hispanic children: 3.28 (3.12, 3.45)). (Figure 1). Autism Navigator is a collection of online courses and tools for professionals and families with a new web-based platform for universal screening for communication delay and autism, designed to reduce the age of screening and referral.

Objectives: We will report on results from two trials in 6 states that collectively screened over 25,000 young children for ASD risk. The trials used different approaches to screening and support for rapid engagement in services. Our goals are to assess the efficacy and implementation of each approach to affect autism diagnostic ascertainment and referral for early intervention.

Methods: For FN, we used a mixed-methods approach to assess navigator training, fidelity to FN delivery, and implementation. Fidelity was assessed quantitatively in two domains from randomly selected audiotaped visits: adherence to visit content based on a pre-specified checklist and use of motivational interviewing (MI), using the Motivational Interviewing Supervision and Training Scale Revised (MISTS). Concurrently, we interviewed 7 Family Navigators and 14 parents who received FN to understand fidelity and intervention implementation. For the Autism Navigator, we recruited providers in 4 states who completed the Autism Navigator for Primary Care training and screened children with the new web platform from 9 to 18 months of age. We assessed age at first screen and rate of referral to early intervention.

Results: Both studies successfully recruited diverse families (race/ethnicity, parent education, and income) (Table 1). The FN curriculum, which included training in ASD management, psychoeducation, and principles of patient navigation, was standardized based on the training of 5 bicultural navigators and augmented with MI training. Content and MI fidelity was 78% and 75%, respectively. In interviews, both navigators and parents expressed interest in expanding the navigator role, particularly longer duration of support. 315 providers completed the Autism Navigator for Primary Care and screened a total of 10,259 children. The average age of first screening was 15.5 months, and rate of referral to early intervention for positive autism screens was 40% at 12 months, 64% at 15 months, and 67% at 18 months.

Conclusions: The findings of FN trial and the use of Autism Navigator tools have important implications for lowering the reachable age of early detection of ASD and access to early intervention among traditionally underserved populations. The next step of our collaborative team is to incorporate FN and Autism Navigator into an intervention package to rapidly engage families of children with early signs of autism in early intervention.

PANEL SESSION — **DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT**

208 - Understanding Individual Differences in Autism: Predictors of Developmental Trajectories and Intervention Outcomes

Panel Chair: Catherine Bent, *Victorian Autism Specific Early Learning and Care Centre, La Trobe University, Melbourne, Australia*

Discussant: Cheryl Dissanayake, *Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia*

Individual differences in autism have been documented since Kanner (1943) first described the condition. A large degree of heterogeneity is evident in the profile of symptoms and skills and individual developmental trajectories over time, including in individual responses to interventions. This panel seeks to explore the theme of individual differences in autism by examining predictors of developmental trajectories and early intervention outcomes across a variety of cohorts. The first presentation will examine trajectories of symptom emergence and predictors of ASD/NON-ASD status in a cohort of infant siblings of children with ASD. The second and third presentations examine predictors of response to specific interventions in preschool aged children, describing profiles associated with more and less favorable responses. The final presentation extends into adulthood, examining predictors of diagnostic stability across the lifespan. The discussant will synthesize key learnings and common themes that emerge from these presentations, with the objective of highlighting what is needed to move the field forward.

208.001 *(Panel)* Early Predictors and Developmental Characteristics of ASD/Non-ASD Trajectories from 14 to 36 Months

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Background: Longitudinal prospective research with infant siblings of children with ASD (Sibs-A) shows that trajectory of autism spectrum disorder (ASD) is characterized by a prodromal period during infancy followed by symptom emergence in the 2^{ne}-3rd years of life. Little is known about trajectories of ASD/Non-ASD status in that symptom-emergence phase, or predictors of those trajectories. Identification of such predictors and first-birthday behavioral characteristics could inform assessment and intervention decisions.

Objectives:

1. To identify early predictors of ASD status trajectory between 14-36 months.
2. To determine whether expressive language, cognitive, or social characteristics differ across trajectory groups during transition from the prodromal to symptomatic phases of ASD trajectory.

Methods: 372 children (sibs-A, non-sibs-A) were assessed at 6, 14 and 36 months. Clinical Best Estimates (CBE) of ASD or non-ASD at 14 and 36 months obviated four trajectory categories: Stable ASD; Stable Non-ASD; Improving (ASD to Non-ASD); and Worsening (Non-ASD to ASD). Dependent variables included: summed score of clinician-rated ASD-related qualities; Mullen Scales of Early Learning (MSEL) Fine Motor, Expressive Language, and Visual Reception T scores; frequency of initiation of joint attention (IJA). Analyses: multinomial logistic regression (separate models for males and females); pairwise t-tests of differences.

Results: At 14 months, 18% of children had CBE of ASD; at 36 months, 59% of these children still had ASD (Stable ASD) and 41% did not (Improving). Of those without ASD at 14 months, 81% remained Non-ASD (Stable Non-ASD); 19% transitioned to ASD (Worsening). Males and sibs-A were more likely to belong to Stable ASD and Worsening groups compared to females or non-sibs-A (Table 1, $p<0.0001$).

For males and females, higher Fine Motor score at 6 months was associated with reduced odds of having Stable ASD relative to Stable Non-ASD trajectory (females: OR=0.77, 95% CI: 0.6-0.99, $p<0.05$; males: OR=0.9, 95% CI 0.82-0.99, $p<0.05$). In males only, higher loading of ASD-related qualities at 6 months also was associated with greater odds of having a Stable ASD trajectory (OR=1.13, 95% CI 1.00-1.27, $p<0.10$).

Children with ASD at any point (Stable ASD, Improving, Worsening) had lower IJA at 14 months relative to children who never exhibited ASD (Stable Non-ASD). At 14 months, Fine Motor and Visual Reception scores were significantly lower in children in the Improving group (concurrent ASD) than those without ASD regardless of ASD/Non-ASD status at 36 months (Stable Non-ASD and Worsening groups). The Stable ASD group had lower Expressive Language scores compared to the other three trajectory groups. See Table 1, all differences were significant at $p<0.05$.

Conclusions: During the prodromal phase of ASD, fine motor skills predicted later ASD/non-ASD trajectory. Males with later ASD appear to exhibit earlier ASD-related behavioral qualities than females. During transition from the prodromal to symptom-emergence phase of ASD trajectory, low IJA is associated with ASD, regardless of its stability or timing of onset, and low expressive language is associated with early and persistent ASD symptomatology. Children with mid-infancy disruption in motor development require developmental surveillance. Those with IJA or language delays at 14 months should receive tier 2 ASD screening.

208.002 *(Panel)* 'What Works for Whom?': Understanding Early Intensive Behavioural Intervention for Autism

C. A. Bent[1]*, C. Dissanayake*[2]*, S. Glencross*[3]*, K. McKinnon*[3]*, K. Hudry*[4] *and G. Vivanti*[5]*, (1)Victorian Autism Specific Early Learning and Care Centre, La Trobe University, Melbourne, Australia, (2)Olga Tennison Autism Research Centre, La Trobe University, Melbourne, Australia, (3)Autism Partnership, Melbourne, VIC, Australia, (4)Victorian Autism Specific Early Learning and Care Center, Olga Tennison Autism Research Centre, Melbourne, Australia, (5)A.J. Drexel Autism Institute, Drexel University, Philadelphia, PA*

Background: Autism is characterized by remarkable variability, with important differences apparent in almost every aspect of the condition including onset, presentation, early trajectories, long-term outcomes, and response to early intervention. It therefore seems likely that different types of early intervention might be best suited to different children, depending on their unique learning profiles. Currently, however, knowledge on what programs work best for which children is limited.

Objectives: We expect that, at the group level, children will make significant gains in cognition in response to both the Group Early Start Denver Model (G-ESDM) and a Comprehensive Applied Behaviour Analysis (ABA) program. The primary aim in this project was to identify characteristics associated with improved child outcomes across both programs (i.e., Prognostic Indicators) and characteristics associated with better outcomes in response to one or other particular intervention approach (i.e., Predictors of Intervention response).

Methods: The study included 80 children with autism (78% boys), aged between 17 and 59 months (*M*=37.67) at entry into community-based intervention, with half receiving G-ESDM and half receiving ABA. Intake assessments (T1) included the Mullen Scales or Early Learning (MSEL), Autism Diagnostic Observation Schedule (ADOS-2), as well as a battery of eye-tracking tasks designed to measure putative prognostic indicators and predictors of Intervention response. These included tasks designed to assess early learning processes that are theoretically and/or empirically related to developmental outcomes and response to early intervention, including Sustained Attention, Joint Attention, Social Attention and Attention to Actions. The primary outcome of interest (T2) was children's MSEL Verbal and Non-Verbal Age Equivalent scores (V/NV AE) following one year of intervention. T2 data is currently available for 60 children, with the remaining assessments to be completed in late 2019. The current data allow the examination of prognostic indicators for abstract submission, with examination of differential predictors of intervention response completed by May 2020.

Results: As predicted, large variability was evident in developmental gains across the two groups, but at the group level children receiving G-ESDM and ABA made significant gains in VAE (T1 *M*(SD)=15.68(9.18), T2 *M*(SD)=26.25(11.85), $p<.001$) and NVAE (T1 *M*(SD)=21.32(7.47), T2 *M*(SD)=30.59(10.42), $p<.001$) scores. Hierarchical regressions examining the unique predictors, controlling for site, child age and ADOS Calibrated Severity Score at intake indicated that T2 VAE scores were predicted by Sustained Attention, Social Attention and Attention to Actions. The only significant unique predictor of T2 NVAE score was Sustained Attention.

Conclusions: Knowing which children with autism benefit most from which particular intervention models will allow families and clinicians to make informed decisions about how best to support children's learning. Identifying predictors that are specific and modifiable will better inform the tailoring of intervention programs by identifying proximal intervention targets.

208.003 *(Panel)* A Second Look at the ASAP Intervention: Examining Sample Heterogeneity and Predictors of Treatment Response

***B. A. Boyd**, Juniper Gardens Children's Project, University of Kansas, Kansas City, KS*

Background: Advancing Social-communication And Play (ASAP) is a manualized, classroom-based intervention for preschool-aged children with autism spectrum disorder. The initial efficacy of the ASAP intervention was examined using a cluster randomized controlled trial (n=161). The findings demonstrated statistically significant differences and small to moderate effects in favor of the ASAP group on the secondary outcomes of child engagement and teacher burnout. However, no significant differences were found for the primary outcomes of social-communication and play. Given that significant differences were found for the secondary outcomes, ASAP is not an ineffective intervention; therefore, it is important to explore sources of sample heterogeneity and predictors of treatment response to understand discrepancies in primary versus secondary outcomes.

Objectives: There were two study objectives: (1) To use empirical methods to examine how children group by subtype based on pre-treatment, child level variables as well as predictors of group membership; and (2) To examine if group membership changed over time as a function of treatment.

Methods: The initial ASAP study used a randomized trial design (child n=85 ASAP, n=76 control). For this study, secondary data analysis was undertaken. Specifically, latent profile analysis (LPA) was used to examine group membership based on pre-treatment child characteristics (i.e., symptom severity, challenging behavior, social-communication skills, play skills, and classroom engagement) and demographic variables were examined as predictors of group membership (i.e., child sex, baseline cognitive ability). In addition, latent profile transition analysis (LPTA) will be used to examine changes in group membership from pre- to post-test.

Results: After comparing fit statistics (i.e., Akaike Information Criterion, Bayesian Information Criterion, Adjusted Bayesian Information Criterion, Vuong-Lo-Mendell Rubin, Lo-Mendell-Rubin, bootstrap likelihood ratio test, entropy) of a 2 to 7 class solution, results suggested a 3 class solution fit best. Mean conditional probabilities for the 3 class solution ranged from 92.5-95.2, indicating good fit. For the LPA, all latent classes were differentiated by pre-treatment characteristics. Children in latent class 2 (n=23), which accounts for 14% of the sample, had the lowest severity scores (i.e., ADOS severity scores and challenging behavior) and highest skill scores (i.e., social-communication, play, and engagement); whereas, children in class 3 (n=43) had the opposite profile to those in latent class two. Fifty-nine percent of children (n=95) fell into latent class 1 showing a mild to moderate symptom and skill profile; essentially their scores fell in the middle of children in latent classes two and three. Gender was not a predictor of group membership; however, latent class 2 was nearly differentiated by a higher likelihood of being female (= -3.09; $p=0.06$) when compared to latent class 3. Cognitive ability significantly differentiated latent class 2 and 3, with latent class 2 having a higher IQ score (= 0.19; $p=0.05$). Additional analyses will define how the latent classes changed over the course of one school year.

Conclusions: Results suggest three distinct pre-treatment profiles emerged, which may account for differences in treatment response during the ASAP intervention. Examining pretreatment heterogeneity may be a useful strategy for understanding predictors of treatment response.

208.004 *(Panel)* Diagnostic Stability in Individuals with Autism Spectrum Disorder: Insights from a Longitudinal Follow-up Study

***R. Elias**[1], J. B. McCauley[2] and C. Lord[2], (1)University of California Los Angeles, Los Angeles, CA, (2)University of California, Los Angeles, Los Angeles, CA*

Background: Regarded as a fixed diagnosis, most individuals with ASD show clinical impairments across the lifespan. Adulthood is associated with a unique set of challenges (Magiati, Tay, & Howlin, 2014) sometimes contributing to overall poor outcomes (Seltzer, Shattuck, Abbeduto & Greenberg, 2005). Little research exists examining individuals who change diagnostic status to a presentation with few signs or impairments associated with ASD as adults, comparable to that of typically developing peers (Anderson, Liang, Lord, 2014; Billstedt, Gillberg, & Gillberg, 2005; Fein et al., 2013).

Objectives: The present study seeks to upwardly extend the work of Anderson, Liang, and Lord (2014) to examine the stability of autism diagnoses in a cohort of participants who were longitudinally assessed at ages 2 to 26 years. Further, potential predictors of diagnostic status among adult participants will be explored. Consistent with prior research, we hypothesized that a small minority of participants would no longer display diagnostic symptoms of ASD in adulthood.

Methods: Ninety-eight participants were seen for diagnostic assessments at several time-points spanning 24 years. Participants comprise a clinically referred sample with diverse races, geography, and socioeconomic status. Those ever given a diagnosis of ASD (86.7%) comprise the focus of analyses (M_{age} = 26.05 years; 82.7% male). Developmental trajectories of adult participants will be described both quantitatively by examining a variety of psychodiagnostic measures and qualitatively through clinical case summaries. Characteristics identified early in childhood (i.e., IQ, ASD symptom severity, & adaptive skills) will also be discussed with respect to later adult outcome and diagnostic status.

Results: At age 26, eleven individuals (12.9%) with a previous diagnosis of ASD no longer met current diagnostic criteria based on consensus-agreement by blinded clinicians. Of the eleven individuals identified, 81.8% no longer displayed diagnostic symptoms after age 9. Interestingly, another 15.3% of the sample converted to a diagnosis of ASD after initial assessment ($M_{age\ of\ autism\ diagnosis}$ = 14.19 years, *SD* = 6.66). Trajectories of each individual presented in the form of individual clinical case studies will be discussed. For example, for one individual no longer displaying symptoms, clinical severity scores (CSS) on the ADOS followed a steady pattern until adulthood (*Mean CSS age 2* = 7; *age 3= 6; age 5= 7; age 9= 6; age 18=4; age 21= 3; age 25=1).* For others, inconsistent patterns were observed (e.g., *Mean CSS age 2* = 4; *age 3= 7; age 5= 1; age 9= 5; age 18=3; age 21= 2; age 25=2)* where lower CSS scores indicate less autistic impairment. Additionally, IQ, adaptive skills, and treatment history will be reviewed longitudinally as these are potent predictors among more and less able individuals with ASD (Anderson et al., 2014).

Conclusions: The majority of individuals diagnosed with ASD retain their diagnosis into adulthood based on clinical symptom presentation. However, understanding the trajectories of diagnostic retention and change over time yields high clinical value. The present study presents unique features of an understudied subset of those with a previous diagnosis of ASD.

ORAL SESSION — DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT

309 - Quantitative Diagnosis and Subtyping Autism

309.001 *(Oral)* Rethinking Measurement of Autism Symptomology in Fragile X Syndrome

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Background: DSM-V diagnostic criteria for autism spectrum disorder (ASD) require symptoms in three social communication (SC) subdomains and two of four restricted and repetitive behaviors (RRBs) subdomains (American Psychiatric Association, 2013). The ADOS-2 (Lord et al., 2012) is the current "gold-standard" assessment of ASD. Sole reliance on the ADOS-2 as a measure of ASD in fragile X syndrome (FXS) research is problematic because individuals with FXS often demonstrate impairments in SC. Over-identification of ASD in FXS may artificially inflate prevalence estimates and may result in inappropriate interventions for FXS.

Objectives: Examine the classification of clinically-relevant symptoms of ASD in adolescents with FXS using three standardized assessments and a parent interview to determine whether use of the ADOS-2 in research may lead to over-identification of ASD in FXS.

Methods: We assessed 42 adolescents with FXS (9 females) using the ADOS-2, the CARS2-ST (Schopler et al., 2010), the Vineland Adaptive Behavior Scales II (VABS-II; Sparrow et al., 2005), and a maternal semi-structured interview (SSI). Based on ADOS-2 and CARS2-ST scores, participants were divided into three groups. Individuals in the Disagree (n = 15) group received "autism or autism spectrum" classifications on the ADOS-2 but "minimal-to-no symptoms" on the CARS2-ST. Individuals in the Agree (n = 15) group received a classification of "autism or autism spectrum" on the ADOS-2 and "mild-to-moderate or moderate-to-severe symptoms" on the CARS2-ST. The No Autism (n = 12) group received "non-spectrum" and "minimal-to-no symptoms" classifications. Responses to items from the VABS-II maladaptive scale and the SSI were equated with DSM-V diagnostic criteria.

Results: Differences in ADOS-2 RRB scores indicated significantly higher incidence of RRBs for the Agree than the Disagree group and for the Disagree than the No Autism group (p <0.001 and p = 0.037, respectively). Although there was no significant difference in ADOS-2 SC scores between the Agree and Disagree groups (p = 0.29), both scored significantly higher than the No Autism group (p < 0.001).

To determine whether adolescents in each group would meet DSM-V criteria for ASD, we calculated the number of subdomains in which each adolescent demonstrated symptoms using the VABS-II and SSI items. There were no significant differences between the No Autism and Disagree groups on the number of SC and RRB subdomains nor on the total scores. The Agree group scored significantly higher than the Disagree group on number of RRB subdomains and on total scores but not SC subdomains.

Conclusions: 79% of boys and 44% of girls met criteria for ASD on the ADOS-2. However, our results suggest that 36% received ASD classifications from the ADOS-2 but not the CARS2-ST. Only 27% would meet DSM-V diagnostic criteria for ASD. Within research, reliance on a single measure of ASD may lead to biased reporting of sample characteristics, limiting replication and generalizability. Similarly, ASD classification as an all or none should be avoided to better consider the severity of autism symptomology in FXS (Abbeduto, McDuffie, & Thurman, 2014). Researchers should include multiple measures of ASD to best represent the variable FXS phenotypes.

309.002 *(Oral)* Validating the Beck Depression Inventory–II in Adults with Autism Spectrum Disorder

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Background: Depressive disorders are common in adults with autism spectrum disorder (ASD), with current and lifetime prevalence estimates of 27% and 42% in this population, respectively (Hollocks et al., 2019). Despite the frequency of these conditions, few studies have examined the extent to which common measures of depression are psychometrically appropriate for use in adults with ASD (Cassidy et al., 2018). Those that have typically utilized such small samples that modern large-sample psychometric techniques are not feasible.

Objectives: This study aims to examine the psychometric properties of a commonly used measure of depressive symptomatology, the Beck Depression Inventory-II (BDI-II), in a large sample of adults with ASD within an Item Response Theory (IRT) framework.

Methods: A sample of 881 adults with self-reported ASD (M_{Age} = 30.94 years, 53% Female, 9% non-binary, 79% Caucasian) was recruited from the Simons Foundation's SPARK database (Feliciano et al., 2018). Current diagnosed or suspected depression was self-reported in 57.7% of the sample, respectively. The latent structure of the BDI-II was evaluated using full-information item factor analysis. A bifactor graded response model was then fit to the BDI-II to detect problematic items and calculate estimated latent trait scores. These latent trait scores were then compared to BDI-II total scores in their ability to predict self-reported depression in the SPARK sample as well as SCID-5-based diagnoses of mood disorders in a rigorously-phenotyped clinical sample of 66 autistic adults (24 with depressive disorders).

Results: A bifactor model with specific "Somatic" and "Cognitive-Affective" factors (Brouwer et al., 2013) fit the BDI-II data well. However, two pairs of BDI-II items (*Loss of Pleasure/Loss of Interest* and *Agitation/Irritability*) were found to be locally dependent (i.e., redundant), and thus the second item in each set was removed. BDI-II item 21 (*Loss of Interest in Sex*), was found to exhibit significant differential item functioning (DIF) by age and was also removed. The 18-item BDI-II scale exhibited improved fit to the data, strong marginal reliability for the general factor (ρ_{xx} = 0.872), no local dependence, and no significant DIF by age, sex, gender, race, sexual orientation, education level, comorbid anxiety, or comorbid ADHD. Three items exhibited DIF by depression status, but these effects canceled each other to produce a negligible impact on BDI-II scores between groups (standardized mean score difference [ETSSD] = -0.03). IRT scores discriminated moderately between individuals with and without depression in both the SPARK sample (*AUC* = 0.80 [0.77, 0.83) and the clinical sample (*AUC* = 0.73 [0.59, 0.85]), exhibiting slightly better performance than BDI-II total scores in both cases. Using our proposed screening cutoff (θ_G = -0.195), the BDI-II IRT score had a sensitivity of 0.82 [0.79, 0.86] and specificity of 0.63 [0.58, 0.68] in the SPARK sample and sensitivity of 0.79 [0.61, 0.95] and specificity of 0.60 [0.45, 0.74] in the clinical sample.

Conclusions: The modified BDI-II can be viewed as a reliable and valid depression screening tool or dimensional measure of depressive symptoms in autistic adults, but its diagnostic specificity is suboptimal in this population.

309.003 *(Oral)* In Search of Subtypes of Children with Autism Using the WISC-V: A Latent Profile Analysis

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Background: Identifying subtypes within Autism Spectrum Disorder (ASD) has been attempted to better understand the significant heterogeneity within the spectrum. Profiles of cognitive functioning have frequently been investigated as one possible subtype. Some studies suggest differential patterns of Performance/Verbal IQ split as possible subtypes, but most studies have relied on relatively small sample sizes and higher-functioning samples and few have used advanced statistical techniques to obtain estimates of underlying profiles of IQ in ASD.

Objectives: The purpose of this study was to use Latent Profile Analysis (LPA) to identify possible subgroups of children with ASD using the Wechsler Intelligence Scale for Children-5th Edition (WISC-V) across a range of ability levels. A secondary objective was to identify meaningful predictors of IQ group membership.

Methods: The sample included 340 children, ages 6-16 (*M*=10.5, *SD*=2.7; 17% Female), who were diagnosed with ASD at a large developmental assessment center between 10/1/2014 and 12/31/2018. Full-scale IQ scores ranged from 42-134 (*M*=90, *SD*=17.4). The primary LPA model consisted of scores on the five WISC-V Index Composites. We then tested a follow-up model consisting of the 10 primary subscales. Multinomial logistic regression was used to predict group membership in the primary model with ASD symptoms (Autism Spectrum Rating Scale), age, biological sex, and Index-level scatter as predictors.

Results: A 4-group solution best fit both the primary and follow-up models. Groupings were similar between both models and generally aligned with traditional classification ranges (i.e., 1-*high average*, 2-*average*, 3-*low average*, 4-*very low*; see figure 1). However, there was a pattern of relatively lower "Cognitive Proficiency" scales across groups, particularly Processing Speed (see figure 1a). This pattern appeared strongest in group 1. Small discrepancies between Verbal Comprehension (VCI) and Fluid Reasoning (FRI) were present in group 1 (VCI<FRI) and group 4 (VCI>FRI). Groups 2 and 4 tended to show the most within-Index subtest discrepancies (see figure 1b). Coding was the lowest subtest score within each group. Significant predictors of group membership emerged in the Composite model (group 2 as reference). Group 4 membership was positively associated with age (Odds Ratio[OR]=1.20, *p*=.02). Group 1 membership was positively associated with social communication difficulties (OR=1.05, *p*=.05) and negatively associated with self-regulation difficulties (OR=0.93, *p*=.01). Group 3 membership was positively associated with repetitive/restricted behaviors (OR=1.05, *p*=.05). Biological sex and Index-level scatter were not significantly associated with group membership.

Conclusions: Overall, data-derived IQ subgroups in ASD generally aligned with traditional IQ classification ranges. Although there were some small variations in profiles between groups, profiles generally showed more similarities than differences. These parallel profiles add evidence to the dimensionality of intellectual functioning within the autism spectrum (versus distinct categorical subtypes). There was also evidence for a possible ASD-related profile consisting of relatively lower processing speed ability, which was found across a range of ability levels. Additional research is needed to identify whether this finding is specific to autism. Core ASD symptoms (i.e., social communication difficulties and repetitive behaviors) were differentially related to being in a *high* or *low average* group compared to an *average* group.

309.004 *(Oral)* Diagnosing DSM-5 Autism Spectrum Disorder in Toddlers: Caregiver Report & Direct Observation

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Background: Diagnostic evaluations of children presenting for autism spectrum disorder (ASD) concerns integrate caregiver report and direct observation to improve diagnostic validity (Kim & Lord, 2012; Risi et al., 2006). The Toddler Autism Symptom Inventory (TASI) is a novel caregiver interview designed for the assessment of toddler-specific manifestations of autism in children under three years.

Objectives: To evaluate whether the TASI and ADOS-2 Toddler Module independently contribute diagnostic information relevant for the diagnosis of autism in young children, thus improving diagnostic accuracy compared to either measure alone.

Methods: Children (*n*=282) 12-30 months of age (*M*=18.9) referred for diagnostic evaluation. completed the ADOS-2 Toddler Module; parents were interviewed using the TASI. Clinical Best Estimate (CBE) diagnosis was assigned by expert clinicians. Seventy-one children were diagnosed with ASD; the non ASD group included subthreshold autism symptoms (*n*=1), global developmental delay (*n*=61), language disorder (*n*=60), and no diagnosis (*n*=89).

TASI algorithms align with DSM-5 ASD diagnostic criteria and “relaxed” criteria for toddlers (Barton et al., 2013). ADOS-2 Mild-to-Moderate (Mild/Mod) and Moderate-to-Severe (Mod/Severe) classifications were considered. Algorithms were compared to CBE diagnosis. Sensitivity and specificity were calculated for meeting threshold for TASI alone, ADOS-2 alone, either, and both.

Results: Validity data are presented in Table 1. While the ADOS-2 Mild/Mod cutoff demonstrated excellent validity, 28 children were misclassified. Requiring both ADOS-2 Mild/Mod and TASI "relaxed" resulted in high sensitivity (0.87) and specificity (0.93), and reduced misclassification to 20 children.

There was significant agreement between the TASI and ADOS-2 (Figure 1); 86% of children in the ADOS-2 Mod/Severe range met TASI cutoffs (Figure 1). Total scores on TASI and ADOS-2 were significantly and positively correlated (r = 0.68).

Conclusions: The TASI with "relaxed" criteria and ADOS-2 both separately and together show good sensitivity and specificity. Most (94%) children who score as Mild-Mod or higher on ADOS-2 and meet “relaxed" DSM-5 TASI algorithm received a CBE diagnosis of autism. Moderate correlations suggest that while each measure broadly quantifies autistic symptoms, each contributes distinct information important for a diagnosis. More specifically, the TASI contributes parent report of the child’s typical communication strategies, play, sensory responses to a wider range of stimuli, and repetitive behaviors that might not be seen in an evaluation. Comparison of the two measures will also allow us to characterize children who meet diagnostic criteria on only one measure compared to those who exceed thresholds on both measures.

ORAL SESSION — DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT

310 - Subtypes and Trajectories in Diagnosis and Development

310.001 *(Oral)* Exploring Latent Subdimensions of Social Communication: A Cross-Measure Factor Analysis

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Background: Social communication deficits are a core diagnostic feature of autism spectrum disorders (ASD). Therefore, measures designed to assess ASD symptoms (e.g., Autism Diagnostic Observation Scale [ADOS], Autism Diagnostic Interview [ADI], and Social Responsiveness Scale [SRS]) include several items capturing various aspects of social communication. While there is great interest in understanding different profiles of social communication abilities (Bishop at el., 2019), success in identifying more nuanced sub-dimensions of social communication has been limited and only with one measure at a time (e.g. Bishop, Havdahl, Huerta & Lord, 2016 with ADOS Module-3; Tanguay, Robertson & Derrick, 1998, with the ADI; and Frazier et al., 2014 with the SRS). No study to date has examined the factor structure of social communication behaviors across multiple measures of ASD symptoms.

Objectives: To explore meaningful latent subdomains of social communication behaviors captured by commonly used ASD diagnostic instruments.

Methods: A large clinically-referred sample was aggregated from six data sources: 1513 children aged from 4 to 10 years old with complete data on 57 social communication items from the ADOS, ADI (current), and SRS. We randomly split the sample into training and validation datasets. The procedure for the novel cross-measure factor analysis was conducted in RStudio with R packages *lavaan* and *blavaan*. First, we introduced orthogonal factors to account for each method of measurement. Then we compared near-saturated nested models with substantive factors composed of items from multiple scales. Once the optimal number of factors was determined, we iteratively constrained item loadings on substantive factors to arrive at an interpretable and parsimonious model.

Results: Based on the fit indices and interpretability as indicated in Table 1, the 4 substantive-factor model was selected. After multiple iterations with additional restrictions and adjustments, the majority of items had a large loading (|λ|>0.3) on at least one factor and cross-loadings were minimized. Items were considered to load on the factors with the largest factor loading.

The final model with the training dataset had a reasonable fit in the training dataset (χ^2_{1607} =3744.668, p=0.000; CFI=0.97; TLI=0.97; RMSEA=0.043; SRMR=0.06). Based on the item content, we labeled the four factors as Conversation Quality and Reciprocity (ni=6); Social Understanding and Behavior Modification during Interactions (ni=15); Social Motivation and Participation (ni=6); and Early Emerging Basic Social Communication Skills (ni=22) (see Table 2). Eight items failed to load highly on any substantive factor. Factor 2 and Factor 4 were highly correlated (r=0.79); other factor correlations were more modest (range: 0.27 to 0.36). The same factor structure was replicated with the validation dataset.

Conclusions: The current analysis expanded previous understanding of subdomains within social communication by identifying four abilities across 57 items drawn from three commonly used measures: a) Conversation Quality and Reciprocity, b) Social Understanding and Behavior Modification during Interactions,c) Social Motivation and Participation, and d) Early Emerging Basic Social Communication Skills. The four-factor structure showed good model fit and was replicated with a validation sample. These findings could inform the development of future measures specific to social communication.

310.002 *(Oral)* Contrasted Clinically and Genetically Relevant Correlates of High-Certainty Autism and ASD Diagnosis

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Background: The heterogeneity of the autistic spectrum disorder (ASD) phenotype, currently favored by inclusive and moderately specific diagnostic criteria, has been implicated in the gradual decrease over time of neurocognitive differences between individuals with and without autism (Rødgaard et al, 2019). Consequently, the stratification of the DSM-5 autistic spectrum by levels of clinical prototypicality may increase our future ability to detect structural, functional, and cognitive differences grounding mechanistic models in neurocognitive and genetic research. Accordingly, subtle autistic phenotypes are probably more prone to represent phenocopies of autism and to be influenced by extraneous factors than ''frank'' autism (De Marchena et al, 2017), quickly and reliably diagnosed by experts, which would unravel intrinsic autistic neurobiological characteristics.

Objectives: Estimate the contribution of the cognitive, behavioral and genetic dimensions on the diagnostician's certainty of autism spectrum disorder.

Methods: Ordinal regression models were used to quantify the effect of core descriptive phenotypic variables of 2,348 autistic individuals from the Simon Simplex Collection (SSC) on the certainty of autism diagnosis a 1 to 15 points scale ranging from very low confidence of having ASD (1 point) to high certainty of being autistic (15 points), based on best clinical judgement. The number of rare deletions and duplications (copy number variations, CNV) were also integrated in statistical models to explain the certainty of diagnosis. An interaction was introduced in each model to test whether the main effects were statistically similar in probands diagnosed with "frank" autism compared to the spectrum group.

Results: Overall, autism core behavioral and neurological phenotypic features are correlated with the certainty of diagnosis (fig. 1a). However, this relationship is statistically different, and sometimes opposite, in frank autistic individuals compared to the spectrum group (fig. 1a). The association between an increase of the social-communication and the RRB ADOS scores with the certainty of diagnosis is stronger in the autism group (β=0.74; p=<2e-16 and β=0.68; p=<2e-16, respectively) compared to the spectrum group (β=0.16; p=0.1 and β=0.35; p=6e-04). A lower verbal/nonverbal IQ ratio, a larger head size than expected from parental head size and body mass, and a delayed language were associated with the certainty of diagnosis exclusively in the autism group (fig. 1a). A higher number of deletion CNVs correlates with a lower certainty of autism diagnosis in the autism group (β=-0.10; p=0.004), but not of the spectrum group (fig.1b). Conversely, a higher number of duplication CNVs is associated with a higher certainty of diagnosis in the spectrum group (β=0.16; p=0.001) but not in the autism group.

Conclusions: Relying on a ''frank'' autism clinical presentation in research increases neurocognitive, structural and genetic signals such as macrocephaly or verbal versus nonverbal IQ ratio, which may be shadowed and considered less sensitive when measured in a broader autism spectrum population. A distinct analysis and interpretation of neurobiological features between "frank" and spectrum individuals is justified.

310.003 *(Oral)* Autism Symptom Trajectories from Early to Middle Childhood in the Children of the Autism Phenome Project

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Background: Previous studies have generally shown autism symptom severity remains stable over time, with small groups decreasing or increasing (1-4). We previously evaluated autism symptom trajectories based on the Autism Diagnostic Observation Schedule-2, Calibrated Severity Score (ADOS-2 CSS) in the UC Davis MIND Institute Autism Phenome Project (APP) cohort between 3 and 6 years of age. Children were grouped according to shared trajectories of change. A Decreased Severity Group (28.8%) decreased by 2 or more points; a Stable Severity Group (54.4%) changed by 1 point or less; and an Increased Severity Group (16.8%) increased by 2 or more points. Girls showed a greater tendency to decrease in severity than boys. Severity decreases were associated with being female and having higher IQ and adaptive functioning, while severity increases were associated with having lower and stable IQ and adaptive functioning. Anxiety has been shown to be a prevalent comorbidity of ASD (5), to associate with impairment in social function (6) and might be related to decreases in symptom severity (7).

Objectives: To examine the trajectories of autism severity from early to middle childhood for the children of the APP and evaluate the relationship between change in severity and anxiety.

Methods: One hundred and sixty nine children with ASD (119 boys, 50 girls) were assessed at approximately age 3 (Time 1), age 6 (Time 3) and age 8-12 (Time 4). Each participant was measured in at least two time points. We used ADOS-2 to evaluate trajectories of general autism severity as well as Social Affect (SA) and Restricted, Repetitive behaviors (RRBs). IQ was assessed using MSEL and DAS-II and adaptive functioning was assessed using VABS-II. Data regarding anxiety were collected using the ADIS/ASA (Anxiety Disorders Interview Schedule/ Autism Spectrum Addendum) and CBCL. Symptom severity trajectories were created using latent change score (8) and latent mixture models (9) and other variables were used as covariates.

Results: We identified a decrease in symptom severity across early childhood (age 3 to age 6) followed by an increase in middle childhood (age 6 to age 12), with large variability between individuals in the magnitude of change. Trajectories of RRBs showed a general decline over time whereas Social Affect symptoms showed a decrease during early childhood followed by a robust increase during middle childhood (Figure 1). Consistent with our previous findings, girls showed a consistent tendency to decrease in symptom severity and to have lower ADOS scores compared with boys. Higher IQ and adaptive functioning were associated with decreasing severity, an association that became stronger with age. Externalizing behaviors were associated with increasing severity. Anxiety levels were also associated with symptom severity change; a decrease in ADOS symptom severity during early childhood was associated with higher anxiety levels in middle childhood.

Conclusions: Our findings suggest symptom severity might show more change than previously appreciated. We noted a tendency to decrease across early childhood and increase across middle childhood. Decreases in severity were associated with being female and having higher IQ and adaptive functioning, but also higher anxiety levels.

310.004 *(Oral)* Developmental Trajectories of Adaptive Behavior from Toddlerhood to Middle Adulthood in Autism

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Background: Adaptive behavior is a critical indicator of quality of life and employment in adults with Autism Spectrum Disorder (ASD). Individuals with ASD experience difficulties in adaptive behavior regardless of their intellectual functioning (Tillmann et al., 2019). There is evidence for a plateau of adaptive behavior skills in adolescence and early adulthood (Meyer et al., 2018; Smith et al., 2012). Few studies have examined trajectories of adaptive behavior beyond young adulthood.

Objectives: The present study examined developmental trajectories of adaptive behavior in individuals with ASD from toddler to middle adulthood.

Methods: Participants included 55 individuals with ASD seen between 1969 and 2000 at the University of North Carolina TEACCH Autism Program. At the time of the first evaluation participants were between 2 and 16 years old (M = 6.39 SD = 3.58) Participants had records of up to 8 follow-up evaluations between the ages of 3-31, and an assessment was completed when individuals were 27-55 (M = 36.7, SD =6.78). Adaptive behavior was measured at multiple timepoints using the Vineland Social Maturity Scale (Doll, 1953), Vineland Adaptive Behavior Scales (Sparrow et al., 1984), and the Vineland Adaptive Behavior Scales, 2nd Edition (Sparrow et al., 2005), with 60% of participants having more than three assessments. Clinical records included the overall adaptive behavior composite measuring communication, daily living skills, and socialization in everyday activities. Vineland age equivalence scores were used to examine developmental change over time.

All growth models were estimated using MPlus Version 8. Fixed effects for linear and quadratic growth models were estimated for adaptive behavior trajectories controlling for IQ trajectories. Model fit criteria was assessed using fit using the -2 Loglikelihood, Akaike's information criterion (AIC) and Bayesian information criterion (BIC).

Results: Controlling for IQ, the best fitting growth model for the adaptive behavior age equivalency scores from ages 3-55 included significant fixed effects for linear and quadratic growth. The average adaptive behavior age equivalence score at 17.5 years was 6.0 years. Scores increased at an average rate of 3 months in age equivalency score per year of age across adulthood. However, the rate of increase slowed over time as indicated by a negative quadratic estimate of -.01. While a majority of adults made gains in their adaptive skills over time, a subset of 9 individuals declined over time creating an overall trajectory of decline (see figure). These adults were older (M = 44.11, SD = 8.10) and had higher CARS scores (M = 35.61, SD = 6.86).

Conclusions: Adaptive behavior scores increased at a slower rate than expected for chronological age, similar to findings across adulthood in daily living skills (Smith et al., 2012). It appears that rather than a plateauing of skills during adulthood (Meyer et al., 2018), there is a slow growth of skills across adulthood. However, some adults show declining skills. It is likely that there is variability in subgroups of adults with ASD in their adaptive behavior trajectories. Future research examining the characteristic of adults with declining trajectories is important to identifying intervention targets.

POSTER SESSION — **DIAGNOSTIC, BEHAVIORAL, SENSORY AND INTELLECTUAL SCREENING AND ASSESSMENT**

415 - Diagnostic, Behavioral, Sensory and Intellectual Screening and Assessment Posters

415.001 *(Poster)* A Case Study: Longitudinal Diagnostic Group Changes from Typical Development to Autism in Four Male Participants

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Background: The Childhood Autism Risks from Genetics and the Environment (CHARGE) study is a comprehensive study of environmental and genetic risk factors for autism and other developmental delays. Children ages 24–60 months were enrolled into one of three groups: autism spectrum disorder (AU), developmental delays (DD), and general population with typical development (TD). Since 2003, over 2000 children and their families have participated. The Revisiting CHARGE (ReCHARGE) study is designed to follow up with CHARGE participants, at 8-19 years of age, to assess longitudinal change in cognitive ability, adaptive functioning, and diagnostic group.

Objectives: To describe the longitudinal diagnosis change of four participants from the TD group to the AU group.

Methods: Diagnostic groups were determined by cognitive, adaptive, and autism diagnostic assessments during CHARGE and ReCHARGE visits. The exit diagnostic criteria in CHARGE for TD children was defined by both the Mullen Scales of Early Learning (MSEL) and Vineland Adaptive Behavior Scales (VABS) standard scores of ≥70, and the Social Communication Questionnaire (SCQ) total score of <15. Clinical judgement was used with elevated SCQ scores to determine the need for further AU evaluation in the TD group. The Autism Diagnostic Interview-Revised (ADI-R) and the Autism Diagnostic Observation Schedule (ADOS) were administered to confirm that possible TD cases met or did not meet DSM-IV criteria. The ReCHARGE final diagnosis for TD children was determined by Stanford-Binet Intelligence Scale, Fifth Edition – Abbreviated Battery score of ≥70, VABS-3 composite score of ≥70, and the SCQ total score of <15. To confirm AU cases, the ADOS-2, an informal parent interview, and a DSM-V checklist were used.

Results: Of 118 TD children seen in ReCHARGE, six changed diagnostic groups from TD to AU. Two participants were omitted from our analysis. One had an incomplete SCQ at the CHARGE time point with 11 missing questions. The other had an SCQ score of 16 in CHARGE; clinical judgement was used to determine that further AU evaluation was not needed. The four remaining participants met TD criteria for MSEL, VABS, and SCQ between the ages of 24–60 months. Participants 1 and 4 received an AU diagnosis after their CHARGE evaluation by a community clinician; these diagnoses were both confirmed at ReCHARGE by ADOS, and DSM-V checklist. The remaining participants were identified by clinician judgement and met criteria on the ADOS-2 and DSM-V checklist. Refer to *Table 1* and *Table 2.*

Conclusions:The diagnostic change from TD to AU was unexpected, especially as **no developmental concerns** were noted in their CHARGE files. In pediatric research a multitude of problems may exist in obtaining accurate data including parent report and consistency, parent understanding of developmental milestones, and difficulty in testing young children. This study shows the challenges parents and providers have in reporting and identifying all AUT cases in children ages 2–5 years. Further research is warranted to explore causes of late diagnoses. Additional assessments and secondary AUT screening during middle childhood could prove helpful in these cases as well as in cases when SCQ scores are elevated.

415.002 *(Poster)* A Latent Profile Analysis of Infants' Sensory, Motor, and Social Communication Risk on the First Years Inventory and Age-3 Outcomes in a Community Sample

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Background: Autism spectrum disorder (ASD) is a complex condition that encompasses difficulties in sensory reactivity and motor coordination, in addition to social communication problems. Thus, it is important for an ASD-specific screener, such as the First Years Inventory, version 3.1 (FYI), to cover the breadth of developmental domains that may be implicated as potential risk markers early in development. Assessing the behavioral manifestations of risk, which may vary across developmental domains, is therefore critical to parsing ASD heterogeneity and testing the predictive validity of the FYI.

Objectives: To better understand variations in early risk signs of ASD, this study adopted latent profile analysis (LPA), a person-based approach to classifying infants based on three FYI domain scores: Social Communication (SC), Sensory-Regulatory Functions (SR), and Motor Development (MD). We also aimed to examine whether the identified profiles (i.e., subgroups) differed in demographics and later parent-report outcomes.

Methods: A community sample of parents who had a child 8-16 months of age completed the FYI A- or B-form, each consisting of 48 items across three domains: SC, SR, and MD. When children reached 3 years of age, 2,194 parents who had previously returned the FYI completed the Developmental Concerns Questionnaire (DCQ), Social Responsiveness Scale (SRS-2) and Sensory Experiences Questionnaire, version 2.1 (SEQ) as follow-up measures of children's clinical outcomes. Using the FYI domain scores as indicators, LPA was conducted to identify profiles. After choosing the optimal model based on fit statistics, means or proportions across the identified profiles were compared on demographics (e.g., child's age upon FYI completion) and age-3 outcomes, using ANOVA or equivalence tests for odds ratios.

Results: LPA indicated that the best-fitting model was a four-profile solution (Figure 1) for both A/B-form cohorts. The largest profile (Profile 1) had the lowest risk levels in all three domains. Both Profile 2 and Profile 3 scored high on SC and MD, while Profile 3 showed higher overall severity. Profile 4 scored particularly high on SR. The odds ratios relative to base rate (Table 1) indicated that children in Profile 2 were more likely to be premature and to have motor-related concerns at age 3. Children in Profile 3 and 4 were more likely to have a later outcome of ASD or sensory processing disorder (SPD). Also, the odds of having various types of parental concerns differed across the four profiles. Profile 4 had significantly higher SEQ scores at age 3, particularly in hyperresponsiveness and seeking behavior.

Conclusions: These findings revealed heterogeneous manifestations of early ASD-related risk in a large community sample, with four subgroups differing in demographics and later developmental outcomes. The two most severe profiles, based on FYI scores at 8-16 months of age, were related to higher probabilities of ASD-related outcomes at age 3; however, one of these profiles showed higher risk in SR, while the other showed more risk in SC and MD. These findings stress the importance of dimensional assessments in parsing heterogeneity of early ASD risk profiles, and may have implications for better tailored interventions in the future.

415.003 *(Poster)* A Novel Framework for Autism Diagnosis Using Structural MRI

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Background: Autism spectrum disorder (ASD) is a neuro-developmental disorder that has three main associated characteristics: (i) social functioning disorders, (ii) communication impairments, and (iii) restricted and repetitive behaviors. In order to study various types of abnormalities correlated with ASD, several magnetic resonance imaging (MRI) based modalities have been used, such as:(i) structural MRI (sMRI) for anatomical abnormalities, (ii) functional MRI (fMRI) for brain activity abnormalities, and (iii) diffusion tensor imaging (DTI) for connectivity abnormalities. In this work, we study the differences between autistic and typically developed (TD) subjects using sMRI anatomical features.

Objectives: To distinguish among TD and autistic subject using sMRI anatomical features per area to achieve both global and local classifications.

Methods: Morphological and volumetric features are calculated for each subject's MRI volume. Each subject is then to be classified either autistic or typically developed based on combinations of these features and random forest classifier. First, preprocessing is done using FreeSurfer as follows: 1. Intensity normalization, 2. Brain extraction and skull stripping, and 3. Brain segmentation and areas labeling. Second, extract our features as follows: For each subject and for every feature, a 68×68 areas delta matrix is created. Where each element in this matrix is the difference between the value of a feature of this area and the value of the same feature of a different area.

Results: Using the proposed framework on several datasets of total 1112 subjects obtained from the Autism Brain Imaging Data Exchange (ABIDE), 8 features were extracted from 68 brain regions for each subject. In this experiment, we used random forest classifier for each dataset. CMU has demonstrated accuracy, sensitivity and specificity of 100%, KKI 94% accuracy, 93% sensitivity and 95% specificity, MaxMun showed 98% accuracy, 100% sensitivity, and 96% specificity. Rest of sites has shown accuracy, sensitivity and specificity all over 90% except NYU showed 73% accuracy, 72% sensitivity, and 76% specificity.

Conclusions: In this work, a new sMRI brain volume representation is proposed that might be more robust against confounding variables like IQ and age. The new framework is tested on ABIDE dataset which is collected from different sites and has high variability in the confounding variables we are targeting. The framework shows promising results that we aim to generalize of other datasets and prove that this framework can be a first step towards generalized autism diagnosis system.

415.004 *(Poster)* A Novel Sensory Perception Measurement As a Possible Bio-Marker for Autism Spectrum Disorder

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Background: Hyper- or hypo- reactivity to sensory input and sensory integration impairment are common to people on the autism spectrum. Sensory perception (SP) activity of the brainstem affects auditory efferents activity. Auditory efferents control the selective production of stochastic auditory signals: oto-acoustic emissions (OAEs) by the outer hair cells (OHCs). Therefore, OAEs response measurement is an indication of SP reactivity.

Objectives: To assess the potential of a novel non-invasive and easy to administer method for measuring sensory perception as a diagnostic biomarker in autism spectrum disorder (ASD).

Methods: We used an OAE measurement device to record the auditory efferents' activity. The test instrument includes two earphones and two microphones to capture both the ipsi- and the contra-lateral responses of all stimuli. The stimuli used are longer and more complex compared with those used in standard OAE tests. Two of the stimuli were used for analysis: The first part of the word "Enrich" ("Eh") and a short gap in pure tone delivery. The OAE patterns we were looking for in the response are time/frequency distribution patterns relative to the basic stimulus profile. We have measured OAEs from 12 children with ASD (ages 2-9 years) and 12 age and gender matched typically developing (TD) children. Exclusion criteria included: serous otitis media, absence of OAE activity, hearing loss of sounds quieter than 45dB., and in the TD group also a family history of ASD.

Results: Sub-sections analysis of the OAE time/frequency measured response matrix revealed a significant group difference between the ASD and TD groups. In some sections, similar responses were found but at different frequencies and in others sections the frequencies were the same but the ASD group response was delayed. The stratified mean accuracy of ASD/TD discrimination, across all folds was: 89.7% ± 3.2% for EH responses, and 83.8% ± 3.5% for gap responses.

Conclusions: We found different OAE response profiles in children with ASD compared with TD children. These results support the feasibility of OAE measurement as a diagnostic and possibly stratifying biomarker for ASD. Further studies are required to assess the stratification validity of OAE measurement and its correlation with sensory perception.

415.005 *(Poster)* A Roadmap for Using Applied Research to Tailor Clinical Practice Recommendations for ASD Screening Using the M-CHAT

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Background: While concerns about ASD's prevalence and delays in diagnosis have mobilized significant investments in research in the US, recent reports indicate persistent gaps in timely and accurate identification. Last year at IMFAR, we modeled a research roadmap capturing the potential progress from basic to applied research focused on improving identification, and suggesting downstream impacts on practice, policy, and outcomes. Applying this roadmap to applied research involving the Modified Checklist for Autism in Toddlers (M-CHAT) yielded many clinical validation studies suggesting the potential for improving identification. Nonetheless, some researchers remain skeptical because of variability across low- and high-risk samples, and across key validity metrics. Community-based practitioners deciding whether to use the M-CHAT - especially those who struggle with statistics - may be unable to untangle contradictory recommendations. This is further complicated by the mismatch between the certainty sought by researchers, and the urgency experienced by community-based clinicians eager to help their patients now. For reasons we have outlined elsewhere, we believe that practitioners have other opportunities to mitigate some uncertainty, and might consider a decision model that re-balances priorities once the risks are clarified.

Objectives: (1) To demonstrate a practitioner-friendly template for summarizing key validity metrics by applying it systematically to eligible M-CHAT studies; (2) Drawing from this template, to model 3 standards guiding decisions to adopt the M-CHAT.

Methods: Building on an earlier, comprehensive review that categorized all applied research involving the M-CHAT along the research roadmap, we coded validity studies as focusing on low-risk (i.e., no concerns) versus high-risk populations (i.e., concerns or family history of ASD) of children not yet diagnosed with any developmental disability. Excluding studies that did not confirm an ASD diagnosis, we extracted key data on validity, study design, and other characteristics. We tracked studies on separate publication timelines for low- versus high-risk samples that capture accumulating evidence relative to three different standards for balancing uncertainty and opportunity: (1) a model prioritizing the detection of True Positives; (2) a model that balances True Positives, False Negatives, and False Positives identified with other previously undetected conditions, and; (3) a traditional model seeking a high degree of certainty across key metrics, with more restrictive study inclusion criteria.

Results: We discovered more than 40 eligible studies reporting at least one key metric. About one half of these studies involved a low-risk population, but fewer met the more restrictive selection criteria for Model 3. For both Low- and High-Risk populations, Model 1 rapidly accumulated consistent support, at the cost of significant uncertainty regarding False Negatives and False Positives. Support for Model 3 was difficult to establish because of the limited and sometimes contradictory conclusions. Model 2 clearly supported a decision to adopt the M-CHAT, as long as some False Negatives are tolerated and False Positives capture other important, un-diagnosed conditions.

Conclusions: These analyses suggest that flexible standards may help practitioners make best use of available research when deciding whether to adopt the M-CHAT, and support the implementation research needed to begin to close persistent gaps in identification.

415.006 *(Poster)* A Survey on Private Rehabilitation & Education Services for Children with ASD in Guangzhou China

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Background: In the recent 10 years, quite a number of rehabilitation and education service facilities for ASD(autism spectrum disorder, ASD) emerged in China largely due to increasing market demand. However, the quality of the services can vary significantly especially in the private sector. It is necessary to characterize the key aspects of these service providers for service improvement and policy-making.

Objectives: This study aimed to provide data on the current state of private rehabilitation & education services for children with ASD in Guangzhou. The results are expected to assist with governmental decision making in respect of monitoring and supporting healthy growth of these services.

Methods: In 2019, questionnaires, telephone interviews, on-site visits, social media were employed to collection information from teachers and parents on the scale (number of ASD children practitioner), intervention approach(ABA,SIT,ST), teacher's education background, monthly fees , etc.

Results: Sixty-five facilities participated in the survey. NPOs (non-profit organization) and commercially registered companies accounted for 64.6% and 35.4%. of the surveyed facilities, respectively. From the perspective of teachers, only 4 facilities require all teachers to hold bachelor's degree or above, 14(21.5%) facilities had staff graduated from polytechnic schools or with lower education level. There were 20 facilities (30.8%) that required new teachers hold teacher certificate or a training certificate in the field of autism rehabilitation and education.

The average number of staff of surveyed facilities was 25. Among them, 63.1% facilities had less than 20 teachers. Regarding intervention, ABA, sensory integration, speech therapy, structural education, music therapy, were the most commonly applied. Floor-time and Sand play were also adopted in some facilities.

Fifty-one facilities （78.4%） charged 3000 ~10000 RMB per month. Seven centers charged more than RMB10000/month among which 2 centers charged up to RMB 20000/month or above. Forty-five facilities (69.2%) had not received any governmental subsidies. Parents' questionnaires showed that 57% families paid all expenses out of pocket, and 42.86% of surveyed parents reported that their autistic children had not received any intervention due to financial difficulty.

Conclusions: In Guangzhou, the majority of private service facilities did not require minimum education of teachers, which raises concerns about the professional quality of their service. Invention costs were high, but government subsidies were relatively low and only covered a fraction of families in need. Government supervision is lagging behind the development of autism service due to a lack of matching laws and regulations. Unlicensed operations over profit-seeking, deceptive advertisement have been reported from time to time. Given the limited number and capacity of public special education schools and lack of inclusive education support in mainstream schools, the overall rehabilitation and education services for children with ASD in China are still far from sufficiency in terms of quality and quantity.

415.007 *(Poster)* A Systematic Review of Diagnostic Tools for Autism in Chinese Populations

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Background: Autism screening and diagnostic tools help clinicians identify autism-like behaviours through observations and interviews with parents and inform the judgement of the autism team when making a diagnosis. Most tools were originally developed in the West world, some have been adapted or translated across the years to increase the cultural validity for different population. Previous studies have reviewed screening tools for autism rather than diagnostic in Chinese populations. This study aims to identify which diagnostic tools have been used with this population and the processes undertaken when translating.

Objectives: To review all diagnostic tools for autism that have been used with Chinese populations and report on the relative methodological and cultural quality of these tools.

Methods: Studies from nine databases were retrieved from each database and between 2001 through October 2019. To be included, the study must have used an autism diagnostic tool with someone of Chinese ethnicity and be published in English. Quality assurance and appraisal was carried out by the co-authors of this study.

Results: Among the 57 papers included in the review, 39 were from conducted in China, 13 in Taiwan, 3 in Hong Kong, 1 in the USA and 1 in both China and Taiwan. Four autism diagnostic tools were located in the studies, namely the Childhood Autism Rating Scale (CARS [N=29]), the Autism Diagnostic Interview- Revised (ADI-R [N=21]), the Autism Diagnostic Observation Schedule (ADOS [N=16]) and the Developmental, Dimensional and Diagnostic Interview (3Di [1]). The combine use of both ADOS and ADI-R during autism assessment have been regarded as the gold standard assessment method for autism. Among the 57 papers, 10 (14.9%) adopted such method. Over 40% of the papers stated the use of adapted or translated versions of existing tools specifically (3Di: 100%, ADI-R: 52,4%, CARS: 44.8% and ADOS 1.9%). The cultural appropriateness and the methodological quality of the papers are also evaluated and rated.

Conclusions: Only one paper involved the use of an adapted diagnostic tool with the Chinese population in an English-speaking country. Therefore, it is unclear whether such practice is common for other researchers and practitioners within Western countries with Chinese migrant populations. We recommend that improved steps need to be taken when using diagnostic tests for autism with Chinese populations to enhance the reliability and cultural relevance with this population .

415.008 *(Poster)* A Systematic Review of Tools Used to Measure Suicidality Among Children and Youth with and without ASD

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Background: Suicidality (suicidal thoughts and behaviours) is exceptionally common, and often overlooked in individuals with autism spectrum disorder (ASD), affecting up to two-thirds of individuals. Importantly, the risk of death by suicide is seven times higher in individuals with ASD than in the general population. Cassidy and colleagues (2018) found that despite the growing number of studies assessing suicidality in this population, no studies involving autistic adults had used a validated suicide assessment tool. To date, no study has identified what tools are currently being to measure suicide risk in children and youth in both research and clinical contexts. Furthermore, it is not known whether existing suicide assessment tools are reliable or valid for use in children and youth with ASD. Identifying valid assessment tools is crucial to understanding, recognizing, and treating suicidality, as well as preventing premature death in this vulnerable population.

Objectives: The present study aimed to extend Cassidy and colleagues' (2018) study of suicidality in adults with ASD, to systematically examine the suicide assessment tools used with children and youth. Specifically, we aimed to: 1) identify measures commonly used to assess suicidality in children and youth in the general population, as well as in children and youth with ASD; and 2) provide suggestions for future research in this area.

Methods: A systematic literature search was conducted using the following bibliographic databases: PsycINFO, Medline, Embase, and Web of Knowledge. Searches were carried out for 1) children and youth with ASD, and 2) the general population of children and youth.

Results: Overall, we did not identify any tools that were commonly used in children and youth with ASD. Majority of studies screened utilized single-item measures of suicidality either independently or taken from tools that assess for depression or psychopathology more broadly (e.g. K-SADS; CBCL; MINI-KID, etc.). Several studies also used measures of their own creation with no evidence of validity. Of tools that measure suicidality specifically, we identified five tools (Columbia-Suicide Severity Rating Scale [C-SSRS] Paykel Suicide Scale [PSS]; Self-Injurious Thoughts and Behaviours Interview [SITBI]; Suicide Behaviours Questionnaire-Revised [SBI-R]; Beck Scale for Suicidal Ideation [BSS]) commonly used in general population youth.

Conclusions: Results highlight the absence of any tool that has consistently been utilized to measure suicidality in children and youth with ASD. Additionally, there is a lack of research examining the validity of utilizing existing suicide risk assessment measures in children with ASD. Future research should aim to either validate the use of existing tools in this population; adapt existing measures to reliably capture the unique presentation of suicidality in this population, and/or develop new measures to facilitate clinically meaningful research to further understand and prevent suicidality in autistic children and youth. We will propose a framework for future research and clearly define steps that should be taken to fill this gap.

415.009 *(Poster)* A Systematic Review on the Psychometric Properties of Motor Assessments for Young Children with Autism Spectrum Disorder

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Background: The diagnosis of Autism Spectrum Disorder (ASD) is often delayed till 38 months of age or older, because the defining features of ASD do not fully emerge until the second year (Daniels & Mandell, 2014). However, children with ASD start to show multidimensional developmental delays in infancy. Despite being most frequently identified behaviors by parents to raise concerns (Flanagan et al., 2012), motor differences among young children with ASD are often neglected by clinicians during screening and early interventions. In fact, children with ASD experience different levels of motor delays from an early age (Koterba, Leezenbaum, & Iverson, 2014). With an increasing interest in early motor development of young children with ASD, there is a need to identify which motor assessments are the most accurate and sensitive to use with this population. By systematically reviewing the psychometric properties of existing motor assessments, clear recommendations can be provided to clinicians.

Objectives: To systematically evaluate the psychometric properties of motor assessments and screening tools for young children with ASD from birth to 6 years old.

Methods: A comprehensive search strategy was performed in February, 2019 in seven English databases (Medline [Ovid], Embase, Scopus, CINAHL, ERIC [Proquest], SportDiscus, and PsycInfo) and four Chinese databases (Chinese National Knowledge Infrastructure, Wanfang DATA, and CUHK Libraries) to avoid Tower of Babel bias. Studies that met the following criteria were included: 1) The studied instrument contains an isolated score in the motor domain; 2) Included studies report ≥1 psychometric property outcome; 3) Participants ranged in age from birth to 6 years old; 4) Studied population: children with ASD. Methodological quality was assessed with the Critical Appraisal Tool for Validity and Reliability Studies of Objective Clinical Tools and the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2).

Results: A total of 6574 articles were identified during the title and abstract screening (180 published in Chinese). 400 full-text studies were screened for eligibility. Nine articles were included in the data extraction (PRISMA Flowchart). Nine assessment tools from nine studies met the inclusion criteria: Test of Gross Motor Development-3 (TGMD-3), Mullen Scales of Early Learning, Peabody Developmental Motor Scales-2 (PDMS-2), Miller Function and Participation Scales (M-FUN), Child Development Inventory, Skills Assessment, Preschool Imitation and Praxis Scale (PIPS), Ages and Stages Questionnaires (ASQ), and Tokyo Child Development Schedule. Methodological quality varied from poor to excellent and validity and reliability varied from fair to excellent.

Conclusions: This systematic review summarized the psychometric properties of existing motor assessments, developmental scales and screening tools for young children with ASD. The majority of assessments included have fair-excellent reliability and validity. The tools demonstrated moderate to high levels of agreement in identification of motor delays in young children with ASD. Future research on evaluating motor assessment tools for young children with ASD is urgently needed. Clear assessment and screening recommendations for clinicians have the potential to improve the comprehensive evaluation process, so that young children with ASD can receive proper early intervention services sooner.

415.010 *(Poster)* ADOS Characterization of a Broad Sample of Women with Autistic Traits

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Background: Females are diagnosed with autism at much lower rates than males. It is still uncertain how much of this discrepancy is because different trait presentations in girls and women are not recognized by standard diagnostic measures. This discrepancy may be especially pronounced for women with autistic traits, who often report significant social and mental health concerns but have been frequently underdiagnosed or misdiagnosed and thus do not receive appropriate services.

Objectives: We aimed to characterized profiles on standard diagnostic measures in a broad sample of fully verbal women with average- to above-average IQs, who self-report that social situations are difficult. We explored relationships between diagnostic measures and previous autism diagnosis and looked at the standard vs. revised algorithm for Module 4 of the ADOS-2.

Methods: Adult women with social difficulties were recruited from existing research databases and by posted flyers that asked 'Do you find social situations confusing or exhausting.' Participants did not need to have an established diagnosis of autism. Those who scored 3.0 or above on the BAPQ screening measure administered online were invited for in-person lab visit. Participants in the in-person study included 66 women (mean age=24.8; mean estimated IQ=114.25). Module 4 of the Autism Diagnostic Observation Schedule-2nd Edition was administered by trained clinicians supervised by research-reliable administrators. We calculated ADOS-2 scores using both the standard and revised algorithms (Hus and Lord, 2014). We also looked at ADOS-2 vis-à-vis CATQ camouflaging scores for a subset of women (n=56) who had both measures.

Results: One third (n=22) of the sample had a previous diagnosis of autism. Of these, 12 had been diagnosed in childhood, 4 as teenagers and 6 as adults. For all participants, 20 of the 66 women scored at or above the autism spectrum range on the ADOS-2 revised algorithm. This is 30% more than the number above cut-scores on the old algorithm (n=14). ADOS-2 scores were not significantly correlated with autism trait self-report ratings (the AQ, r=.191; the SRS-2 r=.158) though these ratings were highly correlated with each other (r=.556). There were no group differences in camouflaging scores from the CAT-Q, for those above or below the ADOS cut scores (t=.060) or the dimensional trait measures. However, many women scored high on these trait measures, with SRS-2 mean scores (92.02) and AQ mean scores (28.48) well into the range of concern for autism symptoms.

Conclusions: The revised algorithm for Module 4 identified many more participants in the autism spectrum or autism range than the previous algorithm. However, overall there is a large discrepancy between self-reported social distress (on the BAPQ, SRS-2, AQ) and functional impairment identified by the ADOS. This gap poses many questions. Which is more correct? Are these women camouflaging social distress and able to "pass" the ADOS despite everyday disruption in social function? Or do the dimensional questionnaires exaggerate or mix distress related to anxiety and other concerns? There remains an urgent need to develop and validate multi-modal measurements of social distress and impairment in females and in women especially.

415.011 *(Poster)* Age of Concern and Evaluation Trajectory in Developmental Coordination Disorder (DCD) and Autism Spectrum Disorder (ASD) with Co-Occurring DCD

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Background: Motor symptoms in ASD include abnormalities of gait and balance, postural instability, and incoordination, and for some individuals these are significant enough to warrant a diagnosis of Developmental Coordination Disorder (DCD). Despite the documented presence of significant motor symptoms in patients with ASD, motor function is often not prioritized in assessment or intervention. There are few published studies examining the pathways used for diagnosis, referral, and early management of pediatric patients with ASD, DCD, and ASD+DCD with regard to age of first concern and follow-up motor assessments.

Objectives: Our aim was to assess differences in the timing of initial developmental concerns and follow-up care among patients with ASD, DCD, and ASD+DCD in a local children's hospital. We hypothesized that the groups would not differ in age of first concern, first concern visit, or age at referral visit with specialist.

Methods: We retrospectively evaluated the records of patients who were 0-21 years old at the time of first chart entry (1994-2017), with a diagnosis of ASD, DCD, or ASD+DCD based on DSM-IV or DSM-5 criteria. The number of patients since 1994 was 7540 (ASD = 6,779, DCD = 470, ASD+DCD = 291). We collected primary and co-occurring diagnoses; age at which patients met developmental milestones; age at first concern, first concern visit, and follow-up visit with specialist; demographics.

Results: The mean age of first concern for the DCD group was 46 months, 24 months later than the ASD+DCD group. Though this difference did not reach statistical significance ($p = 0.07$), a 2-year delay in addressing developmental concerns is clinically significant. There was a significant main effect of group on age at first concern visit ($p = 0.001$). Mean age at first concern visit for the ASD+DCD group was approximately 3 years lower than the DCD group and 2 years lower than the ASD group. A similar pattern persisted for age at referral visit with a specialist. Children in the DCD group continued to lag approximately 34 months behind the ASD+DCD group in their care trajectory. In our current study sample, of 81 patients, 38% of children were either noted as having a Global Delay and 50% Delayed in Some Areas. 12.3% of children were marked as Within Normal Limits regarding developmental milestones, but were eventually diagnosed with a developmental disorder. Global Delay was noted less often in the DCD group ($p = 0.03$) relative to the ASD and ASD+DCD groups.

Conclusions: This study highlights differences in the timeline from concern to care for children diagnosed with ASD, DCD, and ASD+DCD. For children with DCD, the average age of first concern drove later care (nearly 3 years) compared to children with ASD and ASD+DCD, and we observed wide variability in age of first concern in the DCD group. It's plausible that ASD and ASD+DCD may manifest as greater functional impairment or symptom severity, prompting earlier caregiver or provider action. The long-term goal is to clarify which elements of the care can be improved to increase diagnostic efficiency and access to services.

415.012 *(Poster)* Age of Initial ASD Diagnosis By Gender, Race, and SES Based on Insurance Type

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Background: Autism spectrum disorder (ASD) occurs more frequently in males than females (Kogan et al., 2009; Lai et al., 2015; Rynkiewicz et al., 2016) with some evidence suggesting females are misdiagnosed or diagnosed later than males (Haney, 2016). In addition, there are disparities in age of diagnosis based on a child's race/ethnicity and insurance type (Mandell et al., 2002). A better understanding of how gender, race/ethnicity, and SES (e.g., insurance type) impact age of diagnosis could inform practice guidelines that promote screening and earlier diagnosis.

Objectives: The purpose of this study was to identify the potential influence of gender, race/ethnicity, and SES (as measured by private or public insurance/Medicaid) on age of referral for autism evaluation and for receiving a diagnosis.

Methods: Retrospective analysis of de-identified clinical data included 1,089 children or adolescents who were referred for an evaluation of autism spectrum disorder at an academic medical center in the Midwestern United States (mean age = 6.01 years, SD = 3.99). The sample was primarily White (66.1%; 33.9% racial/ethnic minority) and male (74.4%; 25.6% female) with about equal rates of public/Medicaid (47.2%) or private (52.8%) insurance. Following evaluation 594 (54.5%) received a diagnosis of ASD. Those diagnosed with ASD had an average age of 5.69 (SD = 4.04), were predominantly White (62.5%; 37.5% racial/ethnic minority), male (76.3%; 23.7% female) and had private insurance (59.4%; 40.6% public/Medicaid). A linear regression was conducted to examine the relationship between gender, race/ethnicity, and SES with age of clinic evaluation. A second regression examined the relationship between demographic variables and age of receiving a diagnosis of ASD.

Results: Among all children evaluated in the clinic, race/ethnicity was significantly related to age of evaluation ($p < .001$), such that racial/ethnic minorities were evaluated 1.3 years earlier (i.e., at a younger age) than White children. Gender was marginally significantly related to age of evaluation ($p = .08$), such that females were evaluated 6 months later than males.

Among those individuals who were diagnosed with ASD, race/ethnicity was significantly related to age at ASD diagnosis ($p < .001$), such that racial/ethnic minorities received a diagnosis, on average, 1.5 years earlier than White children. Gender and SES were not significant predictors.

Conclusions: Findings within this clinical sample suggest children from racial/ethnic minority groups were evaluated for ASD at a younger age compared to their White peers. This is contrary to previous findings in which White children were evaluated earlier than African American children (Mandell et al., 2002), suggesting further exploration within this sample. The marginally significant finding that females were evaluated later than males is consistent with previous literature (Rutherford et al., 2016). Plans for subsequent analyses will examine individual characteristics related to cognitive ability, age, and enrollment in early intervention as additional factors.

415.013 *(Poster)* Am I Autistic? Utility of the GQ-ASC As an Autism Assessment in Adult Women.

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Background: There are a number of factors that prevent or delay autistic females from being diagnosed. These include gender bias in referral processes and assessment tools, misattribution of autistic traits to other causes, and camouflaging by autistic females. As a consequence, autistic females frequently reach adolescence or adulthood without a diagnosis. The rate of identification and diagnosis in girls has improved over time, though females as a whole are still thought to be under-represented. So, while the future for autistic girls continues to improve, it begs an important question: Where are all the autistic women?

Objectives: This study aimed to explore the structure of a modified version of The Girls Questionnaire for Autism Spectrum Condition (GQ-ASC; Attwood et al. 2011) to test its utility as an autism screening measure for adult women.

Methods: We recruited 672 women aged between 18 and 72 online. The sample contained 350 diagnosed autistic women (*M* age=36.21, *SD*=10.10), and 322 non-autistic women (*M* age=34.83, *SD*=9.93), each screened using the Autism Quotient (AQ). A Principle Component Analysis (PCA) of GQ-ASC items was contrasted against a Monte Carlo Parallel Analysis (1000 permutations) to determine their appropriateness for use in autistic women over the age of 18 years. Group differences between autistic and non-autistic women on the extracted components of the GQ-ASC were assessed, and a Receiver Operating Characteristic (ROC) curve was used to define a scoring cut-off value that demonstrated good sensitivity and specificity in discriminating between autistic and non-autistic cases.

Results: The PCA and Parallel Analysis revealed a five-component solution that accounted for more than 40% of the total variance. The extracted components were consistent with the female profile of autism, and interpreted as 1) Inner world: describes interest in fantasy, fiction, and reflection on the quality and content of imaginative play in childhood; 2) Camouflaging: describes effortful attempts to reduce the visibility of autistic traits; 3) Sensory Sensitivities: describes sensory processing abnormalities across various modalities; 4) Social Challenges: describes barriers to social understanding and participation; 5) Interests: describes age advanced, and non-stereotypically feminine interests. Significant differences were observed between autistic and non-autistic women across all extracted components, and the GQ-ASC total score. A ROC analysis indicated an excellent level of discrimination, with an area under the curve of 0.89, (95% CI 0.87 to 0.92). When applying a cut-off score of 57, the GQ-ASC correctly identified 80% of autistic cases.

Conclusions: The modified GQ-ASC is an effective and highly discriminant screening tool for use in adult autistic women. It provides valuable insight into the shared features and experiences of this under-recognised and under-represented subset of the autistic community. It has the potential to allow autistic women access to diagnostic services and supports that they may have otherwise missed.

415.014 *(Poster)* An Innovative Way to Screen for Nutritional Risk in Individuals with ASD

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Background: It is well established that feeding disorders occur in approximately 25-35 percent of typically developing children and as high as 90 percent in children with ASD. Based on the literature and clinical practice, children with an ASD are reported to have problematic eating behaviors such as food refusal, unwillingness to consume a large variety of foods, repetitive and ritualized eating behaviors, motor impairments and due to the complexities of problematic eating behaviors, there is a need for a comprehensive eating screening inventory.

Objectives: This pilot study was to develop a comprehensive eating screening inventory, named the Sensory Processing, Aberrant Mealtime Behaviors, Motor, Inventory for Eating (SAMIE). The SAMIE accurately screens for nutritional risk by identifying the four primary domains that affect eating in children with an ASD.

Methods: The development of the questions was executed in three steps. First, a review of the literature was conducted. Second, expert opinion was acquired in developing the questions. The eight experts had at least five years of experience in their area of expertise. Third, ten think-aloud protocols were made to simplify the first draft and to ensure that the questions were accurately addressing each of the domains and that primary caregivers understood the question. Recruitment of the primary caregivers to children with an ASD for the TAP sessions and for the completion of the SAMIE occurred through elementary schools, private practitioners, local Autism conferences and local Autism organizations. Prior to the pilot study, four participants were recruited to complete the SAMIE online. The final version for the pilot consisted of 78 questions, not including demographic information.

Results: To better understand the sample of participants, descriptive statistics (frequencies, means, standard deviations, and minimums)were calculated with the demographic variables (age, sex, height and weight of the child, primary caregiver income and education level), sample size and power calculations were performed. A two sample t-test was performed for continuous variables such as weight and height, whereas a chi-square or Fisher's exact test were performed to compare binary or categorical data, such as age category and sex of child. A total of 162 participants completed the online demographic questionnaire and the SAMIE. Overall, participants did not differ between groups for demographic characteristics, BMI status and dietary intake. After conducting a series of statistical tests, results illustrated that the SAMIE is a valid measure to screen nutritional risk in children with ASD.

Conclusions: Failure to accurately screen, diagnose and treat the complexities of eating difficulties in children with ASD exists due to the relative lack of knowledge and limited standardized eating assessments. Current identification of eating difficulties relies primarily on qualitative methods such as observation and primary caregiver interviews that are expensive and time-consuming. Therefore, the SAMIE was developed to include the four domains that impact eating and nutritional risk in children with ASD and to fulfill a need to have a validated screening inventory, and, in doing so, laying the foundational work toward the development of an in-depth eating assessment instrument, and empirically-validated eating treatment interventions

415.015 *(Poster)* Assessing Autistic Traits in Adult Population in Russia: A Pilot Study

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Background: In 2017 Russian Ministry of Health issued a letter of instructions prohibiting an unfounded change of diagnosis from ASD to another mental condition for individuals reaching adulthood. Until then the diagnosis was routinely changed from ASD to schizoaffective disorder and/or mental retardation, and it was virtually impossible to get an official recognition of ASD for high functioning adolescents and adults. In this situation the need for self-assessment tools in the autistic community was always high, and several attempts were made to provide Russian versions of internationally recognized questionnaires, even if just for a rough reference. Despite that, to our best knowledge, no self-assessment tools for evaluating autistic traits and/or risk of ASD in adult population or adolescents has been officially developed, adapted or validated on Russian-speaking samples. There are anecdotal evidences that most tools used with cut-offs established for European samples tend to overestimate the prominence of autistic traits but no data on this issue has been published in peer-reviewed journals.

Objectives: The aim of the study is to perform initial translation and cross-cultural adaptation of two self-assessment tools, RAADS-14 (a screening tool for ASD in an adult psychiatric population) and AQ (Autism Spectrum Quotient, a continuous, quantitative measure of autistic traits, adult version) on Russian adult neurotypical population in order to provide initial estimates of their reliability and validity.

Methods: Both RAADS-14 and AQ were translated into Russian (front and back translation by a professional team including a representative from autism community; the authors are grateful to Antonina Steinberg for her input to the project). The data collection was performed online, and factor structure, item loads, and score distributions were assessed for each questionnaire for adult neurotypical population.

Results: RAADS-14. The factor structure of the Russian RAADS-14 (sample size 325 participants) corresponded well to the factor structure of the original, yielding domains of mentalizing deficits, social anxiety, and sensory reactivity. The most important culture-specific issue was related to a distinctly different score distribution for the Russian sample (Mean = 17.03, Median = 17, Mode = 15, SD = 8.37) probably stemming from response bias.

AQ. The factor structure of the Russian AQ (sample size 140 participants) best fitted a 2-factor solution (Social interaction and Attention to detail), akin to the data from a Dutch version validation. Several items yielded low loads to the both factors; the Russian AQ may further benefit from excluding these questions or performing some wording alterations. There was no response bias as 50% of the items have reverse scoring, and the scoring distribution was similar to the European samples (Mean = 17.35).

Conclusions: Russian versions of RAADS-14 and AQ were characterized by reasonably good factor structure but RAADS-14 yielded culture-specific changes in score distributions. Further research and validation on clinical samples is needed, and particular measures (like balancing direct and reverse scored items) may be required to minimize response bias.

415.016 *(Poster)* Assessment Profiles of Toddlers Referred for ASD Concerns Based on Foster Care Status

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Background: Research indicates that the overall risk of experiencing foster care in childhood is roughly 6% (Wildeman & Emmanuel, 2014), and approximately 104,000 children under the age of 3 are in foster care on any given day in the United States (U.S. Department of Health and Human Services, 2017). Young children in foster care placement are known to have an increased risk for autism spectrum disorder (ASD) and developmental disabilities (Cidav, Xie, & Mandell, 2018; Kistin et al., 2016). Although it is difficult to disentangle the specific consequences of early adversity (e.g., maltreatment, unstable caregiving conditions) on developmental and behavioral functioning, research suggests that children in foster care experience an increased risk for delayed language development, social delays, and behavioral problems (Leve et al., 2012; Stock & Fisher, 2006). Given that differentiating between the presence of ASD from general developmental delays that are often present in children in foster care can be difficult, research in this area is warranted.

Objectives: The purpose of the current study is to consider differences in assessment profiles of toddlers referred for ASD based on foster care status and final diagnosis.

Methods: Retrospective chart reviews were conducted for toddlers who received the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2) Toddler Module from 2/2015 to 5/2019 at a large autism center. Children were referred by pediatricians due to concerns of possible ASD. Child-level demographic, assessment results, and diagnostic information was gathered. Children in the foster care group were either in a foster care placement with a relative, foster family, or group home at the time of evaluation or had previously been in a foster care placement.

Results: See Table 1 for demographic information. A chi-square test of independence, which examined the relation between ASD diagnosis and foster care placement, was significant, ^{2} (1, N = 302) = 16.48, p < 0.01. Results indicate that children in foster care (M = 12.11, *SD = 7.87*) had significantly lower Total ADOS-2 scores than children who were not in foster care (M = 22.45, *SD = 6.08),* t(299), = -6.69, p = < 0.01. In addition, when considering *Little to No Concern* and *Moderate to Severe Concern* ADOS-2 severity levels, the overall sensitivity of the ADOS-2 for children in foster care placement and those with no foster care involvement, respectively, was 100% and 83%. The respective specificities were 88% and 97%.

Conclusions: Toddlers in foster care referred for ASD evaluations are less likely to receive an ASD diagnosis than toddlers who are not in foster care. However, children in foster care who do not receive ASD diagnoses demonstrate similar developmental profiles as children who are not in foster care and receive ASD diagnoses (Stock & Fisher, 2006). Results indicate that the ADOS-2 reliably identifies toddlers in foster care with and without ASD. Findings also highlight the continued need for research on factors that may differentiate between common developmental deficits from ASD-specific deficits in children in foster care.

415.017 *(Poster)* Assessment of Early ASD Signs and Outcomes in Children with Severe Visual Impairment: Does Social Communication Abilities at 2-3 Years Predict ASD Diagnostic Outcomes at 4-7 Years?

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Background: Children with congenital visual impairment (VI) are at high risk of ASD (risk ratio of 31 times typically developing children (Do et al, 2017), with socio-communicative difficulties becoming evident from the early years. Existing tools used to measure socio-communicative development and ASD are highly vision-dependent and not validated for children with VI. We recently validated the modified ADOS (fluent language) with 97 children aged 4-7 years with severe VI, leading to a new diagnostic algorithm with high sensitivity and specificity against clinician formulation. Twenty (20.6%) were classified as ASD; nineteen (19.6%) with borderline ASD according to clinician formulation. A subgroup (36; 37%) were investigated longitudinally in an earlier study (Dale et al, 2019). As part of their earlier assessments the children participated at 2-years-old in standard behavioural items and social 'presses' to elicit social and communicative behaviours and coded using the novel Social Communication Schedule (SCS-2).

Objectives: To establish whether early social communication measures (SCS-2) at 2 years predict the independent clinician formulation and diagnostic algorithm scores on the modified ADOS at 4-7 years in children visual impairment. The aim is to establish predictive validity and continuity between newly validated social communication assessments and to consider the SCS-2 as a screener for early risk.

Methods: The reliability and validation methods of the modified ADOS and the SCS are described briefly. Thirty-eight children (M=25.51m, SD=2.36) with congenital severe-profound VI were rated using the SCS-2 (high scores indicated better social communicative abilities), whilst engaging in social and independent play tasks. The same children were assessed 3 years later with the modified ADOS (M=63.75m, SD=8.27). A longitudinal analysis of the SCS-2 scores and later clinician ratings and ADOS algorithm ratings are undertaken.

Results: A Kruskal-Wallis test examined differences in three clinician categories (Non-ASD, Borderline, ASD) and SCS. A significant difference was found between groups on SCS scores $\chi^2(2)=7.2$, $p=.027$. A Dunn-Bonferonni pairwise test revealed the significant difference between the Non-ASD group and the ASD group, $p<0.05$; children in the ASD group (N = 6; M=10.50) scored lower SCS scores than children in the Non-ASD group (N= 26; M=22.69). A ROC analysis on the modified algorithm for ADOS scores based on the clinician formulation groups had revealed good discriminant validity (AUC=1.00), with sensitivity/specificity of 100 for clinician ratings and identified a modified ADOS threshold score for *High Risk for ASD* (≥9.5) or *Non-Spectrum* (<7.5). Using these cut-off scores the two groups differed significantly on SCS scores (High Risk for ASD N=5; M=23.00, SD = 7.21 vs Non-Spectrum N=26; M=25.95, SD = 5.93) U= 27.50 p=.04; Cohen's d effect size of 0.78 suggesting a medium effect.

Conclusions: The SCS-2 scores differed significantly according to later diagnostic thresholds, providing predictive validity for the novel diagnostic thresholds on the modified ADOS with children with VI. The findings provide further support for the social communication constructs of the two assessment measures and suggest the SCS-2 as a future screener of early signs of high autism risk in young children with VI. The clinical practice implications are discussed.

415.018 *(Poster)* Assessment of Sensory Issues in Adults with ASD: The Senses; A New Questionnaire

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Background: Sensory issues are a key DSM-5 diagnostic feature of ASD (APA, 2013). There is no standardized Dutch questionnaire available that measures both (1) hyper-, hyporeactivity, and unusual sensory interests, and (2) a broad range of sensory modalities, including interoception.

Objectives: We wanted to develop and validate a self-report sensory questionnaire for adults with ASD.

Methods: We developed the Senses (63 items), based on extensive literature search, clinical impressions and examination of other questionnaires.

In total, 381 adults filled in the Senses and the AQ-10 (Alison et al, 2012). There was a norm-group (N = 180) and a clinical group (N = 201).

The norm-group was gathered from the general population (age: $M = 40.94$, $SD = 10.99$; 33 men, 147 women). The clinical group consisted of adults suspected for ASD, who underwent an extensive ASD assessment at a general mental healthcare institution (age: $M = 32.62$, $SD = 11.91$; 94 men, 107 women). Ultimately, 73% received an ASD diagnosis (ASD group, N = 147); the others received other psychiatric diagnoses (non-ASD group, N = 54).

A sub-group also filled in an AASP (Brown & Dunn, 2002) (N = 20). Another sub-group participated in retesting the Senses within two months (N = 19).

The mean AQ10 was different for group membership (ASD: $M = 6.10$, $SD = 2.28$; non-ASD: $M = 4.87$, $SD = 2.47$; norm: $M = 1.71$, $SD = 1.53$) (Welch's $F(2, 127.85) = 214.18$, $p < .001$).

Results: Cronbach's alpha for the Senses was excellent (ASD group, $\alpha = .930$). Test-retest reliability was good ($M_1 = 67.12$, $SD_1 = 24.34$; $M_2 = 67.95$, $SD_2 = 21.84$; $r = .87$, $p < .001$). Senses Total Score was correlated with AQ-10 Total Score (N = 381; $r = .67$, $p < .001$), AASP Scales Low registration and Sensory sensitivity ($r = 68$, $p = .001$ and $r = .72$, $p < .001$, respectively). Senses Scale Hyperreactivity correlated highly with AASP Scale Sensory sensitivity ($r = .91$, $p < .001$), not with AASP Scale Low registration ($r = .35$, ns). Senses Scale Hyporeactivity correlated highly with AASP Scale Low registration ($r = .70$, $p = .001$), not with AASP Scale Sensory sensitivity ($r = .24$, ns).

Senses Total Score was significantly different for group membership (ASD-group: $M = 66.30$, $SD = 25.83$; non-ASD group: $M = 46.20$, $SD = 26.17$; norm-group: $M = 24.06$, $SD = 15.20$) (Welch's $F(1, 127.11) = 158.46$, $p < .001$; Games-Howell post hoc analysis, $p < .001$). Using the 95th percentile of the norm-group as a cut-off, 78% of the ASD-group reported sensory issues.

Conclusions: The Senses has strong psychometric qualities: excellent internal consistency, good test-retest reliability and good convergent validity with the AASP. The amount of sensory issues was associated with the amount of ASD characteristics, supported by the different Senses mean scores over the three research groups and a strong positive correlation of the Senses with the AQ-10

In subsequent factor analysis, we will explore which items are eligible for removal and we will develop subscales.

415.019 *(Poster)* Autism Symptomatology in Children with Neurofibromatosis Type 1

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Background: Neurofibromatosis Type 1 (NF1) is an autosomal dominant genetic condition (Nordlund et al., 1993). Sequelae varies, but often includes characteristic café au lait spots and neurofibromas, and in some cases, neural abnormalities such as optic gliomas or focal areas of signal intensities on brain imaging. Cognitive difficulties are also prevalent in NF1 including visual-perceptual deficits, attention deficit hyperactive disorder, and learning disabilities (Gutmann, 1999). Recent studies have focused on the presence of autism spectrum disorder (ASD) traits in some children with NF1 (Walsh et al., 2013), yet the nature of such symptoms and the behavioural correlates in NF1 is not well understood.

Objectives: We examined whether children with NF1 and ASD symptomology displayed a similar behavioural profile as children with ASD without NF1. To this end, we focused on a key ASD behavioural phenotype: poor theory of mind (i.e., attributing others' mental states). The findings will provide insight into whether the ASD symptoms commonly observed in NF1 manifest in their behaviour, which has implications not only for our understanding of the disorder, but also in the types of interventions used.

Methods: Twenty-four children and adolescents with NF1 were recruited from a large children's hospital in Toronto, Canada. Typically developing controls (n=20) were recruited from the community. Parent ratings using the Social Responsiveness Scale (SRS-2) screened for ASD symptoms in all groups, and was primarily used to identify participants with ASD (e.g. Garg et al., 2013, Walsh et al., 2013). All participants completed a computerized task where they made judgments of a character's perception of a task based on prior experience. The key dependent variable was performance in the false belief (theory of mind) condition (e.g., Jack moves a ball to a hat in view of the children, but Jill cannot see this. The children are then asked where Jill will look for the ball). Children with NF1 who scored above the cut-off on the SRS-2 were expected to exhibit difficulties with the false belief condition due to difficulties with theory of mind inherent in ASD.

Results: Fifteen children with NF1 were assigned to the ASD symptom group based on an SRS-2 total score of 60, indicating mild clinical symptoms. Compared to the control group, the children with NF1 and ASD symptoms did not display significant differences on the baseline, working memory or true belief conditions of the task, but did perform worse on the false belief condition ($p = 0.049$) with a large effect size (Cohen's $d = 0.77$). There were no behavioural differences between the children with NF1 without ASD symptoms.

Conclusions: Over half of the participants with NF1 exhibited clinically significant symptoms of ASD. These children also performed poorer than controls on a false belief task, indicating difficulties with theory of mind that requires perspective-taking; the phenotypic behaviour of children with ASD. This study raises important clinical considerations regarding the co-occurrence of ASD traits and behaviours in children with NF1.

415.020 *(Poster)* Autistic Adults' Views of Their Own Social and Executive Functioning Do Not Correlate with Informants' Views of Them

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Background: There is growing recognition of the importance of including the perspectives of autistic individuals in autism research. Research has only begun to explore how autistic individuals' views of themselves differ from those of informants. Lerner et al. (2019) found that autistic youth reported less impairment on the Social Responsiveness Scale (SRS) Self Report than their parents reported on the informant SRS. Regarding executive functioning, there is evidence for discrepancy between self-report and informant Behavior Rating Inventory of Executive Functioning (BRIEF) scores in older adults and youth with impaired executive functioning (Rabin et al., 2006; Wilson et al., 2011). More data are needed to understand the relationship between autistic adults' views of themselves and informants' views of them.

Objectives: We sought to evaluate the degree of discrepancy between self and informant reports on core autism and autism-related traits in autistic adults and their family members.

Methods: Eighty-two autistic adults without intellectual disability (54 male, 28 female; aged 18 to 76 years) and 128 of their family members (52 male, 76 female; aged 18 to 81 years) were recruited via the Autism Spectrum Program of Excellence genetics study. For autistic adults, diagnosis was confirmed through detailed clinical and developmental history and DSM-5 criteria. All participants completed self-report versions of questionnaires measuring autistic traits (SRS-2-Adult) and executive functioning (BRIEF-Adult). Informant report versions of the same questionnaires were collected on each participant. Discrepancy scores were calculated by subtracting the self-report score from the informant score for the same questionnaire.

Results: Pearson correlation analyses showed that, among autistic adults, there was no significant association between the self-report and informant scores on the SRS-2-Adult (self-report range 48-90; informant range 39-92; $r = 0.08$, $p > 0.05$) and BRIEF-Adult (self-report range 40-92; informant range 41-84; $r = 0.09$, $p > 0.05$). In contrast, their family members showed a moderate to strong association between the self-report and informant scores for the SRS-2-Adult (self-report range 37-77; informant range 36-93; $r = 0.53$, $p < 0.001$) and BRIEF-Adult (self-report range 35-94; informant range 35-87; $r = 0.50$, $p < 0.001$). Hierarchical regression analyses for the SRS-2-Adult and the BRIEF-Adult showed that ASD status of the participant ($\beta = -0.27$, $p < 0.001$; $\beta = -0.27$, $p < 0.01$) affects the discrepancy score, while participant age, participant sex, relation of the informant to the participant, informant sex, and informant ASD status have no effect (see Table 1 and Table 2).

Conclusions: These results demonstrate, in adults with ASD, a discrepancy between self-report and informant scores on questionnaires measuring autistic behaviors and executive function, yet greater agreement among family members of autistic individuals. Discrepancy is driven by the ASD status of the participant and not by other tested characteristics of the participants or tested informant characteristics (including ASD status) of the informant. The inconsistency in discrepancy direction in the ASD group suggests that there are individual traits that drive the direction. Future research is needed to identify the specific traits that drive inconsistencies in self- vs. informant report.

415.021 *(Poster)* Autoscreen: Phase I Results of a Digital Tool for Clinically Efficient Assessment and Decision Making for Toddlers with ASD Concerns

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Background: Early identification of Autism Spectrum Disorder (ASD) is essential for early intervention, which has been shown to improve lifespan outcomes. The American Academy of Pediatrics endorses ASD screening during well child visits at 18 and 24 months, but a wide range of challenges result in many children waiting until 4-5 years of age for a diagnosis. These challenges include limited screening in primary care and—where screening is available—low specificity of screening instruments, often resulting in long waitlists for access to specialty diagnostic services.

Objectives: In previous work, we developed Autoscreen: a digital ASD screening platform for pediatric providers that incorporates an interactive 15-minute assessment method and an embedded rating system. Autoscreen is the first tool of its kind to provide real-time guided instruction via a simple user interface along with a novel risk assessment algorithm derived from computational analysis of a large diagnostic dataset. The current work concerns the complete results of our Phase I pilot as well as recent technological enhancements based on iterative stakeholder interviews with more than 40 providers. Our three primary aims were: (1) to assess overall usability, (2) to assess preliminary instrument validity, and (3) to identify, through stakeholder interviews, means by which to enhance and improve the technology.

Methods: Participants included 42 children (ages 18-36 months) clinically referred for ASD evaluation. Forty-two pediatric providers representing a range of professional backgrounds (e.g., developmental-behavioral pediatricians; clinical psychologists) were recruited to conduct screening assessments using Autoscreen. A separate provider, blinded to the results of the Autoscreen assessment, were then asked to provide a "best estimate" clinical diagnosis (Yes/No ASD) for each child.

Results: Providers reported a mean System Usability Scale (SUS) index of 85.65 (SD = 10.8), which is regarded as "excellent" usability. Regarding preliminary instrument validity, compared to best estimate clinical diagnosis, Autoscreen demonstrated 80% accuracy with a sensitivity of 0.77 and specificity of 0.88. Over the course of more than 40 post-session interviews with providers, we identified a set of features that providers desired in a next iteration of Autoscreen. Specifically, providers wanted a simple means by which to log structured notes in Autoscreen; these notes could be used to log specific pieces of information relevant to a given activity (e.g., observed instances of response to name) and could be valuable when forming clinical impressions.

Conclusions: The results of our pilot study provide preliminary, but compelling, evidence that Autoscreen is a highly user-friendly digital platform for guided, interactive ASD screening. A larger clinical evaluation of Autoscreen is ongoing in order to demonstrate its validity, specifically its accuracy, sensitivity, specificity, test-retest reliability, and inter-rater reliability as compared to gold standard comprehensive evaluation.

415.022 *(Poster)* Calling Attention to Children Who Are Not Diagnosed with ASD Who Exhibit Social Difficulties, Excessive Interest in Specific Topics or Repetitive Behaviors

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Background: Troyb et al (2014) claimed that Restricted and repetitive behaviors (RRB's) persist among children who "grew out of Autism" . Harrop et al (2014) found that in both ASD and TD groups , a higher frequency of RRB's was associated with lower language abilities . Following these works, we describe a group of 38 boys who are not diagnosed with ASD, exhibit social difficulties , intact Social affect, excessive interest in specific topics or repetitive behaviors and linguistic difficulties.

Objectives: The aim of this presentation is to call attention to a unique clinical group of children who do not meet the critetia for ASD diagnosis but nevertheless needs further evaluation and treatment .

Methods: A cross sectional study that compared 40 children who were diagnosed with ASD to 38 children who were not diagnosed with ASD. All children were referred to an Autism clinic in a major children's hospital due to social difficulties . They were evaluated with ADOS-2 and DSM 5 by a team of neurologists, psychiatrists and psychologists . IQ ,age and gender were controlled.

Results: Three characteristics of this unique clinical group are described :

1) The group had significantly lower mean scores on the Social Affect Domain of the ADOS-2 (4.73; SD = 3.53) as compared to the mean of the group of children who were diagnosed as having ASD (8.54; SD = 4.41; F = 17.113; p = .000). (e.g., properly functioning non-verbal communication with the clinician such as eye, facial and hand expressions.)

2) High percentage of children who presented behaviors delineated in item D4 in ADOS-2: "Excessive interest in unusual or highly specific topics/objects or repetitive behaviors". 30.8% of the children who were diagnosed as having ASD presented behaviors delineated in item D4 in ADOS-2 as compared to 52.6% among the non-ASD group.

3) The children had various linguistic difficulties in the realms of naming and retrieval, and scanty vocabulary

60 percent

of the 38 children of the group were referred to a speech therapist at the end of the assessment for further assessment and treatment. This percentage is about six times higher than that of typically developing children referred to a speech therapist for a professional assessment .

Additional data characterizing the group relates to the following three background variables: Family status of parents; type of school (i.e. special vs. regular); and use of medication.

Conclusions: We propose that having RRBs with no impairment in social affect should be examined and studied to determine whether this clinical group described above represents a unique disorder. Tentatively, we suggest naming this disorder ISA-RRB to denote Intact Social Affect Repetitive Restricted Behaviors. Children who belong to the ISA-RRB group are characterized by an intact social affect and repetitive and restricted behaviors, excessive interest in unusual topics or objects, as evaluated by the ADOS-2.

The lecture will present further therapeutic interventions for this group .

415.023 *(Poster)* Can Autism Spectrum Disorder be Validly and Reliably Screened with Combination of a Short Caregiver Interview and Play Observation?; Behavior Development Screening for Toddlers (BeDevel)

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Background: Early childhood screening for autism spectrum disorder (ASD) leads to timely referrals and diagnosis, which results in quicker access to interventions and improved long-term outcomes.

Objectives: To confirm the validity and reliability of new instruments for the screening of ASD, Behavior Development Screening for Toddlers (BeDevel) which utilizes the combination of short caregiver interviews and semi-structured observations in the large samples and to examine the most potent risk markers under 42 months.

Methods: We developed BeDevel, a new culturally relevant ASD screening instrument with high diagnostic predictive value that accounts for a range of characteristics. BeDevel is an early screening instrument that includes caregiver interviews (BeDevel-Interview: BeDevel-I) and semi-structured observations (BeDevel-Play: BeDevel-P) that can be administered by healthcare professionals specializing in ASD as well as paraprofessionals trained to work with young children. Both instruments cover five age ranges: 9~11, 12~17, 18~23, 24~35, and 36~42 months. The study included 621 toddlers (ASD, n=268; developmental delay, n=79; typically developing, n=274), aged 9~42 months without significant medical conditions, neurological disorders, sensory and/or motor deficits, which limit participating in activities needed for observations. For all participants, BeDevel-P and BeDevel-I were conducted along with the diagnostic procedures using ADOS, ADI-R, CARS, and VABS. The existing screening questionnaire, SCQ and SRS, were also implemented. We analyzed sensitivity, specificity, positive predictive value, and negative predictive value of the BeDevel Classification in relation to the clinical best estimate diagnosis that provides ASD/non-ASD classification. χ^2-test were used to analyze validity of individual items and *kappa* validation was used to check the consistency of diagnosis and screening result.

Results: A total of 613 toddlers (mean [SD] age=30.21[8.31] month; 65.7% male; 12-17 months, n=57; 18-23 months, n=87; 24-35 months, n=259; and 36-42 months, n=210) were included in the analysis. The *k* values of BeDevel-I and BeDevel-P items were .02~.64 and 0.12~0.67, respectively. Items related to social referencing in BeDevel-P had a particularly high diagnostic validity across age groups (*k*=.37~.62). Reliabilities of BeDevel-I and BeDevel-P were sufficient with the average Cronbach's α values of 0.874 (range=0.857~0.887) and 0.939 (range=0.919~0.953), respectively. Based on *k* values, items with a high degree of diagnostic consistency were selected as *primary items* and sensitivity, specificity, PPV, and NPV were identified accordingly. BeDevel-I and BeDevel-P showed high sensitivity (83.72~90.00%, 85.00~91.47%), specificity (84.15~86.99%, 82.19~94.03%), PPV (66.67~89.26%, 79.37~91.47%), and NPV (76.67~96.67%, 86.59~95.45%), respectively. The agreement between the composite BeDevel score and ADOS, ADI-R, K-CARS, and SCQ were all above 70% (range=71.1%~87.2%). The results showed that, items related to *Social Referencing* appear to be consistently high discriminant and the low validity of *Social Interest and Social Relationships* was contrasted with the high validity of *Interest in Peers* and *Levels of Play* in the older age group.

Conclusions: Combination of short interview with caregiver and direct observation is valid and reliable screening process, and more studies on social referencing as an important early marker is needed. BeDevel can be utilized as a secondary screening instrument before diagnostic confirmation in clinical and community settings possibly after primary screening with a caregiver-rated questionnaire.

415.024 *(Poster)* Caregiver-Examiner Consensus: Assessing the Relationship between Caregiver Report and Direct Assessment of ASD Symptomology in Toddlers

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Background: The Modified Checklist for Autism in Toddlers - Revised (M-CHAT-R, Robbins, Fein, & Barton, 2009) is widely used as a caregiver-reported screening tool for autism spectrum disorder (ASD) and has demonstrated sensitivity in identifying children for further evaluation for developmental delays/disorders including ASD (Kleinman, et al., 2008; Toh, et al., 2018). The M-CHAT uses total score to indicate risk-status and referrals, however, research has not thoroughly explored the accuracy of reporting on specific items, which assess subtle social communication behaviors that are critical to the determination of high-risk status as well as to eventual ASD diagnosis. The Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) is a gold-standard ASD diagnostic tool that is clinician administered and evaluates many of the same early indicators that appear on the M-CHAT. Examining the consistency between caregiver reported symptoms and the observations of trained examiners may clarify the extent to which caregivers accurately report the presence of critical social communication deficits without the requisite training.

Objectives: To assess the relationship between caregiver responses on the M-CHAT and examiner ratings on the ADOS-2 regarding social communication behaviors including pointing, eye contact, response to name, showing, and initiating and responding to joint attention.

Methods: Data were collected from six toddlers between the ages of 18-36 months (*m*=28.3 months, *SD*=6.3; 2 females) anticipating enrollment into an early intervention study. The M-CHAT was administered to the caregiver during a screening visit and the ADOS-2 (Module 1 and Toddler Module) was administered at each child's first visit. The research team selected individual items from the M-CHAT and ADOS-2 that a) reflected core basic social communication behaviors, and b) had corresponding items on both measures. Spearman's rank correlations were calculated between individual M-CHAT and ADOS-2 items capturing pointing, response to name, response to/initiation of joint attention, showing, and eye gaze.

Results: Correlations between caregiver responses on the M-CHAT and examiner scores on the ADOS-2 were strong across social communication behaviors. Caregiver ratings of pointing to ask for help (M-CHAT question 6) as well as pointing to show something interesting (M-CHAT question 7) were both strongly correlated with pointing on the ADOS-2 (r_s= -.95, *p*=.01, r_s=-.71, *p*=.12, respectively). Caregiver reported response to name (M-CHAT question 10) was significantly correlated with performance on the ADOS-2 response to name task (r_s=-.89, *p*=.02). There was also a strong correlation for reporting (M-CHAT question 1) and observation of response to joint attention (r_s=-.89, *p*=.02). There was a moderate correlation for showing (r_s= -.42, *p*=.41). M-CHAT and ADOS-2 scores were not strongly correlated for eye gaze and initiation of joint attention.

Conclusions: Parent ratings on the M-CHAT and examiner scores on the ADOS-2 were significantly correlated across multiple domains, suggesting that parents are able to accurately detect and report early and subtle ASD symptomology including pointing and response to name. Continued data collection is underway to examine these relationships in a larger sample and with additional measures. Future studies aim to identify which caregiver report items may require additional clarification when administered.

415.025 *(Poster)* Childhood Autism Rating Scale (CARS) Factor Scores Vs. Total Score for Predicting Longitudinal Outcomes in Children with ASD

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Background: The Childhood Autism Rating Scale (CARS) is a widely used tool to assess autism symptom severity in both clinical and research settings, but it has been criticized for combining items from different domains of symptoms. Having only an omnibus score is inconsistent with DSM-IV and -5 criteria structure as well as gold standard measurements that differentiate, at the least, social communication (SC) from restricted and repetitive behavior (RRB) domains. Recently Moulton et al. (2016) published a factor analysis study using CARS scores from young children with ASD, suggesting three factors of Social Communication, Stereotyped Behaviors, and Emotional Regulation. No studies to date, however, have examined subscales based on CARS factor scores for prediction and validity purposes. This study applies such scores within a longitudinal study of children with ASD followed from toddlerhood to school age to determine their predictive validity and if they offer more precise information than the total CARS scores.

Objectives: To examine ifCARS Total and CARS factor scores are differentially predictive of 1) concurrent adaptive behavior scores at Time 1 (before age 3 years), and 2) with adaptive behavior and autism symptom scores at Time 2 (school age).

Methods: This was a longitudinal study that followed children diagnosed with ASD before age 3. 51 children had CARS and Vineland scores at Time 1 (M_{age}=28.5 mos, SD=2.8 mos, 75% male,) and 29 had Vineland and GARS at Time 2. Instruments. *Childhood Autism Rating Scales*represented autism symptom severity at Time 1. Based on the factors generated by Moulton et al. (2016), three subscales were created: Social Communication (SC), Stereotyped Behaviors and Sensory Sensitivities (RRBs) and Emotional Reactivity (ER). Adaptive behavior at Time 1 and 2 was measured with the *Vineland Adaptive Behavior Scale (VABS-2).*Autism severity at school age was measured using the parent-rated *Gilliam Autism Rating Scale (GARS-3).*Procedure. Time 1 CARS and VABS scores were recorded from early intervention charts containing multidisciplinary evaluation reports. Time 2 VABS was completed through phone interview with caregivers, andparents completed the GARS as part of a questionnaire-by-mail follow-up study. Data analysis. Pearson correlations and Steiger's Z-test for significance between non-independent correlation coefficients were employed.

Results: Between Time 1 CARS Total and CARS subscales and concurrent Time 1 VABS domains, few differences occurred except for the ER subscale, which showed no significant relationships to the VABS domains scores, whereas others tended to correlate, often significantly. This was also the case for Time 2 GARS. In contrast, a number of CARS subscale scores were highly significantly correlated with Time 2 VABs domains and ABC scores *and* there were significant differences in magnitude between CARS Total and the various CARS subscales, depending on the VABS domain score. Of particular note was the predictive value of the CARS Hyperactivity item on its own (ranging from -.57 to -.65).

Conclusions: CARS subscales appear to provide additional information over the Total score alone, depending on the criterion being examined. The predictive value of the CARS Hyperactivity item during early childhood was particularly striking.

415.026 *(Poster)* Clinical Assessment of Repetitive and Restricted Behaviors in Toddlers on the Autism Spectrum

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Background: Repetitive and restricted behaviors (RRBs) are core symptoms of ASD and often emerge in the first year of life. Despite early onset, parents cite RRB concerns far less often than language and social concerns when presenting for diagnostic evaluation (Herlihy et al., 2015). Given low rates of reporting and the importance of accurate, complete information for clinical diagnosis, it is important to understand how best to integrate diagnostically relevant information from multiple methods of assessment in clinical settings. Few studies have directly compared the utility of multiple methods to assess RRBs for facilitating diagnosis.

Objectives: Characterize the association between parent report and clinical observation of RRBs in order to determine the utility of each method for eliciting information on RRBs in toddlers at the time of initial diagnosis.

Methods: Participants were 65 children ages 18-39 months diagnosed with ASD. Associations between a parent report rating scale (Repetitive Behavior Scale Revised (RBS-R)), clinician-driven parent interview (Toddler Autism Symptom Inventory (TASI)) and clinician observation (Autism Diagnostic Observation Schedule (ADOS)) were determined using Kendall's tau-b and point biserial correlations where appropriate. Correlations were run for each of six behavioral subdomains: (1) sensory (2) hand and finger stereotypy (3) whole body stereotypy (4) combined stereotypy (5) self-injurious behavior (SIB) and (6) repetitive behavior. Non-significant correlations were further investigated using incidence of behavior on each measure.

Results: Parent report on the RBS-R and TASI were correlated in all domains, except sensory behaviors (Table 1), indicating good association between the rating scale and clinical interview. Sensory behaviors were reported on the RBS-R in 65% of cases compared to 48% on the TASI. The ADOS was not correlated with either the TASI or RBS-R in any domain except hand and finger stereotypy. In the domains of repetitive behavior, whole body stereotypy, and SIB, behaviors were reported more frequently on parent report measures compared to clinician observation (Table 2). The reverse was true for sensory behaviors; clinicians indicated more sensory behaviors on the ADOS (77%) compared to either parent report measure.

Conclusions: In most behavioral subdomains, parent report of RRBs on a behavioral rating scale and clinical interview were consistent. The method of assessment did not impact parent report. Clinical observation on the ADOS revealed fewer RRBs than parent report in four of six subdomains and comparable report on one subdomain. Differences may be due to the brief observation window or the introduction of novel toys. Notably, none of the measures were correlated for sensory behaviors. Clinicians reported more atypical sensory behaviors on the ADOS, followed by parent report on the RBS-R and TASI. Overall, parent report offers valuable information on RRBs that go beyond what is typically observed by clinicians in an evaluation. However, clinical observation appears to be particularly important for identifying sensory behaviors. Sensory behaviors may be difficult for parents to identify or discriminate as atypical, particularly in young children. Results indicate that both parent report and observation contribute to a more complete representation of RRBs and should be included in diagnostic assessment.

415.027 *(Poster)* Clinical Implications of Ratings By Parents and Preschool Staff: Introducing a Multi-Informant Model for Diagnostic Assessment

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Background: Autistic symptoms should be present in multiple contexts to meet the DSM-5 criteria for autism spectrum disorder (ASD). In the diagnostic assessment of young children this condition can be hard to fulfil if the clinician find significant autistic symptoms in the clinical context but parents do not in the home context. In these cases, autistic behaviors could be evaluated by preschool staff in the preschool setting. In a recent high-risk-for-ASD-sibling-study regression analyses showed that preschool staff rated general autistic symptoms more in line with both diagnosis and clinically assessed autistic behaviors than parents. However, we know little about how to approach multi-informant report in the diagnostic process.

Objectives: To present a multi-informant model to be used in diagnostic clinical practice and to investigate the value of adding preschool report to the assessment of ASD.

Methods: Results for a high-risk sibling group with and without ASD were analysed at 36 months based on 10 participants (five girls) with ASD diagnosis and 32 (18 girls) participants with no diagnosis. All but one child in the ASD group had IQ within normal ranges.The pervasive developmental problem subscale from the Child Behavior Checklist 1,5-5 and the Caregiver Teacher Report Form (Achenbach and Rescorla 2000, 2004) were filled in by parents and preschool staff, blind to the result of the diagnostic assessment. Sensitivity and specificity were calculated in relation to diagnosis with cut-off at T- score ≥ 65 indicating significant autistic symptoms. In the model parent report was considered first and preschool report second as is common in clinical practice. In the model at least one informant should be in agreement with clinical observation of autistic symptoms in order to fulfill the criteria of symptoms present in multiple contexts. Support for no significant autistic behaviors was also evaluated requiring at least one informant to rate in agreement with clinical observation to rule out ASD.

Results: By including report on autistic behaviors from preschool staff, true positive rate (sensitivity) increased from 50% to 70%. True negative rate (specificity) increased from 91% to 97% when considering negative ratings of autistic symptoms by preschool.

Conclusions: Ratings by preschool staff complementary to parent report add support for clinical findings of significant autistic behaviors. In future studies the model should be applied to larger clinical samples with ASD and other neurodevelopmental disorders.

415.028 *(Poster)* Common M-CHAT-R/F Endorsement Patterns Among Children Who Screen Negative for Autism Spectrum Disorder

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Background: Screening for Autism Spectrum Disorder (ASD) improves long-term child and family outcomes via early diagnosis and intervention (Zwaigenbaum et al., 2015). The most commonly used screening measure, the Modified Checklist for Autism in Toddlers–Revised with Follow-up (M-CHAT-R/F; Robins et al., 2014), is a well-validated, open-source 20-item parent checklist, and includes a follow-up interview when there is an initial score between 3 and 7. A positive screen for ASD risk is associated with an earlier ASD diagnosis by 7.5 months to 2 years (Guthrie et al., 2019; Robins et al., 2014). However, studies suggest that the M-CHAT-R/F has significant shortcomings in its predictive validity. A recent longitudinal study assessing universal screening in a large sample (n=21,543) revealed that the M-CHAT-R/F missed 60% of children who later received an ASD diagnosis (Guthrie et al., 2019). Considering that the M-CHAT-R/F is widely used and that a positive screen decreases the ASD detection to treatment pipeline, it is important to better understand the patterns of endorsement for children who pass the initial stage of the M-CHAT-R/F, but may be at-risk nonetheless.

Objectives: To characterize the patterns of M-CHAT-R/F endorsed items for children who receive a score one point below the cut-off for the follow up interview (i.e., a total score of 2).

Methods: A digital version of the M-CHAT-R/F (webM-CHAT-R/F) was developed for use by primary care providers in traditionally underserved communities. The webM-CHAT-R/F uses REDCap (Harris et al., 2009) and a tablet interface to digitally present the initial 20 items and automatically trigger the follow-up questions when appropriate. Sixty-one primary care providers (PCPs) participating in a statewide research project designed to expedite access to ASD-specialized services administered 6,143 webM-CHAT-R/F records at 18- and 24-month well-child visits over a 32-month period. The R statistical program was used to identify common response patterns using flat contingency tables.

Results: The mean child age at screening was 21.80 months (SD = 3.96). Tables 1 and 2 present summary statistics on the webM-CHAT-R/F scores and the most frequent endorsement patterns. For the group with 2 failed items (n=602), 190 possible endorsement patterns exist; however, a majority of responses (69.93%) fall into 13 endorsement patterns, each with a minimum of 10 respondents. The modal endorsement pattern, which occurred in 211 (35%) screens, had two failed restricted and repetitive behavior (RRBs) items out of a total of three possible RRB items. Nine prevalent patterns represented a combination of a failed social communication item and an RRB item. Three prevalent patterns included two failed items in the social communication domain.

Conclusions: Our results suggest that there are common endorsement patterns on M-CHAT-R/F screens that yield a total score 1 point below the cut-off to receive the follow-up interview (i.e. an initial screen negative). These endorsement patterns fall into a minority of possible 2-item response patterns. The most common screen negative pattern included two items from the RRB domain. Further study of item content and failure patterns, especially if diagnostic outcome is available, may improve the screening properties of the M-CHAT-R/F.

415.029 *(Poster)* Comparing the Clinical Utility of the ADOS-2 in a Children with Psychiatric Disorders in Both and Inpatient and Outpatient Setting.

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Background: The ADOS-2 is widely used for the assessment of Autism Spectrum Disorder (ASD) but there is little information regarding its clinical utility for those with significant psychiatric concerns. As comorbid mental health conditions occur at higher levels in those with ASD than the general population (e.g., Hudson et al., 2019) and accurate diagnosis is essential for accessing appropriate intervention, having better understanding of how instruments perform in complex populations is of significant interest. One recent study (Colombi, Fish, and Ghaziuddin, 2019) examined the sensitivity and specificity of the ADOS-2 in an inpatient psychiatric setting (N=58) and found underwhelming values. Little additional research has been conducted in this area, particularly with children and adolescents.

Objectives: To examine the utility of the ADOS-2 for children and adolescents with complex presenting conditions, specifically those with psychiatric conditions such as psychosis, mood disorders, and/or disruptive behavior disorders, in both inpatient and outpatient settings.

Methods: The sample includes two groups. The first group (n=79) is comprised of children and adolescents receiving a targeted ASD evaluation while hospitalized in an inpatient psychiatric unit housed within a large children's hospital between 2014 and 2019. Assessment on the unit was conducted as part of a consultation/liaison (C/L) service requested by inpatient staff, and typically included administration of the ADOS-2 as well as comprehensive review of the medical record, and when possible, a thorough caregiver interview and the administration of rating scales. The second group is comprised of children and adolescents presenting to an outpatient clinic for ASD-specific assessment (n=500). Assessments in this setting were completed over two days, by an interdisciplinary team and included a range of assessments which included the ADOS. For both groups, the children and/or adolescents had presenting concerns of psychosis, mood disorder, and/or disruptive behavior. All of the children and/or adolescents were administered the Module 3 or Module 4 of the ADOS-2.

Results: Of the inpatient sample, over 50% individuals received an ASD diagnosis. In other cases, ASD was ruled out, or the patient was referred for additional assessment at the outpatient clinic. Additional analyses will further compare use of the ADOS-2 and autism diagnosis in a psychiatric inpatient setting with more traditional outpatient assessments in a similarly complex population. Sensitivity and specificity calculations will be conducted with the available data for each module and setting.

Conclusions: In the inpatient sample, we anticipate similar results as found by Columbi et al. It is notable that the majority of the patients referred for evaluation on the inpatient psychiatric unit receive an ASD diagnosis. Even with increased recognition, many children with ASD do not receive a diagnosis early in the developmental period, possibly placing them at higher risk for mental health conditions, lack of access to intervention services, and unmet needs.

References

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415.030 *(Poster)* Comparison of Adaptive Behavior Profiles between Children with Autism and Children with Down Syndrome and Comorbid Autism Symptoms

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Background: The rate of comorbidity between autism spectrum disorder (ASD) and Down syndrome (DS) is 5-39% (Reilly, 2009), making it important to understand how their co-occurrence might impact adaptive behavior. Research suggests that children with DS and ASD have more impaired adaptive functioning than children with DS only (Molloy et al., 2009), but no comparisons have been made to children with ASD only. Furthermore, little is known about adaptive behavior profile differences based on autism symptom severity in children with DS.

Objectives: The current study analyzes whether adaptive behavior profiles differ between children with DS and low autism symptom severity (low ASD-DS), children with DS and high autism symptom severity (high ASD-DS), and children with ASD only.

Methods: Parents of children with ASD and/or DS between 6-18 years of age completed an online survey. The sample included 76 children with DS (M_{age}=11.88 years, *SD*=3.28) and 39 children with ASD (M_{age}=11.96 years *SD*=3.61). Diagnostic and demographic information, as well as the Social Communication Questionnaire (SCQ), the Autism Spectrum Rating Scales (ASRS), and the Adaptive Behavior Assessment System, third edition (ABAS-3) were collected for each child. Based on SCQ screen positive cut off scores, children with DS were divided into high ASD-DS (n=17) and low-ASD-DS (n=59) groups, which corresponded with high and low autism symptom severity on the ASRS. Adaptive behavior profiles based on the ABAS-3 were compared across the high and low ASD-DS groups and the ASD only group.

Results: Analyses revealed a significant difference between the high ASD-DS, low ASD-DS, and ASD only groups across the Conceptual, Social, and Practical domains on the ABAS-3 (*p*'s<.001). The high ASD-DS group had significantly more weaknesses in the Conceptual and Practical domains compared to the low ASD-DS and the ASD only groups (*p*'s<.001), who did not significantly differ from each other on those two domains. For the Social domain, children in the low ASD-DS group displayed better social functioning compared to children in the high ASD-DS group and children in the ASD only group (*p*<.001), suggesting similar impairments in social skills between those two groups. Overall adaptive functioning as measured by the ABAS-3 General Adaptive Composite score was more impaired in children in the high ASD-DS group compared to the other two groups (*p*'s<.001).

Conclusions: Overall, children with DS and high autism symptom severity tend to be more impaired in their adaptive functioning compared to those with ASD only or DS and low autism symptom severity. The relative strengths in social skills typically observed in children with DS appear to be affected by more severe autism symptoms, as these children have similar social impairments to children with ASD only. While social impairments are similar to children with ASD, impairments in the Conceptual and Practical domains appear to be magnified in children with DS and severe autism symptoms. Understanding how autism symptom severity and DS interact can help inform diagnostic practices to avoid diagnostic overshadowing of ASD in DS, as well as help create more targeted inventions for each unique adaptive behavior profile.

415.031 *(Poster)* Comparison of Social Communication Deficits and Restricted Repetitive Behaviours in Children with ADHD and Children with ASD

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Background: There is a growing awareness of the overlap in symptomatology of Attention Deficit Hyperactive Disorder (ADHD) and Autism Spectrum Disorder (ASD) which were once seen to be distinct. While social communication deficits are not a core diagnostic feature of ADHD, these deficits have frequently been reported in these children. Other features such as difficulties with emotional regulation, attention, and sensory sensitivities have also been reported in both conditions. This research looks at the similarities and differences in the social communication deficits and repetitive, restricted behaviours in children with ADHD and children with ASD, comparing across different measures.

Objectives:

- To compare the Social Communication Questionnaire (SCQ) scores of the children who are diagnosed with ADHD vs those with ASD vs typically developing (TD)
- To determine if there a subset of children diagnosed with ADHD who behave more like those diagnosed with ASD
- To compare the social communication deficits between children with ADHD and children with ASD across different measures
- To compare the repetitive and restricted behaviours and interests between children with ADHD and children with ASD across different measures

Methods: SCQ, Child Behaviour Checklist (CBCL), and Repetitive Behaviour Scale – Revised (RBS-R) scores from the Province of Ontario Neurodevelopmental Network (POND) data were analyzed using Analysis of Variance (ANOVA) and logistic regression model, with gender and age controlled, across those who have a primary diagnosis of ASD, ADHD, and those who are typically developing.

The SCQ is a screening measure for symptoms associated with autism spectrum disorder. The CBCL is a screening measure for internalizing and externalizing behaviours of a child (preschool and school-age), which includes measures of social deficits.

Results: Preliminary results reveal that, as expected, SCQ scores (n= 1,688) of those diagnosed with ASD (n=817) are significantly higher than those who are diagnosed with ADHD (n=648), and both of these groups have scores that are higher than those who are typically developing ($p<2X10^{-16}$; F=936; df=2). However, there were children diagnosed with ADHD who scored as high as those diagnosed with ASD, on both SCQ and CBCL. Subgroup analyses of domains across groups with SCQ scores greater or equal to 9 and 11 show similar communication deficits between ASD and ADHD groups but no repetitive behaviours in ADHD group. SCQ scores of 15 and greater across groups show children with ADHD having similar social communication deficits and restricted, repetitive behaviours as those diagnosed with ASD.

Analyses of the CBCL social communication subdomains (T-score equal or greater than 65 and 70) reveal similar results.

Conclusions: Almost 40% of children with ADHD present with social communication deficits. Children with ADHD, with SCQ scores in the range of 9-14, show a pattern of social communication deficits consistent with social communication disorder. Children with ADHD, with SCQ scores of 15 or greater, have both social communication deficits and restricted, repetitive behaviour patterns that are presenting more similar to children with ASD.

415.032 *(Poster)* Comparison of a Video-Based ASD Screening Tool in Infancy across High-Risk and Community Samples

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Background: There are multiple ASD screening tools available, but few were developed for use in the first year of life. Although feasible for large-scale screening, written questionnaires rely on subjective interpretation and parental knowledge of developmental milestones, which may be challenging in infancy. We developed the Video-referenced Infant Rating System for Autism (VIRSA), an online screening measure that depicts a range of social-communication ability in infants 6-24 months of age, relying solely on video without written descriptions of behaviors. It has been demonstrated that the VIRSA can detect ASD in infancy when used by parents who already have a child with ASD (Young et al., 2019). This pilot examined whether the VIRSA would also be useful in a large community sample, when rated by parents without familiarity with ASD.

Objectives: 1) compare VIRSA usage metrics (time to completion, trial duration, etc.) and scores in infancy across two independent prospective samples representing different recruitment strategies, and 2) examine if the VIRSA detects ASD within both samples.

Methods: Parents of infants without a family history of ASD in the Community sample completed the VIRSA and the Modified Checklist for Autism in Toddlers (M-CHAT-R) online at 6, 9, 12, 18, and 24 months. Any child screening positive on the M-CHAT-R was seen for a diagnostic evaluation (n = 3 diagnosed with ASD). In the Infant Sibling sample (Young et al., 2019), parents of infants with and without a family history of ASD completed the VIRSA online at similar ages and were also directly assessed from 6 through 36 months (n = 21 with ASD diagnosis).

Results: There were no significant differences found in VIRSA usage metrics between the Community and Infant Sibling samples (Table 1). There were also no group differences in VIRSA scores at most ages (9 months: t = -.71; 12 months: t = .14; 18 months: t = .47; all ps > .05). At 6 months, VIRSA scores of the samples were significantly different (t = -2.18, p = .03). The VIRSA distinguished ASD, as evidenced by the ASD group having significantly lower scores than the non-ASD group, in both samples (Table 2). VIRSA scores of the ASD subgroup in the Community sample were lower than those in the Infant Sibling sample, at most ages, but this was only statistically significant at 9 months (t = 4.52, p < .01), likely due to the small size of the Community sample (6 months: t = 1.59; 12 months t = .91; 18 months t = 2.08; all ps > .05).

Conclusions: VIRSA is operating similarly when used by parents without a family history of ASD as it did in high-risk families (Young et al., 2019). The ASD subgroup differences found between the Community and Infant Sibling samples are likely driven by random variation in the proportion of infants presenting with early symptoms. In the future, as sample size increases and all participants reach 36 months, we will calculate VIRSA's psychometric properties (i.e. sensitivity, specificity, positive and negative predictive values).

415.033 *(Poster)* Computational Phenotyping Detects Atypical Patterns of Facial Expression in Toddlers with Autism Spectrum Disorder

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Background: Despite progress in early screening for autism spectrum disorder (ASD), commonly-used screening tools continue to rely on caregiver questionnaires and clinician observations. Reliable behavioral observation is expensive, time consuming, and requires significant expertise. As such, there remains a critical need to develop scalable, quantitative, and reliable assessment methods that can characterize ASD symptoms and identify those children who are most in need of follow-up by an ASD specialist. In an effort to address this need, we have embarked on a program of research using strategically-designed brief movies shown on ubiquitous devices combined with computer vision analysis (CVA) of recorded behavior to assess early symptoms of ASD.

Objectives: This study assessed the utility of a scalable and objective tablet-based behavioral assessment for eliciting and detecting reduced emotional expression or flat affect, one of the earliest emerging risk signs for ASD, and evaluated whether patterns of facial expression differentiate toddlers with and without autism.

Methods: Participants were 104 children between 16–31 months of age, 22 of which met criteria for ASD based on the Autism Diagnostic Observation Schedule. The mean (SD) age of children was 22 (3.8) months in the non-ASD group and 26.2 (4.1) months in the ASD group with a higher proportion of males in the ASD group (17 males, 5 females vs. 48 males, 34 females). A portable tablet displayed carefully-designed brief movies and used the camera embedded in the tablet to record child responses which were automatically coded with CVA. The movies were designed to capture children's attention, elicit affective responses to novel and interesting events, and assess the ability of the toddler to sustain their attention to the movies and share attention with others. Movies consisted of cascading bubbles, a mechanical bunny, animal puppets interacting with each other, and a split screen showing a woman singing nursery rhymes on one side and dynamic noise-making toys on the other. Based on video recordings of elicited behavioral responses, CVA automatically detected and tracked facial landmarks which were used to estimate head position and facial expressions (Positive, Neutral/no active facial action units, and Other expressions).

Results: Using CVA, we identified certain points throughout the movies in which we were able to differentiate between children with and without ASD based on their patterns of facial expressions. During these instances, children with ASD more frequently displayed Neutral expressions compared to children without ASD, who showed a range of other expressions ("Other" category). Using ROC curves for each video, we demonstrate reliable differentiation of children with ASD from non-ASD children (AUCs for individual movies ranging from .62-.73). Detailed analysis indicated that this was driven by non-ASD children more frequently displaying raised eyebrows and an open mouth, an expression characteristic of engaged/interested looking.

Conclusions: These results suggest that computational coding of facial expressions via a tablet-based assessment involving symptom-eliciting movies can detect one of the early, core symptoms of ASD, namely, reduced affective expression. Computational phenotyping of elicited behaviors may offer a scalable objective method of early autism symptom detection.

415.034 *(Poster)* Concurrent and Predictive Validity of Language and Communication Assessments in Infancy

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Background: Valid and reliable assessment of language and communication skills is a critical component of early ASD assessment and characterization. A variety of standardized measures are used across research and clinical settings to assess these domains including measures reliant on clinician administered assessments, parent interviews, and/or parent questionnaires. Some assessments focus on specific components of communication (e.g., vocabulary) while others assess broader ranges of communication skills. While these measures are generally thought to tap into overlapping constructs of communication, the concurrent and predictive validity of these assessment measures at young ages has not been thoroughly examined. This information is needed to inform interpretation of assessment results in infants/toddlers with implications for improving study design as well as assessment and diagnostic practices for children under two years.

Objectives: To examine the concurrent and predictive validity among assessments of early language in infants, specifically among the MacArthur Bates Communication Development Inventory, Second Edition (CDI; Fenson et al., 2007), the Mullen Scales of Early Learning (MSEL; Mullen, 1995) the Preschool Language Scales, Fifth Edition (PLS-5; Zimmerman et al., 2011), and the Vineland Adaptive Behavior Scales, Third Edition (VABS-III; Sparrow et al., 2016).

Methods: Infants at low or high risk for ASD based on diagnostic status of their older sibling were recruited as part of a longitudinal study on language and social development (current n=58, 27 girls; anticipated n=70). Participants were seen at 9-months, 12-months, and 18-months of age and were administered the MSEL (direct assessment), CDI (parent questionnaire), PLS-5 (assessment/parent interview), and VABS-III (parent interview) at one or all of these time points as part of comprehensive evaluations. Relationships across measures and ages were examined separately for expressive language (EL) and receptive language (RL) skills.

Results: In regard to concurrent validity, preliminary results indicate generally moderate to strong significant correlations among expressive language measures at 9, 12, and 18-months of age as measured in age equivalents ($r's \geq 0.472$, $p's \leq 0.039$). Relationships among receptive language measures were weaker and more inconsistent. In regard to predictive validity, for expressive language, there were generally moderate to strong correlations within a given standardized measure (e.g., MSEL EL scores at 9 and 18-months of age: $r=0.524$, $p = 0.045$) and across standardized measures (e.g., 9-month PLS-5 and 18-month Vineland EL scores: $r = 0.499$, $p = 0.041$). Across timepoints, correlations between receptive language measures were less consistent.

Conclusions: Expressive language measures at 9, 12, and 18 months show stronger and more consistent concurrent and predictive validity than measures of receptive language at these age points, which may highlight the difficulty in accurately capturing receptive abilities at very young ages. Follow-up analyses will compare developmental trajectories across measures and also explore whether the nature and/or magnitude of the concurrent and predictive relationships is moderated by infant risk status. Implications for selecting and interpreting measures for assessment of language skills in infancy will be discussed.

415.035 *(Poster)* Consolidating Clinical Pathways for Screening of Attention Deficit / Hyperactivity Disorder (ADHD), Anxiety and Irritability in Children and Adolescents with Autism Spectrum Disorder (ASD)

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Background: The Autism Learning Health Network (ALHN), which includes 12 autism specialty care centers committed to improving care and outcomes for children with ASD, has been identifying co-occurring behavioral and medical issues in children with ASD using clinical practice pathways previously developed by the Autism Intervention Network on Physical Health (AIR-P), and the Autism Treatment Network (ATN). They developed clinical pathways for treating co-occurring conditions in individuals diagnosed with ASD related to ADHD (published in 2012), Anxiety (published in 2016), and Irritability (published in 2016). Over time, clinicians reported the clinical treatment pathways were useful but there was no clear guidance for identifying those patients who should follow the pathways. Clinicians requested help in achieving desired screening goals. Given the high prevalence of challenging behaviors in children enrolled in ALHN (94% by parent report), especially in the areas of ADHD (63%), anxiety (47%), and irritability (54%), our network prioritized the development of a consolidated reliable screening tool by merging all 3 pathways into one.

Objectives: To encourage reliable screening of commonly occurring behavioral health conditions in children and adolescents with ASD receiving care at Autism Learning Health Network (ALHN) sites.

Methods: Learning Labs (LL), or workgroups, were convened for each of the 3 priority behavioral symptom domains (ADHD, anxiety and irritability). LL members met weekly to biweekly using an online video meeting platform. A literature review was also conducted of the evidence regarding the diagnosis and treatment for each condition individually. Identification of commonalities in the initial phases of screening for these conditions were discussed on line and in an in-person meeting with all 3 learning labs combined, which led to both refinements in each practice pathway and the development of a new consolidated screening approach to identifying all 3 concerns.

Results: Commonalities were found as we developed clinical pathways to screen for anxiety, irritability, and ADHD. The LL members concluded the importance of the need for a single screening pathway to capture overlapping or co-occurring behavioral health conditions. A consolidated approach was developed that guides clinicians to assess for not only the priority behavioral health conditions but also increases identification of medical concerns and psychosocial stressors within and outside the home. Benefits of the new approach include broader screening of physical health issues and more detailed assessment of associated factors while streamlining the behavioral health screening process into a single practice pathway.

Conclusions: Screening for co-occurring behavioral health and co-occurring medical conditions in children and youth with ASD can be systematically done to promote reliability without extensive impact on clinic patient flow. It is anticipated that consistent use of these clinical pathway tools will improve the identification and treatment of common challenging behaviors in children with ASD.

415.036 *(Poster)* Contradictions between DSM-5 and ADOS-2 Classification – a Preliminary Study

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Background:

As both over- and under-diagnosis of ASD are problematic, a standard approach to assessment, employing relevant and psychometrically sound measures, and employing them accurately is of critical importance for evaluation and intervention (Ozonoff, Goodlin-Jones & Solomon, 2005).

Objectives:

To call attention to the possible contradictions between DSM-5 ASD diagnosis and ADOS-2 ASD classification .

To emphasize the need for a combination of a skilled clinician's observation of the child's behavior combined with other sources of information in order to endorse or discard a diagnosis of autism.

Methods:

In the current study, we present four cases of children (mean age -8.87) that were referred to Marot Center at the Tel Aviv Sourasky Medical Center during an eight-month period. These children were referred with complaints of communication and social difficulties, and suspicion of autistic spectrum disorder. All the cases were evaluated by certified child and adolescent neurologists, psychiatrists and psychologists. They were evaluated by clinical observation, ADOS-2 and DSM-5. According to ADOS-2, they were classified as being on the autistic spectrum or with autism. Conversely, none of the children met the criteria for Autism Spectrum Disorder according to DSM-5.

Results:

A summary of the evaluation data of the four cases are presented in Table 1. These data present the diagnoses of the cases using four sources of information – other professionals' impression, the ADOS-2, the DSM-5 and the CAST self-report questionnaire (Scott et al., 2002). Notably, none of the case studies met the criteria for a DSM-5 diagnosis of ASD. Conversely, three of the four cases were above the cut-off score for ASD according to CAST, and they were all on the autistic spectrum according to ADOS-2.

Table 1. Diagnosis of four cases using four sources of information (professional's impression, ADOS-2, DSM-5 and CAST self-report questionnaire

Cases	Case 1	Case 2	Case 3	Case 4
Suspected Diagnosis according to source of referral	Suspected ASD	Suspected ASD	Suspected ASD	Suspected ASD
Previous diagnoses	ADHD Learning Disability Language Disability	ADHD Language Disability Tourette syndrome	ADHD Learning Disability	ADHD
*ADOS-2 Classification	ASD (7)	ASD (8)	Autism (13)	Autism (9)
DSM-5 Diagnoses	No ASD	No ASD	No ASD	No ASD
**CAST (Parent report)	12	18	17	21

Conclusions:

The study points to disparities between ADOS-2 and DSM-5 diagnoses in children ages 8-10 y with additional diagnoses. This can be highly relevant to both clinical practice and research, as in the latter the ADOS is often used as a single source for validating the diagnosis. These preliminary findings point to the confounding influence of age and additional diagnoses and the importance of paying note to specific biases in this regard.

415.037 *(Poster)* Coproducing Holistic Proxy- and Self-Report Assessment of Functioning Tools Based on the ICF Core Sets for Autism Spectrum Disorder

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Background: Autismis a lifelong neurodevelopmental condition associated with social and communication difficulties, persistent repetitive behaviours, and lower outcomes across various domains of functioning. However, describing the functional impact and support needs of autistic individuals is challenging, and there is currently no widely accepted tool taking a holistic approach to capturing ability and disability in autism. The International Classification of Functioning, Disability and Health (ICF) Core Sets for autism have recently been developed for infants, children, and adults, supporting the development of new assessments of functioning for each of these age brackets. In their current form, the ICF Core Sets provide comprehensive descriptions of functioning relevant to autism across the lifespan, but are difficult for autistic individuals and their families to interpret.

Objectives: This study is embedded within a larger program of research developing and evaluating assessment of functioning tools based on the ICF Core Sets for autism and other neurodevelopmental conditions. This study aimed to simplify the definitions of functioning included in the ICF Core Sets for autism and inform the development of proxy- and self-report versions of an assessment of functioning tool for autistic individuals.

Methods: This qualitative project utilised inclusive research methods of co-production, involving autistic individuals and their families in the research process. A consumer reference group consisting of two autistic adults and three caregivers of individuals on the spectrum was convened, providing feedback on all aspects of the research process. Interactive workshops with autistic adults and caregivers were then conducted in four cities across Australia, as well as online via teleconferences. To date 16 participants (seven autistic adults and nine parents/caregivers) have participated in workshops, with data collection continuing in 2019. Participants were involved in co-producing simplified definitions, generating questions and examples, and commenting on the symbolic diagrams used by the research team to portray the ICF items. Qualitative data obtained during these discussions were analysed thematically.

Results: Participants provided simplified definitions for each ICF item, suggesting a more directive style of questioning, with the inclusion of concrete examples. Participants provided what they saw as more appropriate wording of questions and examples for each ICF item, commenting that the current symbolic illustrations were ambiguous and may negatively influence their understanding of the items. There was consensus across participants that photographic illustrations of each item should be used, with ideas for photographic illustrations provided for the majority of ICF items. This feedback has been included in a prototype proxy- and self-report assessment of functioning tool, which is being pilot tested with school-aged children on the spectrum and their parents/caregivers.

Conclusions: This project represents an important first step in operationalising the ICF Core Sets for ASD, which will provide a comprehensive assessment of functioning tool that is both feasible and acceptable to end-users. This assessment will be the first tool co-produced with autistic individuals and their families.

415.038 *(Poster)* Cross-Sectional Comparisons of Autism Symptoms from 2 to 12 Years for Children with Pre-Verbal or Single Words: Implications for Diagnosing Younger and Older Children.

H. Zhu[1], *B. Chen*[1], *Q. Peng*[2], *J. Chen*[3], *Y. Zou*[1], *E. Bai*[1], *Y. Zhang*[1], *S. Lv*[1], *Y. Xu*[1], *H. Chu*[1] *and X. Zou*[1], *(1)Child Development and Behavior Center, Third Affiliated Hospital of SUN YAT-SEN University, Guangzhou, China, (2)South China Academy of Advanced Optoelectronics, South China Normal University, Guangzhou, China, (3)Chalmers University of Technology, Gothenburg, Sweden*

Background: Existing literature show that autism spectrum disorder (ASD) symptoms change across childhood and early adolescence. However, many studies have been limited by small sample size or age range, making it difficult to compare various symptoms within a rather large age range. Most researches have focused on early detection and/or stability of diagnosis during younger age (e.g. less than 3 years old). It is also important to differentiate symptoms that improve or worsen over time from those that remain stable across younger to older childhood.

Objectives: We aimed to investigate how social-communicative symptoms and restricted, repetitive patterns of behavior, interests, or activities change from younger to older childhood for ASD children with pre-verbal or single words speech ability. Based on these comparisons, we distinguished between improving, worsening and stable behaviors and demonstrated the implications of diagnosis and assessments on children at different ages.

Methods: Participants were drawn from an autism database from the Child Development and Behavior Center from 2015 to 2017 consisted of 828 children (ages ~2 to 12) who were referred to Autism Diagnostic Observation Scales Module 1 to assess for possible ASD. The present study involves 702 children who received ASD diagnoses and completed Module 1 assessments. Clinical diagnoses were made based on the clinical interview and other assessments (e.g. Autism Diagnosis Interview-Revised, WISC). All 702 participants (age range 15 - 116 months, average age 43.16±18.29 months, 597 boys) met the criteria for diagnosis of ASD in DSM-5, and were included in further analyses. The frequencies and weighted means for each item from A(Communication), B(Reciprocal social interaction), C(Imagination/Creativity/Play), D(Stereotyped Behaviors and Restricted interests), E(Other Abnormal Behaviors) were calculated by difference age intervals. Spearman correlation and autocorrelation functions were utilized to analyze and test the stability of the time serial data. Furthermore, the permutation test (10,000 times with FDR corrections) was adopted to analyze gender differences.

Results: Results from correlation analysis showed significant heterogeneity of symptom development across different ages. Among Module 1 items, A1, A8, B2, B6, B8, B10, D1, D2, D3, D4, E1 and D3 remained stable over different ages, while A3, A4, and A5 worsened over time. A2, A6, A7, B1, B3, B4, B5, B7, B9, B11, B12, C1, C2 and E2 were significantly improving ($|R_{min}| =0.112$, $P_{max} = 0.007$). Furthermore, boys showed more shared enjoyment of interaction compared to girls (B5, $P_{corrected} = 0.032$).

Conclusions: An ambiguity is present in choosing Module 1 or 2 for older children since results have shown an improved verbal language ability. The relative stability of items suggests that gesture, responsive social smile, response to name, giving, spontaneous joint attention, and unusual repetitive interests or stereotyped behaviors may be core features of ASD with preverbal or single words speech ability. Improvements in symptoms suggest that behaviors used to diagnose younger children may no longer be qualified diagnostic markers for older children. The present study demonstrates the necessity of developing different scoring strategies based on age and gender.

415.039 *(Poster)* Cross-Sectional Comparisons of Autism Symptoms from 2 to 14 Years for Children with Phrase Speech: Implications for Diagnosis

H. Zhu[1], *Q. Peng*[2], *B. Chen*[1], *Y. Zou*[1], *E. Bai*[1], *J. Chen*[3], *X. Zou*[1], *Y. Zhang*[1], *H. Chu*[1], *Y. Xu*[1] *and S. Lv*[1], *(1)Child Development and Behavior Center, Third Affiliated Hospital of SUN YAT-SEN University, Guangzhou, China, (2)South China Academy of Advanced Optoelectronics, South China Normal University, Guangzhou, China, (3)Chalmers University of Technology, Gothenburg, Sweden*

Background: Existing literature provides some evidence to show that autism symptoms change across childhood and early adolescence. However, many studies have been limited by small sample size or age range, making it difficult to compare various symptoms within a rather large age range. Most researches have focused on early detection and/or stability of diagnosis during younger age (i.e. less than 3 years old). It is also important to differentiate symptoms that improve or worsen over time from those that remain stable across younger to older childhood.

Objectives: We aimed to investigate how social-communicative symptoms and restricted, repetitive patterns of behavior, interests, or activities change from younger to older childhood for phrase speech children with autism spectrum disorder (ASD). Based on these comparisons, we distinguished between improving, worsening and stable behaviors, and demonstrated the implications of diagnosis and assessments based on child age and gender.

Methods: Participants were drawn from an autism database from the Child Development and Behavior Center at the Third Affiliated Hospital of Sun Yat-Sen University in China from 2015 to 2017. 424 children were referred to Autism Diagnostic Observation Scales Module 2 to assess for possible autism spectrum disorders. Participants were assessed from ages ~2 to 14. The present study includes 372 children who received ASD diagnoses and completed Module 2 assessments. Clinical diagnoses were made based on the clinical interview and other assessments, including Autism Diagnosis Interview-Revised, WISC, etc. All 372 participants (age range 27.5-143 months, average age 62.73±21.45 months, 318 boys) met the criteria for clinical diagnosis of ASD in DSM-5 and were included in further analyses. The frequencies and weighted means for each item from A(Communication), B(Reciprocal social interaction), C(Imagination/Creativity), D(Stereotyped Behaviors and Restricted interests), E(Other Abnormal Behaviors) were calculated by difference age intervals. Spearman correlation and autocorrelation functions were utilized to analyze and test the stability of the time serial data. Furthermore, the permutation test (10,000 times with FDR corrections) was adopted to analyze gender differences.

Results: Correlation analysis results showed significant heterogeneity of symptom development across different ages. Among all the items of Module 2, A2, A5, A8, B1, B2, B4, B8, B10, C1, C2, D4 showed significant improvement ($|R_{min}| = 0.137$, $P_{max} = 0.009$). Other items were relatively stable. Furthermore, boys displayed significantly more impairment in spontanous using discriptive, conventional, instrumental and informative gestures (A8, $P_{corrected} = 0.020$), unusual eye contact (B1, $P_{corrected} = 0.020$), and stereotyped behaviors and restricted interests (D4, $P_{corrected} = 0.030$).

Conclusions: Improvement in symptoms indicate that older phrase speech children have better skills in communication, social reciprocity, imagination and creativity, and less stereotyped behaviors and restricted interests. Only 5 out of 12 scoring items remained stable across different ages. The present study demonstrates the necessity of developing different scoring strategies based on gender and age.

415.040 *(Poster)* Cross-Sectional Comparisons of Autism Symptoms from 2 to 14 Years for Children with Phrases Speech: Implications for Diagnosis.

H. Zhu[1]*, Q. Peng*[2]*, B. Chen*[1]*, J. Chen*[3]*, Y. Zou*[1]*, E. Bai*[1]*, Y. Zhang*[1]*, S. Lv*[1]*, Y. Xu*[1]*, H. Chu*[1] *and X. Zou*[1]*, (1)Child Development and Behavior Center, Third Affiliated Hospital of SUN YAT-SEN University, Guangzhou, China, (2)South China Academy of Advanced Optoelectronics, South China Normal University, Guangzhou, China, (3)Chalmers University of Technology, Gothenburg, Sweden*

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Conclusions: Improvement in symptoms indicate that older phrase speech children have better skills in communication, social reciprocity, imagination and creativity, and less stereotyped behaviors and restricted interests. Only 5 out of 12 scoring items remained stable across different ages. The present study demonstrates the necessity of developing different scoring strategies based on gender and age.

415.041 *(Poster)* DAS-II Cognitive Profiles Do Not Distinguish Children with Autism: A ROC Analysis

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Background: Intelligence assessment is an integral part of a comprehensive autism evaluation. Many past studies have described a cognitive profile of autistic individuals characterized by higher nonverbal than verbal IQ scores (Giofrè et al., 2019; Jones & Lord, 2013; Kuriakose, 2014; Li, Du, Luan, Li, & Ousley, 2017; Mayes & Calhoun, 2008). Using a discriminant validity approach that emphasizes group differences, some have interpreted the Nonverbal > Verbal IQ profile as a clinical indicator of ASD (Lennen et al., 2010; Tager-Flusberg & Joseph, 2004; Nowell et al., 2015; Mayes & Calhoun, 2008). However, group differences speak to the typical member of a group, not to each individual within that group (Kraemer, Frank, & Kupfer, 2011). Meehl and Rosen (1955) warned clinicians against using psychometric patterns or cut scores to aid diagnostic decision-making when the cut score is based on *between-group differences*, instead of on the cut score's accuracy in making *individual correct decisions*. Thus, when studying a nonverbal-verbal difference or any proposed cognitive profile cut-score, the utility of the cut-score should be evaluated in terms of decisions about individuals, not overall group differences. The true diagnostic utility of the Nonverbal > Verbal IQ profile remains unknown.

Objectives: To determine whether any cognitive profiles (e.g., nonverbal IQ > verbal IQ) serve as useful aides in the ASD diagnostic decision by evaluating the sensitivity, specificity, and Area Under the Curve (AUC) of each profile

Methods: We leveraged Receiver Operating Characteristic (ROC) methods to determine the sensitivity, specificity, and Area Under the Curve (AUC) of three different IQ profiles in a large sample of children who have an autism spectrum disorder diagnosis (N =1228, Simons Simplex Collection) who completed the Differential Ability Scales Second Edition (DAS-II), School Age compared to the normative sample provided by the DAS-II publisher (N =2,200).

Results: The frequently discussed Nonverbal > Verbal IQ profile performed near chance at distinguishing ASD from normative individuals (AUC: 0.54, 95% CI [0.52-0.56]). The Nonverbal > Verbal IQ profile performed significantly worse for females than males (AUC: females: 0.46 [0.41-0.52]; males: 0.55 [0.53-0.58]). The Verbal-Spatial and Nonverbal-Spatial IQ profiles were also examined. All cognitive profiles evaluated showed AUC < 0.56.

Conclusions: We conclude that while significant differences between verbal and nonverbal IQ scores exist at the group level, these differences are small in an absolute sense, and not meaningful at an individual level. Cognitive testing is not likely to be a valuable tool in the ASD diagnostic process in school-age children, even though cognitive testing remains an essential source of information to specify level of functioning and intellectual disability. We do not recommend using cognitive profiles to aid in autism diagnostic decision-making.

415.042 *(Poster)* Demographic, Functional, and Psychological Profiles of ADOS-2 False Positives

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Background: The Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) is a diagnostic gold standard measure for the assessment of autism spectrum disorder (ASD). Although this measure reliably differentiates ASD from typically developing controls, few studies have examined the accuracy of the ADOS-2 when assessing individuals with a variety of psychiatric conditions. Furthermore, there is little information regarding individuals with clinically elevated ADOS-2 scores who do not meet diagnostic criteria for ASD.

Objectives: Examine demographic, cognitive, adaptive, and psychological profiles of individuals with clinically elevated ADOS-2 scores who did not receive an ASD diagnosis.

Methods: This sample included 177 patients aged 5 to 21 years who were evaluated at an interdisciplinary, outpatient autism diagnostic clinic and had clinically elevated ADOS-2 scores (i.e., met clinical cutoff for spectrum or autism). Some received an ASD diagnosis (true positive, n=133), while others did *not* (false positive, n=44). A regression was conducted to determine which demographic, functional, and psychological characteristics predict false positive or true positive group membership. Chi square analyses were then employed to analyze group differences in rates of psychiatric diagnoses other than ASD.

Results: Descriptively, the groups did not differ on age, sex, or race/ethnicity (see Table 1). Regression analyses revealed that higher adaptive skills and greater number of psychiatric diagnoses were significantly predictive of false positive outcome, while greater CSS scores were significantly predictive of true positive outcome. Chi-square analyses showed that the false positive group had greater prevalence of anxiety, ADHD, and disruptive behavior disorders.

Conclusions: These findings indicate that individuals with higher adaptive ability may be less likely to receive an ASD diagnosis despite exceeding clinical cutoff scores on the ADOS-2. Additionally, the presence of various psychiatric disorders other than ASD is associated with decreased likelihood of an ASD diagnosis. Specifically, individuals with anxiety, ADHD, or disruptive behavior disorders may be more likely to present with clinically elevated ADOS-2 scores but not meet diagnostic criteria for the condition.

Table 1. Descriptive Demographic Information

	True Positive (n=133)	False Positive (n=44)	Group Differences
Age (in months)	122.25 (49.99)	136.16 (41.90)	t = 1.66, p =.098
Sex (% female)	30.1%	15.9%	2 = 3.402, p =.065
Race/Ethnicity (%)			2 = 6.05, p =.301
Caucasian	58.6%	61.4%	
Black	5.3%	0.0%	
Hispanic	22.6%	22.7%	
Asian/Pacific Islander	2.3%	0.0%	

Other	3.0%	9.1%
Multiracial	7.5%	6.8%

Note. * = $p < .05$.

Table 2. Regression Results

	b	SE b	β	*t*	*p*
(Intercept)	4.155	.399			
Age	-.001	.001	-.088	-.811	.420
Sex	.35	.102	0.34	.339	.735
Cognitive Ability	.00009	.003	.004	.033	.974
Adaptive Ability	-.009	.004	-.290	-2.40	.019*
ADOS-2 CSS	.069	.030	.255	2.30	.024*
# Psych Diagnoses	-.138	.052	-.273	-2.66	.009*

Note. * = $p < .05$. CSS = Calibrated Severity Score. # Psych Diagnoses = number of DSM-5 psychological diagnoses (not including ASD) given at or maintained after the evaluation. The dependent variable, diagnostic group, was coded such that false positives=3 and true positives=4.

415.043 *(Poster)* Detection of Pathological Cries in Infants Utilizing the Chatterbaby App

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Background: Literature has suggested that infants who have major pathologies exhibit acoustic differences in their cries from typically developing infants. Vocal differences may be related to both structural abnormalities as well as muscle tone differences that are present in disorders such as Down syndrome and cerebral palsy. Additionally, recent evidence suggests infants at risk for autism spectrum disorder (ASD) may cry differently from low-risk infants. Acoustic differences in a high-risk infant's cry may emerge as early as one month old. At 6 months, high-risk infants uttered pain cries that had higher and more variable fundamental frequency than low-risk infants. At one year, infants later diagnosed with ASD showed less waveform modulation and dysphonation than typically developing children. Additionally, cries of 18-month-old children later diagnosed with ASD were judged by blinded listeners to be more atypical and irregular. Given that children with autism often have medical diagnoses, we hypothesized that a machine learning algorithm could discriminate between pathological and healthy cries using acoustic features.

Objectives: To assess whether infants with parent-reported medical diagnoses exhibit differences in cry patterns from control infants.

Methods: Data were collected from (n = 508) users of *Chatterbaby*, a smartphone app that translates a baby's cry for parents. The "*Chatterbaby* Autism Risk Survey" obtains participants' consent for their information to be used in research, collects demographic information of the infant and parents, and screens for ASD-associated behaviors. Major diagnoses included seizure, stroke, Down syndrome, failure to thrive, surgery requiring anesthesia, re-hospitalization following initial hospital discharge, small for gestational age, low birthweight, premature birth <32 weeks, extracorporeal membrane oxygenation, infant respiratory distress syndrome, and intracranial hemorrhage. A total of 452 pathological cries (infant age M = 5 months) were compared to 2945 non-pathological cries (M = 3 months). Roughly 10% of children had a family history of ASD. Over 6000 acoustic features were extracted using OpenSmile, including pitch (F0), energy, jitter, and shimmer measures. A random forests model was trained using the IS13 feature set on 95% of the data to predict whether a cry belonged to an infant with or without a diagnosis. The model was then tested on the held-out dataset, revealing 81.25% Positive Predictive Value and 97.5% True Positive Rate.

Results: By analyzing the acoustic features of cries, the algorithm was able to successfully identify infants who had major medical diagnoses. Babies with diagnoses were found to have weaker cries containing fewer cry waves, lower overall energy, and limited ability to project in the higher frequency ranges compared to controls.

Conclusions: Vocal abnormalities in infant cries may be non-specific indicators of medical risk. Given that ASD is frequently comorbid with the diagnoses included, additional research is needed to assess if children at-risk for ASD exhibit acoustic differences in cry patterns compared to the general pathological cry. Results from this study will be utilized as the foundation for follow-up work focused on this aim.

415.044 *(Poster)* Development and Validation of Assessment of Functioning Tools Based on the ICF Core Sets for ASD Suitable for Individuals on the Autism Spectrum across the Lifespan

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Background: Children and adults on the autism spectrum experience a range of activity limitations and participation restrictions, impacting on daily life and long term role outcomes. International guidelines recommend that functioning be evaluated as part of a diagnostic evaluation, and both the DSM-5 and ICD-11 include functioning related diagnostic criteria for autism spectrum disorder (ASD). The 'Australian National Guideline for the Assessment and Diagnosis of ASD' advocates a strengths-focused and comprehensive assessment of functioning and support needs for all individuals referred for an assessment of ASD concerns. This Australian guideline suggests the International Classification of Functioning, Disability and Health (ICF) as a conceptual framework for an assessment of functioning, along with the use of standardised assessments that cover a broad range of domains, with a suggestion for researchers to develop and validate a fit-for-purpose tool based on the ICF Core Sets for ASD.

Objectives: This program of research aimed to develop and validate assessment of functioning tools based on the ICF Core Sets for ASD that are suitable for individuals on the autism spectrum across the lifespan and available in clinician-administered, self-report and proxy-report versions.

Methods: Prototype assessment of functioning tools were developed in clinician-administered, self-report and proxy-report versions with input from researchers, clinicians and the autism community (n>37). These prototype tools include simplified definitions, examples and symbolic images for each of the ICF Core Sets for ASD items. The clinician-administered version was piloted with at least 75 parents/caregivers of young autistic individuals up to 20 years of age (alongside the PEDI-CAT and Vineland, two established standardised tools). Feedback on the clinician-administered version was also obtained from parents/caregivers (n>30) on acceptability and clinicians (n>30) on clinical utility. The self-report and proxy-report versions will be piloted with autistic adolescents/adults and parents/caregivers of autistic individuals of all ages (expected n>50) between January – March 2020 and feedback will be sought regarding acceptability.

Results: Preliminary psychometrics properties of the clinician-administered version suggest that most activity and participation domains have good to excellent internal consistency, along with excellent inter-rater reliability at the item level. Parent/caregivers and clinicians provided early feedback that the clinician-administered version was holistic and strengths-focused, although time-consuming, and a full set of psychometric properties and normative data for a manualised final version would be necessary prior to wide spread adoption. Further investigation of the psychometric properties and usability of the clinician-administered, self-report and proxy-report versions will be available at the INSAR meeting.

Conclusions: These prototype assessment of functioning tools represent an important first step in operationalising the ICF Core Sets for ASD, which will provide a suite of comprehensive assessment of functioning tools that are feasible and acceptable to the autism and clinical communities.

415.045 *(Poster)* Development of AIIMS-Modified-Indt-ASD Diagnostic Tool for the Age Group 1-14 Years. and a Screening Tool for Identifying the Early Signs of Autism Spectrum Disorder in Children Aged 1-18 Months in a Premier Teaching Institute in North India

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Background: Point of care diagnostic tools based on DSM V criteria for Autism Spectrum Disorder , as well as a screening tool to identify children <18 months at risk for autism are likely to help clinicians.

Objectives: To describe the process of development of AIIMS-Modified-INDT-ASD Tool for 1-14 years age and a screening tool for identifying early signs of ASD in children aged 1-18 months in a premier teaching institute in North India.

Methods: DSM-IV-TR based INCLEN Diagnostic Tool for ASD was modified to incorporate the DSM-5 related changes by Child Neurology Division, Department of Pediatrics, AIIMS, New Delhi, using Delphi method. It included: (a) Rearrangement of questions from the previous tool; and (b) Addition of new questions on sensory symptoms. This AIIMS-Modified-INDT-ASD Tool was validated against DSM-5 diagnostic criteria. Receiver Operating Characteristic (ROC) curves were used to determine the cut-off for total score as compared to Childhood Autism Rating Scale (CARS) score to grade the severity of ASD.

The second study was designed to generate a pool of questions by Delphis technique to identify early signs of Autism Spectrum Disorder in 1-18 months of age. To develop and administer the questionnaire in 4 study groups (ASD vs Healthy & Disease Controls aged 24-30 months) with the aim of developing a tool to identify children between 1-18 months of age predisposed to developing ASD. The study was conducted in three parts. The first part was to generate a pool of questions using Delphi's technique to identify early signs of ASD. The second step consisted of applying this questionnaire in the 4 groups mentioned above. The third and the final part consisted of drawing cut off scores in age specific strata across various domains thus identifying sensitive and specific questions and developing a final tool.

Results: Two-hundred-twenty-five children (159 boys, median age = 47months) were enrolled. for the first study. The AIIMS-Modified-INDT-ASD Tool demonstrated sensitivity of 98.4% and specificity of 91.7% to diagnose ASD. A score ≥14 on the tool was suggestive of severe ASD (CARS>36.5) with a sensitivity and specificity of 80% and 80.7% respectively [Area under the curve = 0.89].

In the second study, 200 Children aged 24-30 months (50 in each group) with diagnosis of ASD, global development delay, hearing loss and typically developing children were enrolled in the study. Out of the 62 questions in the original questionnaire in second study, 30 questions were identified with >80% sensitivity and specificity to screen for ASD in young children. Only six questions could be identified for children in the first 6 months of age and contributed least in terms of identification of the ASD characteristics. The subsequent two age strata had equal representation of the representative questions. Sensitivity of the tool was comparable across each of the age groups, however specificity of the tool increased with age (87.5% at 12 months and 95% at 18 months).

Conclusions: Both AIIMS-Modified-INDT-ASD Diagnostic Tool (age group 1-14 yrs)and screening tool for ASD in 1-18 months children have good psychometric properties.

415.046 *(Poster)* Development of the Tactile and Auditory Observation Schedule (TAOS)

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Background: Sensory atypicalities are highly prevalent in both autism spectrum disorder (ASD) and Williams syndrome (WS). Particularly, auditory filtering has been found to be significantly elevated in autistic[1] and WS[2] children; and relationships between auditory and tactile modalities and other symptoms (e.g. restricted and repetitive behaviours) are reported in both conditions[3,4,5]. This evidence highlights the importance of making distinction between tactile and auditory, and other sensory modalities in order to examine their distinct patterns.

A semi-structured direct observation is a thorough and accurate assessment[6]. Yet, there are only a handful of observational tools administered directly to participants that have been used to assess sensory processing in children with ASD and/or WS. Furthermore these tools either focus on only one modality, one pattern of sensory processing (e.g. overresponsivity), or are not widely accessible.

Objectives: The aim of this study was to develop, administer and evaluate the Tactile and Auditory Observation Schedule (TAOS) with typically developing (TD), autistic children and children with WS.

Methods: Twenty TD children, twenty-three autistic children and seventeen children with WS between 4 and 9 years old and their parents were recruited to the study.

All children undertook:

1. Raven's Coloured Progressive Matrices[7] and British Picture Vocabulary Scale - Third Edition[8] to assess non-verbal reasoning ability and child's receptive vocabulary
2. TAOS - a new play-based measure assessing hypo- and hyper-responsiveness to auditory and tactile stimuli. It consists of a free-play time, auditory and tactile tasks. The content was guided by the content of a number of range of sensory questionnaires and relevant literature. Parents of children with ASD and WS were also consulted to make sure that all appropriate items were considered and included in the tool.

Results: A Chi-squared test/Fisher's exact test was performed to examine whether there was a difference in the distribution of the TAOS scores for both auditory and tactile processing domains, across the three groups. For the TD and ASD groups and TD and WS groups, a significant difference in the distribution of the scores was found in the auditory domain (p=.006; p=.007, Fisher's exact test respectively), but not in the tactile domain (p=.589; p=.196, Fisher's exact test respectively). For the ASD and WS groups Fisher's exact tests were non-significant.

Using item distribution analysis, items related to sound seeking and a range of background noise in the auditory domain and those related to being messy or being made messy in the tactile domain were best at distinguishing between all the three groups.

Conclusions: The ASD and WS groups, in general, performed similarly. Six items were best at distinguishing between all the three groups. The administration of these tasks takes up to 25 minutes and only these could be used when assessing auditory and tactile hypo- and hyper-responsivity in children with typical and atypical development. Further work is required on the validation of the TAOS and its psychometric properties to provide researchers and clinicians with an accurate measure of auditory and tactile processing in children with and without neurodevelopmental disorders.

415.047 *(Poster)* Diagnosis of Autism in Toddlers Using Telemedicine Tools

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Background: The use of telemedicine in assessment for autism spectrum disorder (ASD) presents an opportunity to increase access to care for children and families. Previous work provided preliminary support for accuracy of telemedicine-based diagnosis of ASD (Juárez et al., 2018). However, such work has relied on expert remote psychologists observing a standardized interactive assessment (i.e., the Screening Tool for Autism in Toddlers and Young Children [STAT]) administered by a trained early intervention provider on site with the toddler and caregiver(s). This procedure requires two providers, presenting a major burden to scalability of telemedicine-based ASD diagnosis. In the present study, we evaluated preliminary diagnostic accuracy and perceived diagnostic certainty of psychologists following a telemedicine-based screening procedure. Psychologists verbally guided parents through structured interaction with their toddlers using telemedicine either tools adapted (TELE-STAT) or developed explicitly for (TELE-ASD-PEDS) caregiver-mediated remote assessment by clinician. Afterwards, psychologists indicated a diagnostic decision and rated their certainty of that diagnosis.

Objectives: This study evaluated diagnostic accuracy and clinician certainty in diagnosing ASD after telemedicine assessment using two different parent-led telemedicine tools.

Methods: Clinicians indicated diagnostic impression and certainty after either the administration of assessment alone (Phase 1, n=51) or use of the assessment with a diagnostic interview (Phase 2, n=35). Data collection for Phase 2 is ongoing. In both phases, psychologists interacted with families using HIPAA-compliant video platforms allowing for audiovisual communication. Diagnostic accuracy was determined by comparing psychologists' diagnostic impressions following telemedicine-assessment with toddlers' independent clinical diagnoses. See Table 1 for demographic and diagnostic information.

Results: In Phase 1, accuracy of psychologists' diagnostic impressions following telemedicine assessment (ASD vs. no ASD) was 86 percent. Psychologists accurately identified 33 toddlers as meeting criteria for ASD. Five toddlers with developmental delays were incorrectly identified as having ASD, and two toddlers with clinical ASD diagnoses were not identified as having ASD following telemedicine assessment. In Phase 2, diagnostic accuracy following telemedicine assessment was 94 percent. Following tele-assessment, twenty-nine toddlers were accurately identified as having ASD. Two toddlers with clinical ASD diagnoses were not identified as having ASD. Clinician certainty did not differ as a function of the assessment procedure used (i.e., TELE-STAT vs. TELE-ASD-PEDS) in both Phase 1 ($t(49)= 0.76$, $p = 0.45$) and Phase 2 ($t(33)=.143$, $p=.887$). Clinician certainty also did not differ based on whether the telemedicine assessment included a diagnostic interview ($m=3.03$, $SD=1.07$) or relied only on observation of the TELE-STAT or TELE-ASD-PEDS ($m=3.30$, $SD=0.71$; $t(83)=1.3$,$p=.195$). More information on diagnostic certainty and diagnostic agreement is displayed in Table 2.

Conclusions: This study provides preliminary evidence for the utility and diagnostic accuracy of telemedicine procedures for toddlers with ASD, particularly when parent-led interactions are coupled with diagnostic interviewing. The parent-led tools used in this study represent promising avenues for future use in telemedicine assessment. As Phase 2 continues, we will continue to evaluate diagnostic accuracy, clinician certainty, and parent feedback on these procedures.

415.048 *(Poster)* Diagnostic Accuracy of the Autism Diagnostic Observation Schedule within a Clinical Cohort in Melbourne, Australia

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Background: The prevalence of Autism Spectrum Disorder (autism) is growing and autistic features increasingly recognised among children and families with a range of conditions. Diagnosing autism spectrum disorder (autism) is complex, however, particularly in clinical samples where a broad range of developmental difficulties are common and/or when adverse life experiences, including neglect or trauma, have occurred. Accurate assessment methods are imperative so that resources for comprehensive neurodevelopmental assessment are used appropriately. The Autism Diagnostic Observation Scale, Second Edition (ADOS2) is a commonly used diagnostic tool in research and clinical settings. The tool has good sensitivity but concerns about overdiagnosis have been raised, particularly in cohorts where comorbidities are common.

Objectives: This study aims to assess the diagnostic accuracy of the ADOS2 in a clinical community sample and describe the clinical characteristics of children whose scores did not match their clinical diagnosis.

Methods: Assessment information was collected from 247 participants (aged 2 – 16 years) attending a multidisciplinary clinic in a community health centre in Melbourne, Australia between May 2016 – March 2019. During these assessments, information was collected about childhood exposure to significant adverse events, including witnessing family violence, periods of homelessness, significant parent mental or physical ill health, newly arrived refugee status, substance misuse and/or child protection involvement.

Results: Within this clinical sample, the prevalence of autism was 86% and 33% had experienced a significant adverse event. The sensitivity of the ADOS was 0.96 (CI = 0.93 – 0.98) and specificity was 0.22 (CI = 0.12 – 0.38). Children who were below clinical cut-off on the ADOS (N = 15) were more likely to be female (63%) and older (mean age = 9.4 years) than the 232 children who scored above the clinical cut off (27% female [p =0.05], mean age = 7.1 years [p = 0.03]) regardless of diagnosis. Of children diagnosed with autism, false negatives (N = 8) were more likely to be female (63%) and older (mean age = 8.7 years) than the 204 true positives (27% female [p = 0.01], mean age = 7.3 years [p = 0.07]). Notably, within the group who were not diagnosed with autism, 19 of the 28 children (68%) who were above clinical cut-off on the ADOS (false positives) had been exposed to a traumatic event compared with 3 of the 7 children (42%) who were true negatives, although this difference was not statistically significant (p=0.23).

Conclusions: The ADOS has reasonable sensitivity overall but may be lower in older cohorts with a higher proportion of females. The high proportion of children with a trauma history amongst false positives raises concerns about using the ADOS in isolation within high risk clinical samples.

415.049 *(Poster)* Differential Item Functioning Based on Level of Autism Features and Age on the Parent-Report Version of the Screen for Child Anxiety Related Disorders Among Youth with Autism

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Background: Although anxiety negatively affects quality of life for many children on the autism spectrum (Adams et al., 2019; van Steensel et al., 2017), few studies have examined the psychometric properties of anxiety measures in this population. Preliminary evidence suggests acceptable psychometric performance of the Screen for Child Anxiety Related Disorders (SCARED) in an autism sample (Stern et al., 2014). The validity of research on this topic, however, also requires that questionnaires capture true differences in latent constructs rather than systematic differences in measurement across youth of different ages and level of autism features. Studies have posited that due to potential overlap of anxiety and autism symptoms, scores on these questionnaires may be falsely inflated (McVey et al., 2018), yet this has yet to be empirically tested. Moderated nonlinear factor analysis (MNLFA; Bauer, 2018) allows for testing of threshold and discrimination differential item functioning (DIF) across continuous covariates.

Objectives: The present study sought to first replicate the 5-factor structure of the SCARED, a parent-report measure of anxiety, and subsequently explore DIF across age and level of autism features using MNLFA in a sample of youth with autism.

Methods: Data were from the National Database for Autism Research, a NIH-funded data repository. Participants met criteria for autism on the Autism Diagnostic Observation Schedule (ADOS) (Lord et al., 2000). The sample (N=198) was 83% male (Mage=11.18). Parent-report on the SCARED and Social Communication Questionnaire (SCQ) were used as measures of anxiety and autism features, respectively. Moderated nonlinear factor analysis (MNLFA) in MPlus was used to test each item within a subscale of the SCARED for differential item functioning (DIF). Significant regression paths between the covariates and the candidate item indicates threshold DIF, and significant regression paths between the candidate item and the interaction between the covariate and the latent variable indicates discrimination DIF. A final model was run for each subscale, simultaneously accounting for all items with DIF on that subscale.

Results: A confirmatory factor analysis indicated good fit of the 5-factor structure (CFI = 0.94; TLI = 0.93; RMSEA = 0.05). MNLFA revealed multiple items with threshold and discrimination DIF based on level of autism features and age (Table 1). For items with threshold DIF, parents of children with greater levels of autism features or older age are more/less likely to endorse those items at the same level of the latent construct (anxiety). For items with discrimination DIF, the association between the latent construct (e.g. panic disorder) and that item may be weaker/stronger dependent upon levels of autism features and age.

Conclusions: This study replicated the 5-factor structure identified within neurotypical literature and by a prior study on autism. Results of DIF analyses, however, also provide evidence that multiple items on the SCARED have systematically different measurement properties dependent upon a child's level of autism features and age, and thus, the tool may not capture true differences in anxiety for all children on the spectrum. Clinicians and researchers need to be especially vigilant in measuring anxiety symptoms in autism.

415.050 *(Poster)* Differential Item Functioning of the Social Communication Questionnaire in African Americans

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Background: The American Academy of Pediatrics (AAP) recommends that all children be screened for autism spectrum disorder (ASD) at 9, 18 and 30 months of age. The Social Communication Questionnaire (SCQ) is a screening tool commonly used to detect ASD risk in children. Prior research suggests that the SCQ has lower sensitivity and specificity among black versus white children. Further psychometric evaluation is needed to understand whether specific items on the SCQ contribute to racial differences in screener performance.

Objectives: To determine the degree to which specific items on the SCQ perform differently among white and black children.

Methods: Data for this analysis come from The Study to Explore Early Development (Phase 1 enrollment: 2007- 2011; Phase 2 enrollment: 2012-2016), a multi-site study that evaluated children 30 to 68-months of age with ASD, non-ASD developmental disorders, and those from the general population (total N=7271). The SCQ was administered by phone interview. The SCQ is comprised of 40 yes/no items completed by the caregiver of the child; additional demographic data (maternal race/ethnicity, etc.), were collected via a standardized parent interview.

Differential Item Functioning (DIF) is a psychometric method to determine if different groups perform similarly on specific items of a measure. Analyses of DIF for this study utilized logistic regression. Separate models were computed for each SCQ item with race as a fixed factor. White children were used as the reference group based on high sensitivity and specificity of the SCQ in this group. This DIF method allows for the comparison of white versus black children on performance of each item in predicting total score, factoring out the contribution of that item to the total score. Items will perform differentially between groups if race is a significant factor in the model. Negative betas indicate that black respondents are less likely to endorse that item. Positive betas mean black respondents are more likely to endorse that item.

Results: Logistic regression analyses showed that black respondents were significantly less likely to endorse 10 items and significantly more likely to endorse 9 items relative to white respondents (Table 1). Examples of items with the highest probabilities of differential performance found that black respondents as compared to white respondents were less likely to endorse that their child used odd phrases or socially inappropriate statements and were more likely to endorse that their child used inappropriate facial expressions.

Conclusions: Black parents responded significantly differently than white respondents on 48% of items from the SCQ. This suggests that responses to items on the SCQ may be influenced by racial culture, which may contribute to overall screening differences between these groups (Moody, et al., 2017). It is important that ASD screeners are equally valid among those with diverse backgrounds so that they do not contribute to persistent racial disparities. More research is needed to ensure that the screeners perform similarly at the item and test level, and to determine if DIF is the result of true group differences or the result of the test's construction.

415.051 *(Poster)* Discrepancies in Answering on Suicide Relevant Questions between Autistic Adults and Parents Answering in Their Stead, an Insight into Risk and Masking

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Background: We have been developing a new adult autism screening measure (AutCQ) with responses from an international sample of autistic individuals (N=631) or, because not all may use spoken language, parents answering in their stead (N=75). Here we report results relating to an important part of the experiences of many autistic respondents, depression and suicidality.

There has been a general increase in suicide with rates rising by about 2% a year since 2006. Suicide and suicidality rates appear particularly elevated in those diagnosed as autistic, and in tandem with that, there is growing discussion and awareness of how masking and camouflaging correlate with risk for self-harm and suicide. We are taking the opportunity to highlight discrepancies in responses by parents compared with autistic adults.

Objectives: Our objectives are fourfold. A comparison affords the opportunity to learn how on critical items, where crisis or life-time burden of psychological pain are involved, there are differing response profiles of autistic adults compared to parents. There is the need to understand how the AutCQ performs when a parent is assisting their adult child who may have difficulty with language. There is the need to better understand masking or hidden psychological states and to place them on the developmental timeline. Lastly, we hope to track constellations of responses indicating risks of suicide and crisis.

Methods: The AutCQ's items cited in the research as suicide risk factors were examined. These were: Anxiety, Depression or Sadness, Feeling isolated, Aggression towards self or others, and Suicidal thoughts, and Problems getting adequate sleep. The measure has 6 potential response options, with three focused on when the issue began: ages 2-5 years old, 6-12, and 13 and older; *Never an issue*; and that the issue had been outgrown. *I don't know* was a response not included in this analysis.

Results: Fisher's exact tests indicated that responses differed on all items, $p \leq .02$, except "Anxiety or worry," where $p = .10$. Most powerfully, on the item pertaining to Depression and sadness, the response option that it was "Never an issue" was endorsed by only 3.8% of autistic adults but 20% of parents. Looking specifically at suicidal thoughts, 33.3% of parents reported it was "Never an issue," compared with 16.6% of autistic adults. Similarly, 24.7% of autistic adults but only 16% of parents selected feeling isolated beginning at ages between 2 to 5.

Conclusions: On items related to psychopathology and psychological pain, autistic adults responding for themselves and parents answering for their child provided critically different responses. Where parents are assisting their child to fill out the AutCQ, this should be kept in mind. As the design of the AutCQ helps to place struggles along a developmental timeline, results show struggles occurring out of the awareness of parents. This suggests masking by children which may increase the risk for self-harm, suicide and psychological pain. Results also suggest important interventions are needed, regardless of how other AutCQ are answered. AutCQ is being designed to track intensity of current distress.

415.052 *(Poster)* Disparities in Access to Services for Children Undergoing Routine Autism/Developmental Screening in Primary Care

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Background: The American Academy of Pediatrics recommends screening for Autism Spectrum Disorder (ASD) at 18 and 24/30 months (Johnson et al., 2007), along with developmental screening at 9, 18 and 24/30 months (AAP, 2006). The Modified Checklist for Autism in Toddlers (M-CHAT; Robins et al., 2001) and Parents' Evaluation of Developmental Status (PEDS; Glascoe, 1999) are routinely used to meet these requirements. High rates of screening are not correlated with rates of service referral (Monteiro et al., 2019) and health disparities service access have been documented for children with ASD and developmental concerns (e.g., Khetani et al., 2017; Mandell et al., 2002). As children who receive intervention earlier have improved outcomes (e.g., Reichow, 2012), exploration of the sources of these disparities is warranted.

Objectives: The objective of the study is to examine the predictive validity of the M-CHAT and PEDS for diagnoses of ASD and developmental delay (DD), and if this varies by race or sex. The study also sought to examine the relation between the screening measure scores and access to services. Similarly, moderation of this relation based on sex and race was examined.

Methods: A retrospective review of well visits ($n = 1448$ children) at an urban primary care center housed was conducted. The sample was 90.8% non-White (9.2% White) and 52.3% male (47.7% female). The Time 1 visit consisted of data for the 18-month M-CHAT (total items failed) and PEDS (number of predictive concerns). The Time 2 visit consisted of a well visit between ages 4 to 6 years where diagnoses were extracted (e.g., autism, DD). Access to services was measured by the cumulative number of active and referred developmental services across Time 1 and Time 2 visits.

Results: When examined simultaneously, higher scores on the M-CHAT (but not the PEDS) was a significant predictor of a later diagnosis of ASD or DD (B = 0.28 [SE = 0.09] $p = .002$). This relationship did not vary by race or sex. Higher scores on both the M-CHAT and PEDS were significantly related to access to services (M-CHAT: B = 0.55 [SE = 0.07] $p < .001$; PEDS: B = 2.02 [SE = 0.26] $p < .001$). Demographic differences in this relationship also emerged, such that females and non-White children had access to fewer services (Race: B = -0.40 (SE = 0.12) p = .001 B; Sex: B = -0.24 (SE = 0.06) p = .001). Race and sex also moderated each relation between scores on the M-CHAT and PEDS and service access. When screening measure scores were held constant across groups, females and non-White children had less access to services.

Conclusions: While higher scores on the M-CHAT predicted later diagnosis of ASD/DD, the PEDS did not provide incremental predictive power. Non-White and female patients had lower rates of services access, such that increased risk on the M-CHAT or PEDS was less associated with access. While screening was related to services access overall, findings signal the importance of addressing barriers to access for female and non-White children.

415.053 *(Poster)* Do Self-Diagnosed Adult Women Differ from Those Having Received a Diagnosis from a Multidisciplinary Team?

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Background: Some autistic women may remain undiagnosed, possibly because of gender-biased diagnostic procedures and/or camouflage effects. However, clinicians also report a trend towards over-diagnosis in adult women, driven by a lack of use of differential diagnosis, fear of discriminatory practice, or behavioral consequences of refusing an autism diagnosis to women with borderline personality disorders.

Objectives: Determine on which items of a self-report questionnaire self-diagnosed women most resemble clinically diagnosed women, making these items sensitive enough to screen for "true" autism.

Methods: The Questionnaire for Autism Spectrum Conditions (Q-ASC, Attwood, Garnett, Rynkiewicz. Cf. https://mindsandhearts.net/gq-asc-girls-questionnaire-for-autism-spectrum-conditions/) was adapted into a self-administered questionnaire for adults by duplicating questions into past and present forms. The questionnaire was then translated into French and published & advertised online: https://maca.huma-num.fr/femmes-autistes/. People assigned female at birth with and without autism diagnosis enrolled in the study. Between-groups comparison for each questionnaire item were carried out using t-tests ($p<0.01$) in order to determine whether they differentiated (1) women with autism diagnosis validated by a multidisciplinary center, (2) women without autism diagnosis but self-identifying as autistic, and (3) women without autism diagnosis and not identifying as autistic.

Results: 506 adult women were included (194 clinically diagnosed, 210 self-diagnosed, 102 controls). Answers to 98 questions were analyzed. 35 questions yielded significant between groups differences. 25 of these items were objective (i.e. related to observable behaviors) and could be investigated through a proxy; 10 were subjective (related to inner states or subjective experience) and could be explored through clinical interviews. 13 questions resulted in similar responses between clinically and self-diagnosed women, but differed in controls, and therefore could be useful to detect true autism cases (e.g. “Do you express distress during grooming or when you are touched?”); 11 questions differentiated the clinically diagnosed from the control group, but not the clinically diagnosed from the self-diagnosed group. These items may be useful to discriminate between true and false autism cases within the self-diagnosed population (e.g. “Are you bothered by bright lights or certain kind of lights (e.g. fluorescent light)?”); 11 questions differentiated the self-diagnosed group from the control group, but no difference was found between the clinically diagnosed and control groups. These questions were mostly related to camouflaging strategies (e.g. “Do you copy or ‘clone’ yourself on other women?”). These questions may be sensitive to non-autistic atypical thoughts and behaviours.

Conclusions: Self-reported screening questionnaires may help to facilitate accurate referral and differential diagnosis, especially in people who have already self-diagnosed as autistic. The Q-ASC may provide information differentiating self-diagnosis grounded in a plausible autistic phenotype (which could be corroborated by multidisciplinary assessment), from misguided identification to the autism spectrum.

415.054 *(Poster)* Early ASD Screening: Can We Reduce Average Age of Diagnosis?

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Background: Early screening and diagnosis for children with ASD are critical (Filipek et al., 1999), as early detection and intervention are associated with better outcomes (e.g., Dawson et al., 2010). The American Academy of Pediatrics (AAP; Johnson et al., 2007) recommends universal ASD screening at 18 and 24 months, however, empirical evidence is lacking regarding optimal time points for ASD screening, and whether screening at an earlier age leads to earlier detection. The current study compares children initially screened at 12 months to children screened at the recommended 18 months.

Objectives: This study aimed to: 1) Determine the average age of attending an ASD evaluation when screening is initiated at 12 months compared to 18 months of age; 2) Explore differences in evaluation follow-up by screening age.

Methods: Toddlers (n = 4556) were screened for ASD during primary care check-ups. Sixteen primary care clinics were randomized to begin screening for ASD at 12 months (8 clinics; n = 1506) using the Infant Toddler Checklist (ITC; Wetherby & Prizant, 2002) and the First Year Inventory Lite (FYI-L; Baranek et al., 2009) or 18 months of age (8 clinics; n = 3050) using the Modified Checklist for Autism in Toddlers, Revised, with Follow-Up (M-CHAT-R/F; Robins, Fein, & Barton, 2009). Children enrolled at 12 months were rescreened using the M-CHAT-R/F at 18 months and 24 months of age. Children enrolled at 18 months were rescreened with the M-CHAT-R/F at 24 months of age. Of these children, 272 children who screened positive attended a comprehensive autism evaluation (12m n = 112; 18m n = 160).

Results: Children screened at 12 months were evaluated at a younger age (M = 16.72 m, SD = 3.81) than children screened at 18 months (M = 23.65 m, SD = 6.77; $t(270) = -9.79$, $p < .001$). Earlier screening led to evaluations at younger ages across diagnostic outcome (ASD: $t(99) = -5.16$, $p = .02$; DD: $t(105) = -6.09$, $p < .001$; TD: $t(62) = -6.05$, $p < .001$). However, following a positive screen, evaluation attendance prior to a subsequent screen was lower for the 12 month vs. 18 month group (29.13% vs. 43.30%; X^2 (1, N=515) = 11.16, $p < .001$).

Conclusions: Earlier initial screening, at 12 months of age, compared to later initial screening, at 18 months of age, led to earlier age of receiving an ASD evaluation. Although children who are screened earlier obtain evaluations at a younger age, families are less likely to attend the evaluation following a positive screen compared to children initially screened at 18 months. Caregivers’ acceptance of ASD risk appears to be lower for younger children. However, when they do attend an evaluation, diagnosis can occur even before 18 months, allowing for potentially earlier treatment. Further studies are needed to explore factors associated with evaluation attendance and strategies for ensuring that children who do not attend very early evaluation are rescreened and evaluated if ASD risk remains indicated.

415.055 *(Poster)* Early Autism Identification Disparities in Rural and Medically Underserved Populations

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Background: Research indicates the sooner children with autism spectrum disorder (ASD) are diagnosed and begin evidence-based treatments, the better their long-term health outcomes. While a valid ASD diagnosis can be achieved at age 2, the current average age of diagnosis is between 4 and 5. These delays more profoundly impact families of children with ASD living in rural and medically underserved areas (MUAs). Little is known about the geographical health disparities encountered by these families and ways to effectively minimize them.

Objectives: To identify barriers and facilitators to ASD diagnosis and treatment for families living in rural or MUAs.

Methods: Three focus groups were conducted in-person and online (e.g., Zoom) with parents of children with ASD living in rural and MUAs. A total of twenty participants engaged in focus group sessions. Open- and closed-ended questions were used to identify barriers and facilitators to treatment in rural or MUAs, as well as patient-centered solutions to minimize disparities. Sessions were audio recorded and transcribed. Data were analyzed by three independent qualitative coders using interpretive description qualitative methods.

Results: Identified barriers to ASD diagnosis included distance to healthcare services, limited access to providers, inadequate insurance coverage, lengthy wait times, and lack of education on ASD. Barriers to ASD treatment included distance, limited number of providers, insurance, cost, and competing demands of the family. Facilitators to ASD diagnosis included school system referrals, research studies, and large ASD research centers. Facilitators to ASD treatment included online support groups (e.g., Facebook), school-based treatments, and insurance extenders. Parent-identified ways to minimize barriers were to increase education, enhance awareness of ASD and needs of rural and MUAs, and improve access to care. Parents proposed interventions of telehealth and mobile clinics to improve access to diagnostic and treatment services. Qualitative analysis revealed recurring parental themes of decreased parental autonomy, frustration, disappointment, uncertainty, and desire for support. Results of this study found the use of online (e.g., Zoom) and in-person focus groups to be equally effective in engaging families of children with ASD living in remote and underserved areas.

Conclusions: Early diagnosis and treatment are critical for improved long-term health outcomes of children with ASD. However, little is known regarding factors that contribute to such delays among children in disadvantaged rural or MUAs. Engaging parents of children with ASD is an important step to identifying ways to break the cycle of health disparities. Families living in rural and MUAs face many barriers related to ASD diagnosis and treatment. Future interventions should address these barriers by increasing awareness of ASD, increasing knowledgeable providers, and utilizing electronic technologies to engage individuals in these areas. Research is currently being planned to further engage families of children living in rural and MUAs to better understand effective ways to reduce barriers to diagnosis and treatment in rural and MUAs.

415.056 *(Poster)* Early Detecting for Autism in Young Children before 36 Months of Age in Taiwan: A Five-Year Follow-up Study

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Background: Autism spectrum disorder (ASD) is thought as an innate neurodevelopmental disorder. Over past decade, some studies reported that prevalence of ASD has increased markedly. However, compared to Western countries, the prevalence of ASD in Taiwan is lower, especially for young children. There are a few reasons that cause the differences of the prevalence, such as stigma in Chinese culture, policy of government, and limitation of screening tools for young children etc. Previous studies reported that early intervention improved outcomes for toddlers with ASD. The benefits of early intervention highlighted the importance of earlier identification of young children with ASD. Thus, there is a clear need for improvements in the early identification for ASD in Taiwan.

Objectives: The purpose of this longitudinal study was planned to investigate the predictive accuracy and stability of the Modified Checklist for Autism in Toddlers (M-CHAT）, the Taiwan Version of Screening Tool for Autism in Two-Year-Olds, (T-STAT）and the Autism Diagnostic Observation Schedule (ADOS) which used to detect ASD in young children before 36 months of age at initial assessment who were followed up 5 years after initial assessment.

Methods: We recruited 97 young children with developmental problems aged from 18 to 36 months (Time 1) in this study. Both T-STAT and ADOS are interactive tools which provide a chance for examiner to observe and assess all young children while the M-CHAT is parent-report scale for caregivers to fill out based on daily behaviors of their children. All of M-CHAT, T-STAT and ADOS were used to assess and classify participants at initial assessment (Time 1). And, at 5 years after initial assessment (Time 2), all of young children received assessment again for making final diagnosis. Finally, there are 45 children with ASD and 52 children with Non-ASD.

Results: The classification of the M-CHAT showed poor predicative accuracy (.42-.76) and stability (.53-.71) for detecting ASD in young children before 36 months of age. And, the classification of the T-STAT showed fair predictive accuracy (.76) and stability (.76) for detecting ASD in young children before 36 months of age. In addition, the classification of the ADOS had high predictive accuracy (.82) and stability (.86) for detecting ASD in young children before 36 months of age. Compared to screening tools of parent-report scale (i.e. M-CHAT), the screening tools of interactive method (i.e., T-STAT, ADOS) showed better predictive accuracy and stability.

Conclusions: The findings showed that the accuracy and stability of the ADOS and the T-STAT was high than the M-CHAT, especially for ADOS. However, due to the limit of time in the clinical setting and burden of clinical staff in Taiwan, the T-STAT is still worth to be promoted for screening ASD in young children before 36 months of age as it is a less time-consuming screening tool while its validity was only a bit lower than the ADOS. The finding of this study needs to replicate with large participants and provides implications for early screening.

415.057 *(Poster)* Early Sensory Reactivity Is Associated with Changes in ASD Symptoms from 14 to 23 Months

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Background: Children with Autism Spectrum Disorder (ASD), and those at elevated likelihood to develop ASD (EL-ASD), often display atypical patterns of sensory reactivity, including hyporeactivity, hyperreactivity, and sensory seeking behaviors. More atypical sensory reactivity patterns have been associated with poorer social skills, increased mood and anxiety symptoms, and worse adaptive behaviors. To date, little research has explored the relationship between early sensory reactivity patterns and changes in ASD symptoms over time.

Objectives: (a) Examine associations between sensory reactivity at 14 months and changes in ASD symptoms by 23 months. (b) Determine if sensory reactivity at 14 months moderates intervention effects on ASD symptoms by 23 months.

Methods: Participants included 87 EL-ASD children (60 boys) identified at 12 months based on community screenings with the *First Year Inventory 2.0*(Baranek et al., 2003). Children were administered the *Sensory Processing Assessment*(SPA) and parents completed the *Sensory Experiences Questionnaire*(SEQ). Both the SPA and the SEQ yield domain scores in hyporeactivity, hyperreactivity, and sensory seeking behaviors. Assessment with the *Mullen Scales of Early Learning*(MSEL) yielded scaled scores for visual reception (VR). The *Brief Observation of Social Communication Change*(BOSCC), a treatment response measure that quantifies changes in ASD symptoms, was applied to parent-child free-play videos using standard coding procedures at Time 1 and Time 2 (23 months of age; +/- 0.86) to examine changes in child ASD behaviors in the social-communication (BOSCC-SC) and restrictive/repetitive behavior (BOSCC-RRB) domains.Children participated in a randomized controlled trial of parent-mediated intervention and were randomly assigned to an experimental (Adapted Responsive Teaching; ART; n=45) or control group (Referral to Early Intervention and Monitoring; REIM; n=42); there were no main effects of group on BOSCC outcome. Linear regressions were conducted to examine the relationship between sensory domains scores on changes in BOSCC-SC and BOSCC-RRB, controlling for VR at Time 1. Moderation analyses were also conducted to examine the interaction effects (Group x SPA hyporeactivity or SEQ seeking).

Results: Higher SPA hyporeactivity scores at Time 1 were significantly associated with less improvement in BOSCC-SC (r=0.31, p=0.02). Moderation results revealed that there was a statistically significant moderation effect of SPA hyporeactivity at Time 1 (group x SPA hyporeactivity; p=0.01), indicating that SPA hyporeactivity at Time 1 differentially impacted the relationship between treatment group and improvements in BOSCC-SC (more BOSCC-SC improvement was seen in the ART group with lower SPA hyporeactivity scores compared to the REIM group). See Figure 1. Higher SEQ Seeking scores at Time 1 predicted more improvement on the BOSCC-RRB domain (r=0.25, p=0.03). Moderation results indicated that there was not a statistically significant moderation effect of SEQ Seeking at Time 1 (group x SEQ seeking p=0.13). Results were not statistically significant for SPA hyperreactivity, SPA seeking, SEQ hyperreactivity, or SEQ hyporeactivity.

Conclusions: Specific types of sensory reactivity may be associated with differential patterns of change in ASD symptoms and differential response to early intervention. This work may contribute to defining empirically supported ASD subtypes and provide novel targets for early interventions.

415.058 *(Poster)* Examination of Racial and Sex Differences in Restricted and Repetitive Behaviors in Toddlers Diagnosed with Autism Spectrum Disorder

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Background: Research investigating restricted and repetitive behaviors (RRB) in males and females has yielded mixed results. Hiller et al. (2014) found that females demonstrated less severe and less frequent RRBs when compared to males. Additionally, Ramsey et al. (2018) found that parents of males tended to report more RRB-related symptoms when compared to parents' report of females. In contrast, studies of young children have found males and females to be similar when examining the presence and frequency of RRBs (Harrop, Gulsrud, & Kasari, 2015; Frazier et al., 2014). In terms of age-related differences, RRB's tend to present more frequently and intensely in early childhood (Esbensen, Selzter, Lam, & Bodfish, 2009). Though research often examines age and sex related differences in RRBs, race remains a largely unexplored variable. Given that African-American children are more likely to be diagnosed with disruptive behavior disorders prior to receiving an ASD diagnosis (Mandell et al., 2007; Mandell et al., 2009) it is possible that elevations in RRB symptomology may be a contributing factor.

Objectives: This study investigated the racial and sex differences in ADOS-2 RRB total scores in a sample of toddlers diagnosed with ASD. We hypothesized that AA males will demonstrate higher levels of RRBs in comparison to CA males.

Methods: Toddlers (N = 340, M_{age} = 25.05 months, SD = 3.75) were evaluated in an insurance-based academic medical center clinic in Georgia after receiving a referral from their pediatrician regarding concerns for ASD. All toddlers in the sample were diagnosed with ASD using the Mullen Scales, ADOS-2, and a diagnostic interview.

Results: Exploratory findings using an independent samples t-test from the completed dataset at time of submission indicate, AA males (N = 102, M = 4.83, SD = 2.03) did not significantly differ from CA males (N = 151, M = 4.43, SD = 4.43) in total RRB scores; t (251) = -1.50, p = .14. Additionally, no differences were found between AA females (N = 44, M = 4.39, SD = 1.86) and CA females (N = 39, M = 4.21, SD = 1.91) total RRB scores; t (81) = -.44, p = .66. There were also no significant racial differences between males and females at item level of RRB scores.

Conclusions: In our sample of toddlers who received a diagnosis of ASD, there were no racial or sex differences observed in RRB total score on the ADOS-2. Further, there were no differences in the individual items that comprise this domain. This suggests that the RRB profiles of toddlers with ASD are similar across race and sex. It is important to continue to discern how sociodemographic factors influence differences in the early assessment of autism.

415.059 *(Poster)* Examining Symptoms of Autism Spectrum Disorder in Children with Neonatal Abstinence Syndrome

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Background: Neonatal Abstinence syndrome (NAS) is characterized by symptoms of withdrawal shortly after birth observed in newborns exposed to drugs, such as opioids, in utero. Withdrawal symptoms are caused by hyperactivity of the central and autonomic nervous systems and include irritability, hypertonia, sleep disturbances, gastrointestinal system dysfunction, seizures, excessive weight loss, and respiratory distress (Reddy, Davis, Ren, & Greene, 2017). Infants with NAS are at increased risk for later neurodevelopmental problems including language delay, impulsivity/hyperactivity, learning difficulties, inattention, and social-communcations problems (Hunt et al., 2007; Maguire et al., 2016; Oei et al., 2017; Sundelin, Wahlsten, & Sarman, 2013); however, there is limited research that has examined symptoms of Autism Spectrum Disorder (ASD) in children with a history of NAS. It is important to identify populations that may be at greater risk for developmental and behavioral problems to inform differential diagnosis and treatment practices.

Objectives: The present study aims to charactize symptoms of ASD in children with a history of NAS with and without a clinical diagnosis of ASD.

Methods: Data was gathered through a retrospective chart review study. Total participants consisted of 31 children between the ages of 2-10 years that presented at a tertiary care hospital between the years 2010-2016. This sample was further characterized to include children with NAS that were diagnosed with ASD (NAS+ASD; N = 16) and children with NAS without a diagnosis of ASD (NAS-; N = 15). Evaluations and diagnostic impressions were completed by a team of psychologists, developmental pediatricians, speech and language pathologists, and psychology trainees. Symptoms of ASD were assessed using a multi-method approach including direct observation and parent report. Total raw scores and individual item scores on the *Childhood Autism Rating Scale* (CARS) were used in the present study to assess ASD symptomology across the groups.

Results: Results from independent samples t-tests were performed to analyze differences in ASD symptom presentation in children with NAS that were diagnosed with (NAS+ASD) or without ASD (NAS-). There was a significant difference in total raw scores on the CARS for the NAS+ASD (M= 35.04; SD= 3.72) and NAS- (M = 22.61; SD = 5.67) groups; t (24) = -6.48, p <.001. There also were significant group differences, with the NAS+ASD group displaying more impairment, across the following items on the CARS-2: emotion regulation, relating to people, body use, object use, visual response, listening response, fear/anxiety, verbal communication, nonverbal communication, imitation, and general ASD impressions. No significant group differences were found on the following items of the CARS-2: adaptation to change, taste/smell/touch response, level/consistency of intellectual functioning, and activity level.

Conclusions: We found a unique profile of similarities and differences in ASD symptom presentation in children with NAS with or without ASD. This preliminary investigation suggests that children with NAS may be at increased risk for ASD and present with a unique symptom profile. It is critical to gain a better understanding of how behavioral symptoms emerge and present in children with a history of NAS to better inform diagnostic decisions and intervention efforts.

415.060 *(Poster)* Executive Functioning Is Associated with Autistic Traits in Preschoolers

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Background: Several studies have reported a relationship between executive functioning (EF) and autistic symptoms, including social communication (Leung et al., 2016) and restricted/repetitive behaviors (Miller et al., 2015). However, this work has focused predominantly on school-aged youth, making it unclear how EF profiles relate to autistic traits in young children. There are indications that EF relates to school readiness in autistic preschoolers (Pellicano et al., 2017); if also related to early autistic traits, EF would be an important target for early intervention.

Objectives: Evaluate the hypothesis that EF is associated with autistic traits in young children.

Methods: Participants were drawn from a clinic-based sample of >2,000 children seen in an autism specialty clinic in Washington, DC. A final sample (N=106) was identified who were <6 years; met DSM-5 criteria for ASD; and completed cognitive testing and the Autism Diagnostic Observation Schedule-2 (ADOS-2): Module 1, 2, or 3. Full-scale IQ (FSIQ) and vocabulary were assessed using a standardized measure (e.g., Wechsler Preschool and Primary Scales of Intelligence-IV). Autistic traits were based on the Comparison Severity Score (CSS) of the ADOS-2, and parent report on the Social Responsiveness Scale-Preschool: Social Communication and Interaction (SCI) and Restricted Interests and Repetitive Behaviors (RRB), and the Communication and Socialization domains of the Vineland Adaptive Behavior Scales-II. EF was measured via parent report on the Behavior Rating Inventory of Executive Functioning-Preschool (BRIEF-P), using the Global Executive Composite (GEC) and the Flexibility Index (FI). See Table 1 for demographics and measures. Stepwise regression analyses were used to assess the association between EF and autistic traits with the following variables considered for entry into the model: gender, FSIQ, vocabulary, and BRIEF-P GEC and FI.

Results: Results generally supported the hypothesis that EF would be significantly associated with autistic traits. The SRS SCI was significantly and uniquely associated with the BRIEF-P FI (β=.60, t=6.98, p<.0001), with the model accounting for large variance (R^2=.60, F=48.78, p<.0001). The SRS RRB was significantly associated with the BRIEF-P GEC (β=.40, t=2.63, p=.01) and FI (β=.50, t=3.25, p=.003), with the full model accounting for large variance (R^2=.74, F=6.90, p=.01). Vineland Communication was significantly associated with the BRIEF-P GEC (β=-.41, t=-3.80, p<.0001) and FSIQ (β=.46, t=5.41, p<.0001), with the full model accounting for large variance (R^2=.44, F=14.45, p<.0001). Vineland Socialization was significantly associated with the BRIEF-P GEC (β=-.39, t=-2.97, p=.004) and FSIQ (β=.32, t=3.06, p=.003), with the full model accounting for moderate variance (R^2=.25, F=8.82, p=.004). Across analyses, increased EF problems were associated with higher autistic traits. Higher IQ was associated with better social and communication skills. The ADOS CSS was not significantly associated with any variables.

Conclusions: EF is significantly related to autistic traits in young children in our analyses, in some cases more strongly than cognitive abilities. It is notable that this association held only for parent-report measures, and thus may be driven by known associations of informant report across domains. Further studies are warranted to evaluate the association of EF and autistic traits over development and across measurement contexts.

415.061 *(Poster)* Exploratory and Confirmatory Factor Analyses of Aberrant Behavior Checklist Ratings By Special Education Staff in Autism Spectrum Disorder Samples

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Background: The Aberrant Behavior Checklist-Community (ABC-C; Aman & Singh, 1994, 2017), originally designed for individuals with intellectual disabilities (ID), is now frequently used in autism spectrum disorder (ASD) intervention research. Though the ABC-C has a proposed five-subscale structure, the existing ABC-C factor-analytic research from ASD samples is limited and has resulted in inconsistent factor solutions and marginally fitting models across studies (e.g., Brinkley et al., 2007; Kaat et al., 2014; Mirwis, 2011). This has raised questions about some previous factor analytic methodology, type of correlation matrix analyzed, factoring strategy, range of factor solutions examined, the criteria for factor retention, and the impact of different rater types.

Objectives: The primary objective of the present study was to examine the factor structure of the ABC-C for students with ASD rated by special education staff. Using robust methods, this was accomplished via an initial EFA in a sample of students with ASD, followed by a CFA assessing the fit of available ABC-C factor models for ASD in a separate validation sample.

Methods: Ratings were completed by special education staff members from a center-based, educational agency in New York state that services students with developmental disabilities. The EFA sample consisted of 300 students with ASD, ages four to 21 years (M = 9.17, SD = 4.38), and mean IQ of 56.49 (SD = 18.25). An EFA of the inter-item polychoric correlation matrix was performed using principle axis factoring and direct oblimin rotation. Number of factors retained was determined through a combination of parallel analysis, Velicer's MAP, Kaiser criterion, scree plot, and factor interpretability. The CFA sample consisted of 243 students with ASD, three to 21 years of age (M = 10.79, SD = 4.53), with a mean IQ of 56.69 (SD = 18.71). The CFA was performed using the weighted least squares mean and variance adjusted estimator (WLSMV) in Mplus 8.2 with the inter-item polychoric correlation matrix as input. (Supplemental information criterion indices were generated, using the maximum likelihood estimator, for cross-model comparisons.) Fit of six available ABC-C factor models, from other ASD studies and the EFA, was assessed using absolute and relative fit indices, and information criterion indices.

Results: EFA results led to retention of nine correlated factors. CFA fit indices for the nine-factor model were generally reasonable to marginal (χ^2[1560, N = 243] = 3021.42, p < .001; RMSEA = .062; SRMR = .083; CFI = .941; and TLI = .938). However, all other models yielded poorer fit estimates across all indices. Furthermore, information criteria indices (AIC and BIC) were lowest for the nine-factor model, suggesting that it fit better than competing models from the ASD ABC-C factor analytic literature. Close inspection of the nine-factor solution suggested aspects of the ABC-C in need of revision.

Conclusions: Results from the EFA and CFA clearly suggested the presence of more than five interpretable ABC-C factors based on ratings from special education staff—with a nine-factor solution fitting best. Findings also highlighted the need for scale revisions to improve interpretability and model fit.

415.062 *(Poster)* Exploring Extraordinary Skills and Relative Strengths in Children with Autism Spectrum Disorder and Cognitive Impairment

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Background: Although approximately one-third of children with ASD have intellectual disability (ID) (Baio et al., 2016), they are considerably underrepresented in research (Russell et al., 2019). Research on the strengths of these individuals is particularly lacking. In a study of individuals with ASD or ID, every participant had at least one parent-reported strength, but profiles of strengths varied widely (Carter et al., 2015). This important study, however, included only a small proportion of individuals with both ASD and ID. Further research is needed to characterize strengths in individuals with ASD who also have cognitive impairment. This knowledge will inform the development of interventions and supports that leverage and promote strengths.

Objectives: 1) To examine the frequency of parent-reported relative strengths and extraordinary skills in children with ASD and nonverbal IQ≤70. 2) To characterize the cognitive and behavioral profiles of children with parent-reported strengths.

Methods: Participants were 424 school-age children with NVIQ ≤70 from the Simons Simplex Collection (see Table 1). Children were grouped based on parent report of no outstanding skill (NS), relative strength (RS), and extraordinary skill (ES) in six different skill areas assessed on the Autism Diagnostic Interview-Revised (items 88-93). Paired-sample T-tests were used to examine within group cognitive profiles (verbal, nonverbal reasoning and spatial). One-Way ANOVAs were used to compare verbal, nonverbal reasoning and spatial skills across groups. Independent-sample T-tests were used to compare the NS group to children with any parent-reported RS/ES on scores from the Differential Abilities Scale-II, Vineland Adaptive Behavior Scales-II, Aberrant Behavior Checklist, and ADI-R.

Results: Fifty-four percent of children had at least one parent-reported strength (RS n=156, ES n=105). Frequency of parent-reported strengths varied greatly by domain. Music was the most frequently reported RS (23%) and ES (16%), while computation and drawing were the least frequently endorsed (<4% each). As shown in Figure 1, across skill areas, children in each group (e.g., ES, RS, NS) exhibited higher nonverbal reasoning and spatial skills, relative to verbal abilities ($p<0.05$). One exception was the ES-Reading group, which showed a more even profile. The ES-Reading group also exhibited higher verbal abilities compared to the NS- and RS-Reading groups (d=.81, p=.02; d=.87, p=.05, respectively), while nonverbal skills did not differ across groups. Those with at least one reported strength did not differ from those who had no outstanding skills reported on measures of adaptive behavior, behavior problems, or autism symptoms.

Conclusions: More than half of parents of children with cognitive impairment endorsed relative strengths or extraordinary skills. Children with and without parent-reported outstanding skills were highly similar across other behavioral domains. The relative lack of group differences on broad assessments of cognition and behavior suggests a need for more research to directly assess and characterize skills in these domains reported by parents. Regardless, the high endorsement of outstanding skills suggests a need for research to investigate strengths more broadly. By focusing solely on areas of impairment, we are likely to miss opportunities for improved supports and targeted interventions to promote each individual's potential.

415.063 *(Poster)* Expressive Communication Growth Trajectories of Young Children with Autism: Exploring a Novel Progressing Monitoring Tool

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Background: Social-communication and language skills are important intervention targets for children with ASD because they represent pivotal skills that affect children's developmental potential. The field has made progress in developing measures to characterize and diagnose the language and social-communication patterns of children with ASD. However, to date few standardized measures exist that are sensitive to change over time (Anagnostou et al, 2015; Bolte & Diehl, 2013) and can be used by early childhood practitioners to inform intervention decision making. The Early Communication Indicator (ECI) is one of the Individual Growth and Development Indicators (IGDIs) for Infant and Toddlers (Carta, Greenwood, Walker, & Buzhardt, 2010) developed to address the need for easily administered and scored measures to monitor children's growth and inform intervention decisions for children 6-42 months. Despite evidence that the ECI is sensitive to a child's general disability status, to date, there have been no formal investigations of the measure's sensitivity to specific diagnoses, such as ASD.

Objectives: In the current study, we sought to conduct exploratory analyses of ECI scores of children known to either have an ASD diagnosis at the time of administration or would receive a diagnosis in the future.

Methods: We performed a secondary analysis with data drawn from two registries. One registry is from a university diagnostic center and the other registry is from the IGDI Online Data System. We matched participants from the IGDI registry with those in the diagnostic registry who received an ASD diagnosis, and this resulted in n=23 matches. We used multilevel growth modeling with two levels in each growth model, observation-level and child-level.

Results: Children with ASD had significantly lower ECI total weighted scores than the benchmark sample (-11.66, se = 3.06, $p < .01$) at 42 months of age, but there was no significant difference in the linear or quadratic slopes between the two samples. For the key skill elements, the ASD sample demonstrated significantly higher rates of vocalizations than the benchmark sample at 42 months of age (1.63, se = 0.54, $p < .01$), as well as a faster growth rate (0.07, se = 0.03, p = .03). Conversely, for single words, the ASD sample used fewer single words at 42 months of age (-2.50, se =0.48, $p < .01$), and they had a lower linear growth rate than the benchmark sample. For multiple words, a similar pattern was observed whereby children with ASD demonstrated fewer multiple words at 42 months of age (-3.73, se = 0.78, $p < .01$) and had a slower rate of linear growth (-0.19, se = 0.06, $p < .01$).

Conclusions: These exploratory findings suggest that the ECI can be used to characterize the communication profiles and trajectories of young children with ASD. We found that the magnitude of both prelinguistic (i.e., vocalizations, gestures) and linguistic (i.e., single and multiple words) communication skills, as well as the rate for growth differed between children with ASD when compared to a benchmark sample.

415.064 *(Poster)* Factors Contributing to Age of Autism Spectrum Disorder Diagnosis in Children

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Background: Clinicians can reliably diagnose autism spectrum disorder (ASD) in children as young as 2 years (Kleinmann et al., 2008). Many individuals are diagnosed later, with some undiagnosed until adolescence. Early intervention improves outcomes for individuals with ASD (Fuller et al., 2019) and those diagnosed in adolescent years miss earlier opportunities for treatment and support. A recent review concluded greater symptom severity and increased parental concern are associated with younger age of diagnosis, but findings regarding the impact of other sociodemographic and phenotypic factors (e.g., socioeconomic status, IQ, comorbid diagnoses) have been mixed (Daniels & Mandell, 2014). This could be due to heterogeneity across and within samples.

Objectives: To (1) evaluate sociodemographic and phenotypic variables that may differentially predict age of ASD diagnosis in verbally fluent individuals (as operationalized by being administered ADOS-2 Module 3) and (2) compare secondary and tertiary diagnoses among verbally fluent individuals diagnosed with ASD near the mean age of diagnosis and those diagnosed with ASD during their adolescent years.

Methods: Assessment results were reviewed for 222 individuals (*M* age = 9.64 years; 79.3% male) who received an ASD diagnosis at a tertiary care clinic. Standard multiple regression models were conducted with age of diagnosis as the dependent variable. Two standard multiple regression models were conducted evaluating sociodemographic variables (i.e., gender, income) and phenotypic variables independently (i.e., verbal and nonverbal IQ, ADOS-2 scores). Two groups were also formed from the participants: those diagnosed within 0.5 SD of the average age of diagnosis in the sample (n=97, *M* age=6.90 years) and individuals diagnosed more than 1.5 SDs above the average age of diagnosis in the sample (n=47, *M* age = 15.26 years).

Results: With regard to phenotypic variables, age of diagnosis was correlated with nonverbal IQ (r=-0.35, p <.000), verbal IQ (r=-0.18, p<.01), and ADOS-2 RRB total (r=-0.18, p<.01). Multiple R for the regression model was statistically significant, F (9, 159)=6.28. p<.000. Only nonverbal IQ contributed significantly to the prediction of age of diagnosis (p<.000), with higher nonverbal IQ predicting a younger age of diagnosis. With regard to sociodemographic variables, there were no significant correlations between age of diagnosis, gender, and income level. A significantly larger proportion of older participants received tertiary diagnoses (c^2=[1, N=139]=5.36, p=.02). Though there were no significant differences between the younger and older participants regarding specific secondary or tertiary diagnoses, two trends emerged. A larger proportion of participants in the younger group received a secondary diagnosis of ADHD (31.5% compared to 17.0%; c^2=[1, N=139]=3.35, p=.067). A larger proportion of participants in the older group received a secondary diagnosis of intellectual disability (12.8% compared to 4.3%; c^2=[1, N=139]=3.30, p=.069).

Conclusions: The only variable that was a significant predictor of age of diagnosis was nonverbal IQ. Themes emerged in rates of secondary and tertiary diagnoses, however, there were no significant differences in younger and older participants by specific diagnosis. Significantly more participants in the older group received a tertiary diagnosis, which may reflect more clinically complex cases being diagnosed at a later age.

415.065 *(Poster)* Factors Contributing to Late Diagnosis in Females with Autism Spectrum Disorder

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Background: Children who receive an autism spectrum disorder (ASD) diagnosis at an older age (i.e., at or above the age of 5 years) may miss out on early behavioural supports and intervention (Mussey et al., 2017). Factors impacting the age at which a child receives an ASD diagnosis include cognitive and adaptive functioning, severity of ASD symptoms, and the complexity of symptoms a child presents with. For instance, children with higher cognitive and adaptive functioning, and milder ASD symptoms, often receive a diagnosis of ASD at an earlier age (Duvekot et al., 2017; Hull, Mandy, & Petrides, 2017; Ratto et al., 2018; Salazar et al., 2015). However, findings from existing literature have been mixed examining what clinical factors impact diagnosis in females with ASD, in particular. As females typically receive a diagnosis of ASD at an older age compared to males, understanding what unique factors contribute to this delay is essential in ensuring early access to intervention.

Objectives: The present study aimed to: 1) replicate previous research demonstrating that females often receive a diagnosis at an older age than males; and 2) identify the clinical factors (e.g., cognitive functioning, ASD symptom severity, adaptive functioning, and co-occurring disorders) that might impact late diagnosis, particularly in females.

Methods: Psychological reports of 58 males and 32 females seen at The Autism Spectrum Disorder Diagnostic Clinic (Calgary, AB) for a comprehensive assessment were reviewed. Date of birth; biological sex; language spoken at home; family status; schooling information; assessments completed and services obtained to date; co-occurring diagnoses present prior to attending the diagnostic clinic; age at ASD diagnosis; and scores on specific assessment measures (cognitive, adaptive, ASD severity) were abstracted from each file.

Results: Females did not receive a diagnosis of ASD at an older age (M = 10.50, SD = 4.08) than males (M = 9.43, SD = 2.78). Cognitive functioning, ASD symptom severity, and adaptive functioning did not predict receiving a diagnosis later in life, and biological sex did not influence this relationship. The presence of co-occurring disorders predicted age at diagnosis, in that participants with more pre-existing co-occurring developmental and mental health disorders received a diagnosis at an older age. However, biological sex did not influence this relationship.

Conclusions: Females are at a particular disadvantage of missing out on early supports as on average females receive their ASD diagnoses at an older age than males. However, results from this study indicate there may be more males diagnosed at an older age than previously thought, and that perhaps there is a unique presentation of ASD that is not solely seen in females. TO ensure access to early intervention, it is crucial the health community understands why some individuals with ASD are being diagnosed much later than others, and how to detect these unique profiles in individuals at an earlier age.

415.066 *(Poster)* Gender Differences in Compensation Among Adolescents with ASD

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Background: Some individuals with autism spectrum disorders (ASD) may employ specific cognitive strategies to alter social behaviors to appear less impacted by ASD symptoms, despite persisting impairments at cognitive and/or neurobiological levels, a phenomenon recently coined as "compensation" (Livingston et al., 2017 & 2018). Previous research has contrasted overt social behavior with Theory of Mind (ToM) performance to specify four compensation patterns in ASD (high, low, deep, and unknown) and have found gender may influence manifestation of particular compensation strategies (with males being more likely to exhibit the "unknown" pattern; Livingston et al., 2018). However, this research has relied on expensive and idiosyncratic measures that limit estimation of compensation in other ASD populations. It remains unclear whether other widely-used measures of social behavior and cognition may offer more accessible, cost-effective means for measuring compensation in ASD. Identification of such tools is an important step toward identifying individuals who may otherwise evade formal ASD diagnosis and/or be at greater risk of experiencing negative mental health outcomes, which have been associated with compensation in ASD (Livingston et al., 2019).

Objectives: To explore 1) whether the four compensation patterns could be specified using accessible measures of social behavior and cognition, 2) whether those patterns differ by gender, thereby partially replicating previous compensation research (Livingston et al., 2018).

Methods: Participants were 99 adolescents (77 male) ages 11-17 (M_{age}=14.04, SD_{age}=2.03) with IQ ≥ 70 and ADOS-2 confirmed ASD diagnosis. Social communication skills were measured as the Social Communication and Interaction subscale fom the parent-report Social Responsiveness Scale, Second Edition (SRS-2-SCI; Constantino, et al., 2012). ToM performance was assessed using adolescents' accuracy during an accessible, computerized ToM paradigm (McKown et al., 2015; Russo-Ponsaran et al., 2019). Moderation analyses were performed to assess whether the relationship between social communication and ToM (i.e., the 4 compensation patterns) differs between genders.

Results: A significant interaction was found between SRS-2-SCI and ToM accuracy in predicting participants' gender (b = XX, p = XX), such that higher ToM accuracy is related to a greater likelihood of being male when SRS-2-SCI scores are low (i.e. deep compensation), while higher ToM accuracy is related to greater likelihood of being female when SRS-2-SCI scores are high (i.e. unknown condition; Figure 1). Low and high compensation groups were equally likely to be male or female.

Conclusions: These results replicate the presence of the four compensation patterns using more widely-used and -accessible measures of social cognition and behavior in a large sample of adolescents with ASD. Findings show the deep compensation pattern was associated with male gender. Conversely, female gender was associated with the unknown compensation pattern. Results contrast with prior findings showing the highest male:female ratio in the "unknown" condition (Livingston et al., 2018). However, findings suggest that compensation may indeed differ by gender, but that the combination of social cognitive and social behavioral measures used may uniquely influence estimates of these gender differences. Future research should further explore various measurement approaches of compensation to further elucidate this emerging construct.

415.067 *(Poster)* Hidden Literacy in Minimally Verbal Individuals with ASD Revealed By Involuntary Eye Movements

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Background: Minimally-verbal individuals with ASD (MV-ASD), estimated as 30% of the spectrum, who have little or no spoken language, are typically assumed cognitively impaired after failing conventional tests for cognitive abilities. However, it is yet unclear whether these failures reflect a true cognitive impairment or, alternatively, a severe deficit in behavioral expressions of cognitive skills. Here we suggest that for some or many of the MV-ASD individuals, the main barrier for communication is a severe difficulty in the initiation and control of reliable voluntary or intentional actions, i.e. an "output problem", which calls for using involuntary or physiological measures that could possibly bypass the action-control barrier, such as involuntary eye movements. We presented preliminary results from this study in INSAR 2019.

Objectives: Assess basic reading and lexical-semantic knowledge in young adults with MV-ASD using eye movement measures in comparison to pointing performance.

Methods: Young adults with MV-ASD (N=18, ages 15-24, all with less than 30 communicative words) were tested on a novel "cued looking" paradigm (adaptation of "looking-while-listening"; Fernald et. al., (2008)). Participants watched a sequence of stimuli while their eyes were tracked. In each trial, a text word was presented at fixation (1s), followed by a pair of familiar objects pictures (fruits, animals, vehicles etc., 10 pairs) presented (1s) side by side (~6 deg each side), with next trial following after 800ms. There were 4 short runs (<1 min) repeated 3-6 times in random order with breaks. In a second experiment, the written words were replaced by recorded words. In a third (reading) and fourth (listening) experiments, the same pictures and text were used on 20 cards to measure performance via pointing. We analyzed the lateralization of the eye-gaze according to target side, the time course of correct gaze side, saccade direction and rate modulation. Statistics were obtained via non-parametric permutation tests.

Results: 16 of the 18 MV participants showed a significant effect of reading as reflected by correct lateralization estimates of 75-100% (average 81%), significant from 240-800ms post stimulus onset (group average, p=0.001). In comparison, a control group of young adults (n=10) showed correct lateralization of 90-100% (average 96%). Overall, the MVs made smaller lateral eye movements (3 vs 6 deg.) but were as fast in terms of movement onset. The results of experiment 2 (vocal words) were similar, but only for 10 of 15 MVs tested. In a striking contrast, 14 of the 16 MVs who showed significant reading with the eyes were at or near chance level in pointing (40-65%, 55% on average, compared to 100% of controls).

Conclusions: These results provide the first systematic evidence for reading ability in individuals typically assumed to be severely language and cognition impaired. The results also demonstrate a striking gap between pointing performance and gaze fixation, which opens the way for uncovering unknown cognitive abilities in people with MV-ASD. This would have a significant impact on the way these individuals are treated, and on the intervention young minimally verbal children receive.

415.068 *(Poster)* How Clear Are the Differences between ADHD and ASD Diagnoses in Gifted Children?

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Background: Twice-exceptional (2e) individuals are often under- or misdiagnosed due to limitations in the current diagnostic paradigms for autism spectrum disorders (ASD) and related conditions. Specifically, the cognitive and behavioral profiles of these individuals have not yet been well established, nor have boundaries between diagnoses been defined in high-ability individuals.

Objectives: 1 - Observe cognitive and behavioral functioning in 2e individuals with ASD; 2 - Contrast functional patterns to other 2e groups and gifted/talented controls

Methods: Gifted and 2e individuals were assessed by licensed clinicians at a midwestern-US assessment clinic for talented youth. Of the children assessed (n = 1,366), 506 individuals completed both the Weschler IQ Scale and the Behavior Assessment System for Children (BASC). Diagnostic status varied: 203 were 2e with ADHD, 31 were 2e with ASD, 26 were 2e with ADHD+ASD, and 246 were gifted, IQ-matched controls.

One-way analysis of covariance (ANCOVA) was conducted to explore diagnostic group differences in IQ and BASC sub scores corrected for age. Tukey HSD and Cohen's d were calculated for sub scores with a significant main effect for diagnostic group difference in functioning or a significant diagnostic group by age interaction difference in functioning.

Results: Diagnostic group differences existed in two IQ indices. A significant main effect for diagnostic group($F = 5.002$, $p = 0.002$) and a diagnostic category by age interaction($F = 3.501$, $p = 0.015$) for Processing Speed was noted. Here, individuals with ASD only had significantly lower processing speed than their ADHD and gifted peers. Working Memory demonstrated significant diagnostic group by age interaction($F = 5.696$, $p < 0.001$), yet no significant main effects were found in working memory between groups. The remaining IQ subscales did not display differences in functioning due to diagnostic category.

Intriguing behavioral profiles emerged from the BASC. Aggression($F = 10.769$, $p < 0.001$) and Attention($F = 55.769$, $p < 0.001$) differed between affected and unaffected groups. Differences in Adaptability($F = 34.002$, $p < 0.001$), Atypicality($F = 31.415$, $p < 0.001$), Functional Communication($F = 27.943$, $p < 0.001$), and Leadership($F = 28.697$, $p < 0.001$) distinguished all groups from one another while ASD and ADHD+ASD were statistically indistinguishable. Conduct Problems($F = 7.239$, $p < 0.001$) was associated with ADHD, but not with either ASD or ADHD+ASD. ASD and ADHD+ASD were statistically indistinguishable from one another on Withdrawal($F = 13.892$, $p < 0.001$), as were ADHD and gifted controls. Anxiety scores did not reach significance across diagnostic groups.

Conclusions: Twice-exceptional individuals with ASD demonstrated a behavioral pattern indicative of "classic autism", regardless of a co-morbid ADHD diagnosis. BASC scores suggest 2e with ASD is often associated with struggles in Adaptability, Functional Communication, and more. IQ data demonstrated a key reduction in processing speed for 2e with ASD. Interestingly, 2e individuals with ADHD+ASD do not exhibit the same deficit in cognitive functioning, while still exhibiting the same behavioral struggles. These findings suggest that diagnostic boundaries exist in 2e individuals. Interventions tailored to the unique weaknesses of 2e with ASD may foster best outcomes for affected individuals.

415.069 *(Poster)* Identification of Parent-Report Questions Which Elicit the Most Accurate Estimates of Language Ability

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Background: Autism spectrum disorder (ASD) is characterized by heterogeneity in symptom presentation and severity; at least some of this is explained by variability in cognitive and language ability. Because social communication skills are highly dependent on language, the latter must be accounted for by any attempt to measure the presence or severity of the symptoms of ASD. One example of this is within the Autism Diagnostic Observation Schedule (ADOS), wherein module is selected by the clinician based on a language sample. In the absence of an expert clinician or a language sample, most parent report measures which modulate content based on language ability rely on gross categorizations like *some speech* versus *no speech*. However, precise routing on measures of parent-reported social communication ability relies upon the accurate ascertainment of specific language level (e.g., no words, simple phrases, three-word phrases, fluent speech), which parents report less reliably.

Objectives: Our goal was to identify the combinations of parent-reported items which most accurately identify the specific language level of the child (operationalized as the ADOS module). The results of this study will inform the composition of routing items on a new developmentally based measure of social communication skills. In these initial analyses we explore the Communication items (n=74) of the Vineland Adaptive Behavior Scales, Second Edition (VABS).

Methods: Data were aggregated across eight clinical and research datasets yielding 10,051 individuals with and without neurodevelopmental disability from 27 sites; for the current analysis the sample was limited to the first available observation from each individual which contained item-level data on the VABS (n=490) (84% male, mean age 51±31 months). The first stage of analysis was a random forest classification model with stratified K-fold cross validation to compare the null model (age only) to a model with age and VABS Communication items.

Results: The proportion of participants with each ADOS module were as follows: Toddler/Module 1, 65% (n=318); Module 2, 23% (n=114); Module 3/4, 12% (n=58). Model accuracy of the null model was 0.67±0.08 and the F1 score (an index of the balance between sensitivity and specificity) was 0.58±0.08. The addition of VABS features improved model accuracy to 0.74±0.04 and F1 to 0.84±0.02. Age and Expressive item 24 (tells about experiences in simple sentences...) were the most important features, followed by several other Expressive Language items (e.g., tells basic parts of story..., uses 'and'...) (Figure 1).

Conclusions: The initial results of this study confirm that data from parent-reported VABS items may be used to discriminate between the discrete language levels operationalized by the ADOS module. Content analysis of the most important features suggests that providing context for parents may be important; for example, asking whether a child uses sentences to describe experiences rather than simply asking whether a child uses sentences may elicit a response more consistent with clinical impression based on a language sample. In future work, we will perform incremental feature selection methods to perform ablation studies for feature importance, and ultimately will pilot different versions of routing questions based on these results.

415.070 *(Poster)* Identifying Measured Characteristics on ADOS, ADI-R and SRS Differentiating ASD from ADHD

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Background:

Attention Deficit/Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) are neurodevelopmental disorders that can be challenging to differentiate, especially in verbal, school-age children (Grzadzinski et al. 2016). Clinicians would benefit from more information about specific ASD-related behaviors that best differentiate ASD and ADHD cohorts.

Objectives: To identify items from three widely used ASD symptom measures (ADI-R, ADOS-Module-3, and SRS) that maximally differentiate children with ASD from ADHD..

Methods: Participants were selected from an existing registry of children assessed clinically for ASD or as part of research on ASD and other NDDs. Participants with ASD were selected to match the ADHD sample for age, IQ, and verbal ability. The final sample consisted of 463 verbal school-aged children (49-158 months) with a best estimate clinical diagnosis of ADHD (119 (25.7%)) or ASD (344). Of the 463 children examined, 254 (54.8%; n_{ASD}=177; n_{ADHD}=77) had SRS scores available, enabling an additional analysis including SRS items.

For each item we estimated Student's two-sample *t-statistic* (*t*) to quantify the difference in scores between the diagnoses, and further confirmed the findings using relative entropy (Kullback-Leibler divergence D_{KL}). A value of 0 for D_{KL}or *t* indicates that the two distributions are identical. Larger estimates indicate dissimilar distributions.

Results:

Our results over all 463 reports show that the ADOS and ADI-R items corresponding to facial expression and unusual eye contact have the highest relative entropy between the two clinical groups. Next, scores corresponding to language and speech patterns, social communication and conversational skills in that order were the most differentiating. Applying the same analysis to a subsample of children with available SRS scores, yielded similar results highlighting the same ADOS and ADI-R items as most differentiating.

Among the SRS items, "Does not join group activities unless told to do so", and "Has trouble keeping up with the flow of a normal conversation" yielded the largest t-statistic and entropies with t=-5.5417 ($p<0.01$; D_{KL}=0.3238) and t=-5.3922 ($p<0.01$; D_{KL}=0.3925) respectively.

The two estimates provide complementary information suggesting that the distributions of item scores across the diagnostic conditions were likely sampled from different populations, and hence maximally differentiating between the ADHD and ASD symptoms.

Conclusions:
Consistent with previous research (Grzadzinski et al. 2016, Bishop et al. 2016), we identified directly observed basic social communication behaviors (e.g. eye contact, facial expression) as being most effective in differentiating ASD from ADHD. Language abnormalities and difficulties with conversation also emerged as key differentiating items. Notably, conversational skills were the most differentiable items among those reported by parents, while eye contact, facial gestures, and language ability were identified by clinicians.This suggests that, especially among children referred for ASD assessment, parent-reported atypicalities in basic social-communication and language are less useful than direct observation by clinicians when it comes to certain basic aspects of social-communication.

415.071 *(Poster)* Implementing and Evaluating Social Attention and Communication Surveillance (SACS) to Prospectively Identify Autism in Very Young Children in Nepal

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Background: Early identification of Autism Spectrum Disorder (ASD) is the key first step in early intervention. Although children can be identified as early as 12 months and diagnosed reliably by 24 months, the mean age of diagnosis of ASD in Nepal is ~58 months, with many children missing the opportunity to access early intervention. There is an urgent need for a low-cost, easily accessible, early identification approach in Nepal.
Objectives: The objective in the current study was to implement and evaluate a Nepali version of Social Attention and Communication Surveillance (SACS-N), to identify children between 11-30 months who are at "high likelihood" of ASD in a local community (Kirtipur Municipality) in Nepal. The implementation of SACS-N was evaluated through: 1) referral rates of children identified at 'high likelihood" of ASD when monitored at 12, 18 and 24 months, 2) the PPV (the proportion of children identified as high likelihood on the SACS-N who were diagnosed with ASD, and 3) prevalence estimates of ASD in 11-30-month-olds in Kirtipur.
Methods: Sixty Female Community Health Volunteers (FCHVs) were trained on typical and atypical development of social attention and communication, the early signs of ASD, and how to monitor "key" markers of ASD in infants and toddlers using SACS-N. They were also trained to refer children who showed these early signs to the AutismCare Nepal Society (ACNS).
Results: A total of 1926 children were monitored using the SACS-N during the period of November 7, 2016, to July 16, 2018, with a total of 11 children (0.57%) referred for further assessments to the ACNS (8 male; 3 female;– M:F ratio 3:1) at 11-15 months (n = 4), 16-21 months (n = 4), and 22-30 months (n = 3). Of these 11 children, no information was available on one child (n = 1) who migrated out of Kirtipur. All remaining children (n = 10) had a developmental disorder, including ASD and Global Developmental Delay (GDD). Hence, the overall PPV of SACS-N for all developmental disorders was 100%. Of the children who attended the diagnostic/development assessment at ACNS (n = 7), three had ASD giving a PPV for ASD of 43%. The estimated prevalence of ASD in the current study ranged between 0.16 % to 0.26%.
Conclusions: The findings provide preliminary evidence of the feasibility of implementation of SACS-N by trained FCHVs in a local community in Nepal, which served to identify both children with ASD and GDD. Community-based developmental monitoring of ASD and other developmental delays by FCHVs is a cost-effective and sustainable approach to promoting early identification of developmental disorders in Nepal. However, further training and awareness of ASD is needed to increase referral rates using the SACS-N, including regular supervision of FCHVs.

415.072 *(Poster)* Implications of Developmental Screening and Monitoring Receipt for Reducing Racial/Ethnic Disparities in Early Autism Identification.

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Background: Minority children are less likely to receive an early ASD diagnosis. Furthermore, recent research suggests that conjoint receipt of screening and monitoring is associated with children having greater odds of receiving early intervention and treatment than receipt of screening or monitoring alone. While there is a large body of research outlining racial/ethnic disparities in early ASD identification, there is little work on understanding the interaction between race/ethnicity with screening and monitoring receipt in decreasing early identification disparities.
Objectives: The study reports preliminary findings on the relationship between screening and monitoring and early ASD receipt, and seeks to determine if racial/ethnic disparities in receipt of screening and monitoring are associated with differences in early identified ASD cases. We will test the following hypotheses:

- The odds of identified ASD before the age of 5 will be strongest for children receiving conjoint screening and monitoring and weaker for children receiving screening or monitoring alone;
- There will be minimal racial differences in early identified ASD among populations receiving conjoint screening or monitoring; and
- In populations receiving screening and monitoring alone, compared to White children, Black and Hispanic children will have lower odds of identified ASD

Methods: For these analyses, we used the combined National Survey of Children's Health (NSCH) 2016, 2017, and 2018 with weights appropriately combined per Census Bureau guidance. Reported analyses are survey weighted and stratified logistic regression models ($N_{non\text{-}asd}$ = 28855; N_{asd} = 332). The core model is a *screening/monitoring* (Conjoint, Alone, and None [ref]) X *race/ethnicity* (White [ref], Black, Hispanic, Other) interaction, statistically controlling for: child health, state early intervention Child Find screener cut-off policy, metropolitan status, whether child has a personal doctor or nurse or usual source of care, poverty level, caretaker education status, insurance status, marital status of parents, English language status of caretaker.

Results: Compared to populations receiving none, populations receiving conjoint screening and monitoring had more early identified ASD cases (β=2.58, OR=13.21[4.68-37.32], p<.001) followed by monitoring (β=1.80, OR=6.05[1.98-18.52], p=.002), but not screening (β=0.10, OR=1.10[0.22-5.49], p<.91). Race/ethnic differences between early identified ASD cases in populations receiving conjoint screening and monitoring trended toward statistical significance with Black children having higher (Black: β=2.39, OR=10.95[0.97-123.57], p=.05) and Hispanic lower (Hispanic: β=-1.59, OR=0.20[0.04-1.02], p=.05) ASD compared to White; no differences for Other races (Other: β=-0.64, OR=0.53[0.10-2.81], p=.45). Black children differed from White in screened (Black: β=4.31, OR=74.61[3.83-145.50], p=.004) and monitored populations (Black: β=3.88, OR=48.51[4.04-582.52], p=.002), though not in the hypothesized direction. ASD rates did not differ between White and other races/ethnicities receiving screening (Hispanic: β=1.51, OR=4.53[0.47-44.06], p=.19; Other: β=-0.64, OR=1.16[0.08-16.87], p=.92) or monitoring (Hispanic: β=-0.83, OR=0.44[0.05-3.47], p=.43; Other: β=0.52, OR=0.44[0.27-10.69], p=.58).

Conclusions: Conjoint screening and monitoring received by children 5 and under is associated with greater odds of identified ASD cases, and lower racial/ethnic differences. Notably, across all screening/monitoring populations, Black children were more likely to be identified with ASD compared to White. These data underscore the importance of providing developmental screening and monitoring to minority populations to decrease early ASD identification disparities.

415.073 *(Poster)* Importance of Age of Initial Diagnosis: A Comparison of Factors in Early and Delayed Initial ASD Diagnosis

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Background: Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental disorder, in which symptoms are present in the early developmental period. Although there is increasing evidence that clinicians can reliably identify children on the autism spectrum as young as 2 years of age, some individuals receive the ASD diagnosis later, presumably only when social demands exceed their capabilities. Because these individuals may present with a more subtle phenotype and/or exhibit a prolonged course of symptom development, early diagnosis is precluded. It is important to study ASD manifestation at initial diagnosis in order to avoid misdiagnosing or under-diagnosing ASD after the preschool years. The present study focuses on children referred for initial ASD diagnosis at three time periods in an attempt to analyze similarities and differences in the heterogeneity of ASD.

Objectives: The overall goal of the present research is to compare ASD symptomatology in children referred for an initial ASD assessment at various time periods. Analyses contend with heterogeneity in the severity of symptoms, language and cognitive skills, and co-occurring conditions in girls and boys referred for an initial ASD diagnosis at 3 age periods.

Methods: In order to investigate similarities and differences in the profiles of children with ASD diagnosed for the first time at different ages we have analyzed cross-sectional data from 30 children at each of three formative time periods: (1) early diagnosis group between 18-30 months; (2) transition from early childhood to elementary school between 5-6 years; and (3) school-aged children who are coping with increasing social demands at age 8-10. Variables include autism severity, cognitive abilities, language capabilities, behavioral profiles, and associated conditions.

Results: All age groups revealed heterogeneous profiles for the variables, with some patterns emerging. The early diagnosis group was the most homogeneous, with some intellectual and language developmental delay, while the two older groups revealed more co-occurring conditions. In addition, the later diagnosis group showed less intellectual and language disability. Autism comparison scores on the ADOS were less severe in the 8-10 age group, many of whom came with prior diagnoses. In particular, more than half of the older group had a previous diagnosis of either attention deficit disorder and/or specific language impairment. Males and females revealed different behavior profiles, with girls exhibiting more anxiety and boys more externalizing behaviors.

Conclusions: Overall, our data suggest that individual factors contribute to variation in age of diagnosis. The older the age of diagnosis, the milder the autism symptomatology, which means that some individuals are overlooked. If these disparities can be addressed in diagnostic instruments and clinical expertise, these children would receive appropriate intervention earlier, increasing their opportunities for optimal outcomes. Our data can inform public health officials and clinicians identify and explore methods for earlier identification and intervention, even after the preschool years.

415.074 *(Poster)* Improving Autism Spectrum Disorder Diagnosis Using the Screening Tool for Toddlers with Autism and Checklist for Autism Rating Scale

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Background: Although a reliable diagnosis of Autism Spectrum Disorder (ASD) can be made at 24 months, the median age of diagnosis in the U.S. is 52 months. With evidence that earlier ASD-specific intervention predicts better outcomes, there is an urgent need to improve the diagnosis of children with autism. Limitations to diagnosis include limited use of ASD-specific screening measures by pediatricians, coupled with the low sensitivity of some of the current tools. Once a child is identified for concern for ASD, they are often referred to a developmental evaluation, where wait times range from 4-12 months, further delaying diagnosis. Better diagnostic tools are needed that could reasonably be used within a general pediatrician's office in order to facilitate early identification of children with ASD, and reserve more complex cases for full developmental evaluations.

Objectives: The aim of this study is to evaluate how adding a checklist, the Childhood Autism Rating Scale (CARS), to the Screening Tool for Autism in Toddlers (STAT), a 20-minute behavioral assessment, improves the diagnostic accuracy of an autism diagnosis in toddlers.

Methods: The sample includes 134 toddlers between 24-36-months-old who were evaluated for a diagnosis of ASD by a multidisciplinary team. Diagnostic outcomes were determined based on the expertise of the team, using their best clinical estimate. As a part of their assessment, the STAT was performed and scored in real time, while the CARS was scored later based on the video of the STAT by expert raters who were blind to diagnostic outcomes. Expert raters achieved scoring reliability and inter-rater reliability was completed for 20% of the videos. LASSO regressions were used to determine which items were the most predictive, and were further used to create two-threshold cutoffs to divide participants into diagnostic groups.

Results: The original cutoff scoring of the CARS yielded a sensitivity of 0.79, specificity of 0.78, and a positive predictive value (PPV) of 0.90. The original cutoff scoring of the STAT yielded a sensitivity of 0.92, a specificity of 0.72, and a PPV of 0.89. A LASSO regression model for the STAT and CARS items related to restricted and repetitive behaviors (RRBs) was used to determine an optimal threshold which yielded a sensitivity of 0.97, specificity of 0.75, and a PPV of 0.91. A two-threshold scoring method was employed, using LASSO regression of CARS RRB items and the STAT, to create three diagnostic groups, no ASD, unknown, and has ASD, and 54% of the sample was accurately identified as not having ASD or having ASD.

Conclusions: The current ASD screening methods used in general pediatric offices are not sufficient to address the discrepancy between when children can and actually are diagnosed. Using a 20-minute behavioral assessment, the STAT, along with a checklist of RRB items from the CARS would allow general pediatric practices to accurately diagnose a majority of their patients, reserving the remaining, more ambiguous cases for referral to developmental evaluations. This would allow for earlier targeted interventions for those diagnosed, and shorter wait times for those referred.

415.075 *(Poster)* Influence of Family Structure on Age at Diagnosis Among Children with Autism Spectrum Disorder

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Background: Despite the importance of early detection and intervention, differences in age of Autism Spectrum Disorder (ASD) diagnosis remain due to various sociodemographic factors. The nature and quality of the relationship between the child's biological parents plays an important role during the diagnostic process, and in turn may be one such factor contributing to disparities in age of diagnosis. While several studies have examined changes in family structure (e.g., parental divorce, separation) after a child receives an ASD diagnosis, little, if any, research has examined the relationship between family structure and the age at which the child receives their ASD diagnosis.

Objectives: To understand the extent to which age of ASD diagnosis differs between children with biological parents who are married/together and those who are separated, divorced, or were never married.

Methods: Data for this study came from parents of 517 youth who were evaluated at a Mid Atlantic, urban, ASD outpatient specialty clinic. Youth were only included if: a) parents reported their clinic appointment was the youth's first ASD evaluation; b) the youth received an ASD diagnosis per DSM-V criteria; c) the evaluation included the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2); and d) parents agreed to join the clinic research registry (83% consented; consent status was not related to study outcome).

The median age at diagnosis was 4.5 years (Mean = 5.8 y, Min = 1.5 y, Max = 18.1 y, SD = 3.7 y). Eighty percent of the sample were males, 41% were receiving Medical Assistance, 48% were Caucasian (24% African American, 12% Multiracial, 9% Asian, 6% Hispanic, 1% Other), and 58% of parents did not have a Bachelor's degree. Measures in this study included autism-symptom severity (ADOS-2 Total Score; Lord et al., 2012), child mental health (Child Behavior Checklist; Achenbach, 1992), and demographics, including family structure (via custom clinic forms). Bivariate (Wilcoxon) and multivariate (linear regressions) analytic methods were used to address the study objective.

Results: Most (69%) biological parents were together during the child's initial diagnosis, of which 91% were married and 9% were living together but not married. Among biological parents who were not together (31%), most were never married (65%) and the remaining were divorced (24%) or separated (10%). Median age at ASD diagnosis was 1.9 years later among children whose biological parents were not together, when compared to those who were (4.0 y vs. 5.9 y, $z = -4.8$, $p < .001$).

After adjusting for child race, gender, insurance-type, parental education, ADOS-2 Total scores and module-type, child mental health, number of current (non-diagnostic) services, calendar year, referral source, and number of siblings, children of biological parents who were not together were diagnosed 1.6 years later than children of parents who were together ($\beta = 1.64$, 95% CI: 0.9, 2.4, $t = 4.39$, $p < .001$).

Conclusions: Family structure was a robust predictor of age at first ASD diagnosis, second only to medical comorbidities. Providing support for these families could provide an important pathway to increasing access to early screening, diagnosis, and intervention.

415.076 *(Poster)* Longitudinal Change in Core Symptoms of Autism Spectrum Disorder in Children: Online Survey of Caregivers

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Background: To assess the efficacy of interventions for autism spectrum disorder (ASD), it is important to identify reliable and valid outcome measures that reflect changes in a real-world setting. The Autism Impact Measure (AIM) is a caregiver-administered outcome assessment designed to capture subtle changes in core symptoms of ASD. A longitudinal study was conducted to explore the utility of the AIM score to capture annual changes in symptom severity.

Objectives: This study aimed to describe longitudinal (1-year) changes in AIM scores, by deriving anchor-based clinically important responder (CIR) thresholds, describing determinants of changes measured by those thresholds, and assessing the impact of ASD on caregivers.

Methods: This was a longitudinal electronic caregiver survey with two assessments, 1 year apart, sampled from the US-wide Simons Foundation Powering Autism Research for Knowledge (SPARK) online research initiative. Online surveys assessed demographics, AIM, caregiver impressions of ASD symptoms, and ASD-related caregiver strain among SPARK participants (caregivers of dependents with a professional diagnosis of ASD and aged 3–17 years at baseline). Primary analyses focused on changes in total AIM score (i.e. change of overall core symptoms) between baseline and follow-up. CIR thresholds were derived from coefficients of a linear model of AIM score change during the year as a function of caregivers' assessment of improvement or deterioration during that time as reported in a Caregiver-reported Global Impression of ASD symptom Change survey (CaGI-C; designed to assess caregivers' perceptions of change in severity of ASD symptoms).

Results: Children with ASD (N=2,761 at second assessment) were mostly male (79.2%) with a median (interquartile range) age of 9.0 years (7.0–13.0). Of the 1,078 with reported IQ scores, 74.0% had an IQ score ≥71. Among the total study population, a correlation (r=0.16, p<0.01) was observed in the expected direction between the total AIM score change and the CaGI-C anchor. The relative change in estimated AIM CIR threshold (95% CI) over 1 year for symptom improvement was –2.6% (–4.0, –1.1) and 4.3% (2.1, 6.6) for symptom deterioration. Lower caregiver-reported severity, and children being verbal, lacking cognitive impairment, and being less prone to wandering or eloping, were all found to be associated with symptom improvement (p<0.05). Use of prescription medication, cognitive impairment, inclination to wander or elope, higher rate of hospitalization for mental care, and higher caregiver-reported severity were found to be associated with symptom deterioration (p<0.05). Reports of strain across all assessed caregiver-strain domains (personal time, work, finances, relationships, happiness, fears for child's future, and tiredness) positively correlated with higher AIM scores at follow-up, i.e. worsened ASD symptoms (r=0.39–0.53).

Conclusions: Among a large sample of individuals with ASD in the United States, anchor-based CIR thresholds for, and determinants of, 1-year changes in AIM scores were identified, representing an important benchmark for a relatively new measure. AIM has potential to be used as a clinically meaningful outcome assessment of the core symptoms of ASD. Future longitudinal research at longer time intervals could be conducted to further assess how AIM scores might be used in a real-world setting.

415.077 *(Poster)* Longitudinal Stability of Intelligence Function in Autism Spectrum Disorder: From Age 3 to Adulthood

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Background: Intelligence measures are often used to classify individuals as having an intellectual disability as well as between "low" and "high" functioning autism. Lower levels of intellectual functioning have been associated with higher levels of autism symptom severity and as a factor in assessing long-term outcome. However, little has been reported about the stability of intelligence metrics in autism spectrum disorder (ASD), especially during the transitions from childhood through adolescence and into adulthood.

Objectives: Examine age-related changes and stability of measures of intelligence in the Utah Longitudinal Autism study, an NIH funded project that began testing individuals in 1995, where children as young as 3 years of age were enrolled and have been tracked to the current time frame.

Methods: This descriptive analysis examined all available intelligence scores collected from 1995-2018 from 127 participants on the autism spectrum (120 male, 7 female; mean age 19.9 years, range 2.9-57.9; n=449 visits) and 128 participants as a typically developing comparison group (TDC: 122 male, 6 female; mean age 20.1 years, range 3.6-39.7; n=222 visits). Due to the participant age range and changing protocols over the course of the study, a number of intelligence measures were collected (Mullen, DAS, WISC-III, WASI, WAIS-III, WAIS-IV) providing summary Intelligence Quotients (Full-Scale IQ (FSIQ), Verbal IQ (VIQ), Performance IQ (PIQ)) and Index scores (Verbal Comprehension (VCI), Perceptual Organization (POI), Working Memory (WMI), Processing Speed (PSI)). Linear mixed effects models examined longitudinal changes in intelligence scores over time in the ASD group compared to the TDC sample.

Results: In ASD, all intelligence quotients (FSIQ, VIQ, PIQ) and index scores (VCI, POI, PSI) significantly increased with age except for WMI. FSIQ and VIQ increased with age in the ASD group at a greater rate than the TDC sample. To examine whether age-related changes were driven by the younger ASD participants or persisted throughout adulthood, we reran the mixed models only including participants 18+ years of age (ASD n=96, 235 visits; TDC n=98, 132 visits). We no longer found significant age effects for VIQ or VCI, suggesting stable verbal scores during adulthood in our ASD sample. Finally, an evaluation of IQ stability in those with repeated test scores showed intraclass correlation coefficients (ICCs) ranging from .76 (PIQ) to .85 (WMI). The ASD subgroup with repeated full Wechsler testing (WAIS-III or WAIS-IV) had higher ICCs that ranged from .84 (PIQ, PSI) to .92 (WMI).

Conclusions: Despite similar intelligence summary scores, test version must be taken into account when examining stability of IQ metrics over time. In our sample, verbal intelligence, that may tap into communication impairment evident for the diagnosis of ASD, improved during childhood. Working memory remained the most stable intelligence score throughout the age range sampled. Which intellectual measures remain stable or are variable in ASD over transitions from childhood throughout adolescence and into adulthood has implications with regards to educational planning, vocational training as well as treatment focus.

415.078 *(Poster)* Low Median County Level Income Associated with Higher Rates of Missed Cases of Autism in Georgia Public Schools

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Background: A large body of literature suggests that differences in access to services among children with autism spectrum disorder (ASD) are not accounted for by actual differences in need for services. These disparities in access can prevent children with ASD from receiving both medically indicated and educationally relevant supports. Some literature suggests that factors at the child or family levels, such as race/ethnicity or insurance status, impacts service receipt. Other literature suggests that system-level factors such as availability of resources or policies impact service receipt. There is a need to understand local and state-level factors contributing to lack of access so that system-level interventions aimed at reducing disparities for children with ASD can be developed.

Objectives: The purpose of this study was twofold—first, we aimed to identify rates of unidentified children with ASD using county-level and state-level education records in Georgia; second, we aimed to understand county level socio-demographic factors that related to lower expected rates of autism identification at the county level.

Methods: We used linear regression to evaluate the contribution of county factors on rates of unidentified children with ASD. The outcome variable of interest, *unidentified children with ASD in the school district*, was calculated by comparing actual number of children with an educationally-relevant 'autism' classification (per GA Department of Education records) to the expected number of children with ASD. Expected number of children with ASD was calculated using CDC estimates and the Census Bureau totals of children for that county in 2013. County level predictors included: median household income, high-school graduation rate, minority population rate, and number of primary-care providers per 100,000 people.

Results: In Georgia, 113 (71%) of 159 counties had available educational data on autism in 2013. Counties without educational data on autism classification were significantly more likely to be rural than those with data. Counties ranged in rates of *unidentified children* (15.28-84.12%), with higher rates of unidentified children reflecting lack of children being served with an autism classification in the school district. A statistically significant linear regression ($F[6,103]=3.27$, $p=.006$) was found ($R^2 = .16$). The only significant variable was county median household income ($B= - 0.0006$, $p=.002$). Geographical representation of the counties with low median household income (<$40,000) and high rates of unidentified children (> 60% missing) is pictured (Figure 1).

Conclusions: Research on differences in ASD identification frequently focuses on racial/ethnic disparities, insurance characteristics, and provider biases. Our analysis suggests that median household income at the county level is an important predictor related to school-based autism classification in Georgia, even after controlling for other non-significant factors such as county-level education, availability of providers, minority rates, and rural county status. For each $10,000 reduction in median income, the estimated ASD missing rate increased by 6%. School districts are often the primary providers of autism-relevant identification and intervention services, especially for families who may lack resources. Consideration of the impact of household income on school district resources, and addressing income inequality, may be important aspects of reducing disparities in autism service provision in schools.

415.079 *(Poster)* Maternal Perinatal Depression and Risk of Autism: Preliminary DATA of the "SOS Mood" Project, a Longitudinal Evaluation in Offspring.

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Background: The increasing prevalence of maternal Perinatal Depression (PD) within pregnant women (10-20%) and the rising use of psychotropic medications during pregnancy (>8%) claims attention on the potential long-term effects on offspring neurodevelopment. A possible association between maternal PD and higher risk of Autism Spectrum Disorder (ASD) has been reported in literature with contrasting results. The question whether prenatal pharmacological exposure or maternal psychiatric disorder is linked with an increased risk of ASD remains inconclusive and requires longitudinal studies.

Objectives: Primary aim of the SOS MOOD project (MOOD of **MO**thers and **O**ffspring's **D**evelopment) is to longitudinally evaluate long-term effects of maternal Perinatal Depression on offspring's socio-communicative and behavioral phenotype, with a focus on the increase of ASD risk. Secondary objective is to characterize the clinical phenotype of Offspring of Perinatal Depressed women pharmacologically Treated during pregnancy [O-PD-T] compared to offspring not exposed to drug treatment [O-PD-NT].

Methods: Pregnant women are enrolled during the 1st-2nd trimester of pregnancy. Currently, data are available for 31 women but the recruitment is still ongoing. Women's psychiatric evaluation of PD was performed during the 2nd trimester of pregnancy (Edinburgh Perinatal Depression Scale-EPDS).Offspring's standardized assessment of developmental quotient (Griffith-III), autistic symptoms (Autism Diagnostic Observation Schedule-ADOS-2; Social Responsiveness Scale-SRS) and hyperkinetic-inattentive behaviour (Conners' Parents), was performed at a mean age of 4 years.

Results: We report preliminary results on 31 women (mean age 34 years) and 31 children (mean age 4 years) (Figure1). 18 women were affected by PD, whereas 13 women did not receive diagnosis of PD. Amongst the 18 PD women, 12 women received pharmacological treatment during pregnancy [PD-T], instead 6 women were not pharmacologically treated [PD-NT]. Within PD women, two children received diagnosis of ASD, whereas amongst healthy control women [HC] no child was affected by ASD. No significant statistical difference emerged between the offspring of women affected by PD [O-PD] and the children of HC women [O-HC], in the level of autistic symptoms and socio-communicative difficulties, measured by ADOS 2-Total Score (mean value: 3.00 O-PD vs 2.5 O-HC), ADOS 2-Calibrated Severity Score CSS (mean: 1.7 O-PD vs 1.5 O-HC), SRS total score (mean: 55.25 O-PD vs 51 O-HC).O-PD-NT scored higher on ADOS 2-Total Score (O-PD-NT mean 4.1 vs 2.5) and ADOS 2-CSS (O-PD-NT mean 2 vs 1.6) compared to O-PD-T. Instead, O-PD-T scored higher on Social Problems (O-PD-T mean 53 vs 44.8), ADHD Index (O-PD-T mean 57.4 vs 47.4) and Total Score of Conners' Parents (O-PD-T mean 52.3 vs 46).

Conclusions: Our preliminary results don't show a significant increased risk of ASD in the children of women affected by perinatal depression compared to offspring of healthy control mothers. However, within O-PD, a different behavioural phenotype emerged, depending on the prenatal exposure to psychotropic medications. In particular, higher subtreshold autistic symptoms and lower defiant-inattentive behaviour currently characterize O-PD-NT. Further analysis on the total sample are necessary in order to clarify the possible long-term impact of maternal PD and prenatal use of psychotropic medications on offspring's socio-communicative and behavioural outcome.

415.080 *(Poster)* Measuring Self-Injurious Behavior to the Head Using a Wearable Acceleration Sensor in Individuals with Autism Spectrum Disorders

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Background: Self-injurious behavior (SIB) is apparent in a high proportion of individuals with autism spectrum disorder (ASD). In particular, it has been noted that SIB to the head is likely to be permanent, and early intervention is required.

Objectives: The purpose of this study was to develop a SIB measurement system using an acceleration sensor.

Methods: Participants: Two individuals with ASD participated. Both participants had severe intellectual disabilities. Participant 1 was a 20-year-old woman who had SIB such as hitting her temples or chin with her hand and scratching her head. Participant 2 was a 13-year-old boy and had SIB that involved hitting his head and hips with his hands. For both individuals, their SIBs occurred frequently throughout the day despite behavioral interventions and medications provided.

Materials: A short-wear measurement using an acceleration sensor (Empatica E4 ™ wristband) was performed in the playroom. In this study, we used only acceleration data.

Measurement: The participants wore an acceleration sensor on the wrist on the side where SIB was performed. The measurement was performed 2 to 5 times. At the same time, video recordings of behaviors performed while wearing the wristband were made and the time was synchronized with the behaviors observed. Using the synchronized data, the time periods in which SIB occurred frequently were included in the analysis.

Data analysis: Attempts were made to identify SIB from the sum of the absolute values of the sampled x, y, and z axes of the acceleration and the integration of the sampling interval (hereinafter referred to as ASA). The threshold was examined based on the maximum value of ASA in other behaviors occurring without SIBs such as movement and sitting, and the minimum value of ASA when SIB occurred. When the value is lower, the second smallest value is treated as the minimum value. The coincidence rate was calculated by dividing the number of times the SIB, as assessed by moving image data, occurred by the number of times the threshold in the obtained ASA graph was exceeded and multiplying by 100.

Results: In participant 1, the threshold was set to 0.060. A total of 6 SIBs were observed, 5 of which exceeded the threshold, and the concordance rate was 83.33%. Participant 2 was set to 1.20 as the threshold. A total of 5 SIBs were observed, 4 of which exceeded the threshold, and the concordance rate was 80%. However, the other behaviors without SIBs exceeded the threshold three times.

Conclusions: The findings suggest that the occurrence of SIB can be estimated by the amount of acceleration, and agreement with the coding by the evaluator and the video data was also obtained. However, the other behaviors that exceeded the threshold were also observed. Therefore, it was shown that for individuals with hyperactivity, a method that simply uses a specific value as a threshold may cause false detection of SIB. Measuring self-injurious behavior to the head using a wearable acceleration sensor in individuals with autism spectrum disorders

415.081 *(Poster)* Microanalysis of Daily Living Skills in Adolescents with Autism Spectrum Disorder without an Intellectual Disability

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Background: Daily living skills (DLS) have been associated with a more successful adult outcome in areas such as independent living, postsecondary education, and employment in individuals with autism spectrum disorder (ASD) without an intellectual disability (ID) (Farley et al., 2009). A microanalysis of DLS, as measured by the Vineland Adaptive Behaviors Scales, 2nd Edition and 3rd Edition (Vineland-2 and Vineland-3) will provide insight into the strengths and weaknesses of adolescents with ASD without an ID. An in-depth understanding of the DLS profiles of adolescent can then be used to develop interventions to effectively target DLS and lead to a more successful adult outcome.

Objectives: The aim of the current study was to examine the specific strengths and weaknesses in DLS in adolescents with ASD without an ID as measured by the Vineland-2 and Vineland-3.

Methods: Adolescents with ASD were included in the current study if they had an IQ score ≥70, were between 14-20 years of age, had a diagnosis of ASD based on Module 4 of the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2) and/or clinician judgment, and had a complete Vineland-2 and Vineland-3. Subdomain and domain scores from VABS-2 and VABS-3 were analyzed separately due to marked differences in item order and content. Vineland DLS subdomains (i.e., Personal, Domestic, and Community) were analyzed by v-scale scores and age equivalents (AE). Related items within the DLS subdomains were grouped into item sets, (as determined by the VABS-2 item sets and the VABS-3 interview topics), and analyzed at item set level and individual subdomain item level.

Results: The total sample consisted of 70 adolescents with ASD. A paired sample t-test was run to determine if there was a significant difference between the average chronological age and the average AE for each of the DLS subdomains. Because a significant difference was found for each DLS subdomain (all p's < .001), the data was then analyzed at item set and item level. The average score for each item was computed and every item with an average of <1.5 (items are scored at 0, 1, or 2 – with a score of 2 indicating an item is competed independently most of the time) was categorized as a weakness. Items sets were also analyzed for weaknesses by computing the percentage of items that were weaknesses within an item set.

Conclusions: A microanalysis of the DLS domain of the VABS-2 and VABS-3 provided valuable insight into strengths and weaknesses for adolescents with ASD without an ID. On both the VABS-2 and VABS-3, the Domestic subdomain (e.g., cleaning, doing laundry, cooking) had the largest percentage of weaknesses. The item sets with the largest percentage of weaknesses in VABS-2 and VABS-3 were: Health Care, Kitchen Chores, Housekeeping, Job Skills, Money Skills, Going Places Independently, and Achieving Goals (only VABS-3). A larger percentage of items were labeled as weaknesses in VABS-3 compared to VABS-2. The results have important implications and suggest that it is critical to target certain DLS in interventions for adolescents with ASD without ID.

415.082 *(Poster)* Missed Diagnoses of Autism Spectrum Disorder after Initial Negative Developmental Evaluation

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Background: In 2014, 572 8-year-old children were identified with autism spectrum disorder (ASD) by the Colorado Autism and Developmental Disabilities Monitoring (ADDM) Project, as part of the Centers for Disease Control and Prevention's ADDM Network, which is a population-based surveillance system of ASD. Of the 572 children identified with ASD in Colorado in 2014, 243 (42%) did not have a documented ASD diagnosis in their education and/or health records, indicating a number of children in Colorado may not be receiving optimal services. Notably, these 243 children had documented developmental concerns and underwent at least one developmental evaluation, but were not diagnosed with ASD.

Objectives: To describe a group of children who underwent one or more developmental evaluations, through which they were not diagnosed with ASD, but were identified with ASD during the 2014 surveillance year by the Colorado ADDM Project.

Methods: The current study analyzed data collected by the Colorado ADDM Project for the 2014 surveillance year. Our sample included 243 8-year-old children who resided in Colorado in 2014 and met the ADDM Network ASD case definition, but did not have a documented educational identification or clinical diagnosis of ASD in their records at the time of review. Children's records were reviewed for the number of evaluations completed, type of evaluations received, diagnostic impressions, and documentation of suspicion of ASD.

Results: The children in our sample underwent one to 14 developmental evaluations (M=4.03; SD=2.65), with the age of their first evaluation ranging from three to 104 months (M=51.94; SD=24.64). Many of the children received an occupational therapy evaluation (51%), speech and language evaluation (44%), psychological evaluation (42.8%), or a comprehensive developmental evaluation (42.4%). Suspicion of autism was noted in 65% of the children's records. Furthermore, 58% of children had an autism screener or diagnostic tool documented in their records. Diagnoses given in lieu of ASD included language deficits (57.6%), motor difficulties (49.4%), cognitive difficulties (48.6%), attention deficits (30%), regulatory (i.e., sleeping, eating, and/or sensory processing) difficulties (28%), emotional problems (17.3%), behavior difficulties (11.5%), and genetic conditions (3.7%). For children with identified educational exceptionalities (n=55), documented exceptionalities included specific learning disabilities (27.3%), orthopedic impairments (18.2%), speech or language impairments (16.4%), emotional disturbance (12.7%), other health impairments (9.1%), intellectual disability (7.3%), multiple disabilities (5.5%), developmental delay (1.8%), and traumatic brain injury (1.8%).

Conclusions: Although the majority of children in our sample had suspicion of ASD noted in their records, these children were frequently diagnosed with language disorders, motor difficulties, and cognitive difficulties, which suggests that the presence of other developmental concerns may have masked or overshadowed ASD symptoms, resulting in missed ASD diagnoses. Additionally, our results support the importance of adequate developmental screening and evaluation procedures, as many of the children in our sample did not receive a comprehensive developmental evaluation (e.g., children only underwent an occupational therapy evaluation) and/or did not have an autism screener or diagnostic tool documented in their health or educational records. Furthermore, some of the evaluators may not be allowed to or feel comfortable diagnosing ASD.

415.083 *(Poster)* Modified Checklist for Autism in Toddlers, Revised with Follow-up: A Comparison of Total Scores and Screen Positive Rate By Race/Ethnicity

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Background: Children of racial/ethnic minority background receive Autism Spectrum Disorder (ASD) diagnoses substantially later than White, Non-Hispanic children, despite similar prevalence and symptom profiles (CDC 2006; Fombonne, 2003). The Modified Checklist for Autism in Toddlers, Revised with Follow-Up (M-CHAT-R/F; Robins et al., 2014), a widely used two-stage screener, was normed on a predominantly White, non-Hispanic sample. Most previous studies evaluating the performance of the M-CHAT or the M-CHAT-R/F grouped racial/ethnic minorities together (Scarpa et al., 2013; Khowaja et al., 2014). Analyses suggest that M-CHAT-R items yielding the best diagnostic classifications may differ between racial/ethnic groups (Achenie et al., 2019). Furthermore, a recent universal screening study identified several sociodemographic factors that may affect the M-CHAT/F's performance, though the study did not use the revised screener (Guthrie et al., 2019). Previous research by the authors found that the positive predictive value (PPV) of M-CHAT-R/F was similar in non-Hispanic Black and non-Hispanic White children (Dai et al., INSAR 2019). Further evaluation of the M-CHAT-R/F's effectiveness in these groups is warranted.

Objectives: To compare M-CHAT-R/F total scores and proportion of children who screen positive on each item prior to follow-up interview for non-Hispanic Black and non-Hispanic White children in order to determine whether race/ethnicity predicts the likelihood of an initial positive screen (i.e., ASD risk).

Methods: Data from a multi-site early detection study were used. Children (102 Black, 183 White) were included after screening positive on the M-CHAT-R/F at their 15- or 18- month well-child care visit and completing diagnostic evaluations. Demographic characteristics and screening modality were compared between racial/ethnic groups using independent t-tests, chi-square tests, or Fischer's exact tests depending on variable type. M-CHAT-R total scores and item-level positive screen rates were compared using an independent t-test and chi-square tests of independence, respectively.

Results: Non-Hispanic Black and Non-Hispanic White children differed on screening modality ($\chi^2(1, N = 285) = 14.05$, $p < .001$), screening age ($t(283) = 6.29$, $p < .001$), maternal education ($\chi^2(5, N = 278) = 50.14$, $p < .001$), and annual household income ($U = 13218.50$, $p < .001$). A greater proportion of Black children were evaluated with electronic versions of the M-CHAT-R/F. On average, non-Hispanic White children were screened at a younger age and had higher parental education and income. M-CHAT-R total scores were similar in both groups ($t(285) = 1.80$, $p = .373$). One item-level difference was evident following Bonferroni correction; non-Hispanic Black children were more likely to endorse the item "Does your child make unusual finger movements near his or her eyes?".

Conclusions: Findings indicate that the M-CHAT-R/F detects initial ASD risk similarly in both non-Hispanic Black and non-Hispanic White children in the United States supporting the use of this tool in universal screening efforts. Future studies should continue to evaluate the performance of ASD-specific screening tools in diverse populations as a means of promoting early detection and intervention.

415.084 *(Poster)* NIMH, Under Grant Number R01-MH104400-01, and HRSA, Under Grant Number R40MC26195 Maternal & Child Health Research. and HRSA.

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Background: Research suggests that there may be distinct sex differences in clinical presentation found in high versus low cognitive functioning samples of individuals with ASD. However, when examining sex differences specifically in toddlers with ASD, the evidence for differences in clinical presentation remains largely inconclusive. The ABCD Early Screening Project, a community-based, two-stage screening protocol implemented in Part C early intervention, provides a platform to explore sex differences in clinical presentation during early screening and diagnostic evaluation for ASD.

Objectives: We explore sex differences in ASD symptoms and developmental functioning on a parent-reported screener, an observational play-based screener, and measures used in a developmental and diagnostic evaluation among a group of toddlers with ASD and Developmental Delay (ASD-DD group) and a group of toddlers with ASD without DD (ASD-no DD). DD status was measured as a Mullen visual reception T score under 30.

Methods: Participants were 476 boys and 126 girls (age = 14-36 months), enrolled in Early Intervention (EI) services who screened positive on the two-stage screening protocol and obtained an ASD diagnosis following a diagnostic evaluation. Stage 1 screening consisted of parent-report on the Brief Infant-Toddler Social Emotional Assessment (BITSEA) and Parent Observations of Social Interaction (POSI) and report of parent and EI provider concern. Children who screened positive at Stage 1 were referred to Stage 2, a brief play-based observational screener (the Screening Tool for Autism in Toddlers; STAT). Those screening positive at Stage 2 were referred for a diagnostic evaluation involving the ADOS-2, Mullen Scales of Early Learning, and the Vineland Adaptive Behavior Scales (VABS-3). Linear regressions examined the role of sex on symptomology and developmental functioning for the ASD-DD group and the ASD-no DD group.

Results: There were no differences in ASD symptoms and developmental functioning between boys and girls for the group of toddlers with ASD-DD. On the other hand, girls and boys with ASD-no DD were similar across most domains with a few exceptions. Within the ASD-no DD group, boys and girls had similar ASD symptoms, play skills, and adaptive functioning. However, boys in the ASD - no DD group had higher non-ASD specific (internalizing, externalizing, and regulation) problems on the parent-reported BITSEA compared to girls. [$F(1,266.2)=5.32$, $p<.05$, Cohen's $f = .016$]. Girls in the ASD-no DD group showed a higher level of expressive language skills compared to boys as evidenced by parent-report on the Vineland-3 [$F(1, 264.2)= 45.1$, $p <.05$, Cohen's $f =.331$] and performance on the Mullen [$F(2,264.2) = 43.50$, $p <.05$, Cohen's $f =.319$].

Conclusions: Among children with ASD-no DD, girls exhibited higher expressive language skills and lower non-ASD specific behavior problems than boys. Our study is consistent with the literature in that sex differences in ASD presentation are more evident in children with ASD without cognitive impairment. These results have implications for detection and early diagnosis and contribute to our understanding of the different presenting profiles of boys and girls with ASD.

415.085 *(Poster)* On Which Traits and Behaviours Do Clinicians Rely When Confirming or Excluding Autism in Adult Women?

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Background: Autism without Speech Onset Delay or Intellectual Disability can present uniquely in adult women, making them vulnerable to misdiagnosis of a mental health condition (Bargiela, Steward, & Mandy, 2016). Under current DSM-5 criteria, clinicians must also decide whether difficulties additional to autistic traits constitute a comorbidity or an alternative diagnosis. For example, checking behaviors could be the result of a standalone anxiety disorder, anxiety comorbid to autism, or an autistic trait within itself. However, the reported increase in prevalence of autism raises the issue of potential *overdiagnosis* in psychiatric populations presenting with social difficulties (Rødgaard, Jensen, Vergnes, Soulières, & Mottron, 2019). There is a pressing need to better delineate alternative from comorbid diagnoses, particularly in women. Given that expert clinicians recognise autism more reliably than DSM-5 criteria, based on long-standing exposure to a behavioural phenotype (de Marchena & Miller, 2017), investigating clinical expertise may bring unique insight to this issue.

Objectives: The aim of this study was to investigate the clinical diagnostic decision-making process of expert clinicians evaluating adult women for autism.

Methods: Semi-structured interviews on evaluating *adult women for autism* were carried out with expert clinicians (>100 autism assessments during career) in 5 countries (Canada, USA, UK, France, Australia). 20 clinicians will be included in final analyses. The following topics were addressed: (1) specific traits and past diagnoses which interfere with assessment procedure, (2) diagnostic tools and interview topics used to obtain diagnostic information, (3) most salient traits and behaviours when assessing for autism, whether present in DSM-5 or not, (4) common comorbidities and alternative diagnoses, and (5) close-ended questions on handling cases where the diagnosis is not given. Interviews were recorded, transcribed verbatim, and resulting data was analysed using thematic analysis in NVivo.

Results: Preliminary results (n=5) show (1) an increasing trend towards self-diagnosis of autism prior to evaluation, bolstered by online availability of information on autism, (2) a lack of specificity of instruments such as the AQ, on which most psychiatric condition screen positive, (3) in contrast, behaviours considered specific to adult autistic women included an inability to vulgarise special interests, negatively experienced life events which appear banal, and qualitative differences in the telling of life narratives (temporal associations lacking in context), (4) mood disorders more often considered comorbidities, whereas eating and personality disorders more often considered as alternatives, and (5) increasing proportions of patients exhibiting distress when autism diagnosis was not obtained.

Conclusions: Clinicians have unique insight on the specific behaviours which differentiate autism from psychiatric conditions, and this expertise could be particularly relevant in populations who frequently present in complex ways and are most at risk for misdiagnosis. Investigating clinicians' reasoning mechanism suggest potential mechanisms for overdiagnosis in adult populations, and provide clinically-relevant data to the differential diagnosis literature in adult women.

415.086 *(Poster)* Parent Concerns Prior to ASD Evaluations: Potential Influence of Gender

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Background:

Prevalence rates in autism result in early identification methods, autism assessments, and interventions that are largely based on male samples (Lai et al., 2015). Research examining differences between males and females vary across studies and with respect to age or cognitive ability (Lai, 2014). Some studies suggest females camouflage symptoms (Hull, 2017) or require elevated concerns to receive a diagnosis (Dworzynski et al; 2012). Gender differences in social-communication and behavior within the general population should also be considered. Parents of toddlers were more likely to endorse ASD related concerns for males regardless of eventual diagnosis (Ramsey et al, 2018) and less likely to report concerns related to social interactions for girls (Little et al., 201).

Objectives:

Examine how patterns of parent concerns preceding a diagnosis predicted likelihood of group (gender and diagnosis).

Methods:

We conducted a secondary analysis of data including children (n = 273) ages 36-72 months who presented for an interdisciplinary autism evaluation, divided into an ASD diagnosis group (n=168) and DD group (i.e., global developmental delay, language delay; n=105). Data were drawn from clinical assessments and intake paperwork completed by parents prior to evaluation. Parents reported “yes” or “no” to a list of potential concerns (i.e., internalizing, social communication, repetitive behaviors, speech/language, problem solving), later grouped into related categories (DSM criteria, disruptive behaviors, etc). We used multinomial regression with four diagnostic/gender categories (i.e., ASD females, ASD males, DD females, DD males) as the dependent variables and parent behavior concerns as the independent variables.

Results:

Results are described with ASD females as the comparison group and suggest an overall significant model (x^2= 51.55, *df*= 24, p<0.01). ASD males were significantly differentiated from ASD females by a higher likelihood of repetitive behavior (b = 1.38, p = 0.05), and speech and language concerns (b = 1.08, $p < 0.05$). Females with DD were significantly more likely to have problem-solving concerns (b = 1.58, $p < 0.05$); whereas, males with DD were less likely to have social communication concerns (b = -1.98, $p < 0.05$) compared to ASD females. Play and internalizing concerns did not differentiate ASD females from other groups. Additional findings suggest differences regarding social-communication as well and the need for further analyses to examine if, or how, age and cognitive ability might greater influence females compared to males.

Conclusions:

Our results suggest that parent concerns differentiated females with ASD from males with ASD/DD. Results indicate gender differences for parent concerns regardless of eventual diagnosis, suggesting analyses that collapse across groups. These findings support the notion that girls with ASD demonstrate a different behavioral profile compared to males and the need to consider expected patterns of behavior for males and females (Dean et al., 2017). Given the distinct patterns of parent concerns for girls with ASD, this means we need to be vigilant listeners when discussing parent concerns and recognize these may be less salient for girls with ASD and to consider expected patterns of behavior for males and females without ASD.

415.087 *(Poster)* Parent Perceptions of a Clinician-Guided, Parent-Led Screening for Autism Risk in Toddlers Using Telemedicine Tools

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Background: Telemedicine tools have potential to increase access to diagnostic and treatment services for individuals with autism spectrum disorder (ASD). Previous work has documented the feasibility, acceptability, and diagnostic accuracy of a telemedicine assessment procedure in which a remote psychologist observed administration of the Screening Tool for Autism in Toddlers and Young Children (STAT) by a trained, on-site early intervention provider (Juárez et al., 2018). Although promising, this approach relies on the availability of two expert providers (i.e., administrator and observing clinician), which limits its efficiency and scalability. The present study examined the feasibility and acceptability of a parent-led screening procedure guided solely by a remote clinician. Evaluation of telemedicine diagnostic accuracy in comparison to gold-standard diagnostic evaluation is pending and will be presented separately.

Objectives: This study sought parent feedback on a telemedicine approach to ASD assessment, in which a clinician guided parents via live video to complete an ASD screening procedure with their toddlers.

Methods: Participants were 51 caregivers (42 mothers, 6 fathers, 2 other caregivers) and toddlers (71% male; mean age 2.49 years, SD = 0.35). Thirty-five toddlers had diagnoses of ASD; 10 had diagnoses of developmental delay; and 6 toddlers were typically developing. Remote clinicians were psychologists with expertise in diagnosing ASD in young children. Using tele-evaluation rooms equipped with HIPAA-compliant video platforms, clinicians verbally instructed parents to complete one of two brief tele-assessment tools: the TELE-STAT or the TELE-ASD-PEDS. Both tools are interactive assessments of social communication skills, including opportunities for joint play, shared attention, and social routines. The tele-screening procedure took an average of 23 minutes (SD=5.00), with no significant difference between the two screening tools. Following tele-screening, parents completed a questionnaire eliciting their feedback about the experience.

Results: Quantitative parent feedback indicated that most parents felt comfortable playing with their children during the tele-screening and found the spoken instructions easy to follow (See Table 1). Some parents (12%) indicated that screening activities did not elicit the child behaviors about which they were most concerned. Independent samples t-tests yielded no differences on these items between parents who completed the TELE-STAT and those who completed the TELE-ASD-PEDS. When asked whether they would prefer to play with their child as part of screening or observe a psychologist play with their child, 19% of parents indicated that they would prefer to play with their child, 4% would prefer to observe, and 77% would prefer to both play and observe. Parents provided a total of 111 written comments, including comments about technology (n=25), the parent-led nature of the screening process (n=21), comparisons between full evaluation and tele-screening (n=14), and the convenience of the process (n=8). Parent comments are further summarized in Table 2.

Conclusions: Parents reported that tele-screening was convenient and comfortable. Many enjoyed playing with their children during the screening and noted that this may be preferable to only observing a psychologist interact with their child. Future work will investigate the diagnostic accuracy of tele-screening procedures and incorporate parent feedback to further adapt telemedicine for autism assessment.

415.088 *(Poster)* Parent Report of Social Communication and Language at 18 Months

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Background: Universal screening for ASD at 18 and 24 months of age as recommended by the American Academy of Pediatrics (AAP) remains an area of interest as recent studies report high feasibility, but sub-optimal accuracy using ASD-specific screening tools for universal screening (e.g., Guthrie et al., 2019). Recent estimates suggest that only 17% of pediatricians are conducting universal screenings as suggested by the AAP and there is significant variability in the screening tools used (Crais et al., 2014). Further, many pediatricians report concerns or challenges in utilizing current ASD-specific screening tools.

Objectives: The purpose of this study was to examine the parent report of social communication and language skills at 18 months of age on commonly used non-ASD specific checklists.

Methods: Sixty participants, between the ages of 9- and 36-months of age, were recruited for a longitudinal research project focused on behavioral risk factors for ASD. Advertisements were designed to recruit children with parental concern regarding their development (language and/or general), which included specific parental concerns for ASD, and children without parental concerns; resulting in a sample of toddlers with heterogeneous social communication and language skills. Of 60 enrolled participants, 25 (males n=16) had completed behavioral assessments at the 18-month age interval, with inclusionary age criteria 18-months +/- 2 months (mean age: 18.65 months, range: 18.0 to 20.01). At the time of the behavioral assessments, parents completed several checklists including the Communication and Symbolic Behavior Scales Infant Toddler Checklist CSBS ITC; Wetherby & Prizant, 2002), Ages and Stages Questionnaire (ASQ; Squires & Bricker, 2009), Ages and Stages Questionnaire-Social Emotional (ASQ-SE; Squires, Bricker, & Twombly, 2002), and the Language Development Survey (Rescorla, 1989). Social communication and expressive language skills were directly assessed using the Toddler Module of the Autism Diagnostic Observation Schedule (Lord et al., 2012) and the Mullen Scales of Early Learning (Mullen, 1995), respectively.

Results: Parents endorsed more concerns and/or lower abilities in the areas of speech and language compared to social communication across measures. Specifically, the Language Development Survey yielded the highest percentage of concern (33.3%), followed by the speech composite on the CSBS ITC (16%) and the ASQ Communication Scale (12%). Only a minority of social communication scores (8%) fell within a concern range on the CSBS ITC social composite and the ASQ SE based on parent report. Based on the Mullen Scales of Early Learning, 32% of the sample had expressive language delays with scores falling ≤ 1.5 SD below the mean. Twenty-four percent of the sample met the research cut-off for ASD on the ADOS with 12% falling in the moderate-to-severe concern range, 16% in the mild-to-moderate concern range, and 72% in the little-to-no concern range.

Conclusions: Only a minority of parents of our sample endorsed skills within the concern range across the checklists completed. More concerns were noted regarding early speech and language skills as compared to social communication development with vocabulary on the LDS yielding the highest percentage of concern. A similar pattern was observed on our direct observation measures.

415.089 *(Poster)* Parent and Teacher Inter-Rater Agreement of Middle Childhood Bullying Experiences in Children with Autism Spectrum Disorders

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Background: Children with ASD are more susceptible to bullying than their typically developing peers (Sreckovic et al., 2017). However, teachers and parents may have distinct perceptions of bullying experiences. Some studies report higher levels of parent-reported than teacher-reported bullying (Nowell et al., 2014) while other studies (Maïano et al., 2016) report comparable levels across raters. Such informant discrepancies are common and influenced by the different contexts in which raters observe children and the types of behaviours being rated (De Los Reyes, 2005). As such, it is plausible that inconsistencies in parent/teacher ratings of bullying in ASD may be explained, in part, by the type of bullying being assessed (physical, verbal, social). Further, we hypothesize that agreement may differ at different stages of middle childhood, a period when the forming and sustaining peer relations is rapidly evolving (Sroufe et al., 1993).

Objectives: To examine the inter-rater agreement of teachers' and parents' endorsements of three forms (physical, verbal, and social) of bullying experienced in children with ASD in early vs. later middle childhood.

Methods: Our sample included children with ASD, for whom both teachers and parents completed a modified version of the *Olwues Bullying/Victim Questionnaire* (CBE; Vaillancourt et al., 2008) as part of an ongoing longitudinal study (Pathways in ASD) at either early (N=140; *M* age = 7y:8m; T1) and/or late (N=116; *M* age = 10y:9m; T2) middle childhood with some (N=70) having data across both timepoints. The CBE is a brief screening measure that queries the frequency (from '*never'* to '*several times a week'*) of physical, verbal, and social bullying. ICC estimates were calculated for each type of bullying on parent and teacher CBE questionnaires based on a mean-rating (*k* = 2), absolute-agreement, 2-way random-effects model at T1 and T2.

Results: At T1 parents and teachers, respectively, reported one or more incidents of physical bullying (18.4%, 15.5%), verbal bullying (34.5%, 23.4%), and social bullying (34.8%, 26.9%) of children with ASD. By time T2, these overall rates were more similar per parent and teacher report: physical bullying (12.9%, 11.3%), verbal bullying (28.4%, 29.3%), and social bullying (28.4%, 28.4%). Nonetheless, ICC were generally weak to moderate (range: .15–.49) and only statistically significant for verbal bullying (T1 ICC=.36, T2 ICC=.49), suggesting significant differences in the frequency of bullying, particularly of social and physical bullying, being report by teachers at both timepoints. See Tables 1 and 2.

Conclusions: Findings suggest that parents and teachers provide important, complementary information about the frequency with which children with ASD experience bullying in middle-childhood. Further, they suggest that discrepancies in these reports vary by bullying type and child age. Social and physical bullying may vary or occur more covertly across contexts. Further, these forms of bullying may be less often observed by or reported to teachers, overall. Findings encourage communication between parents and teachers regarding their perceptions of bullying to ensure adequate detection and continuity of care across settings.

415.090 *(Poster)* Parent and Teacher Reports on Screening Instruments As Predictors of Diagnostic Instrument Scores

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Background: Multiple informants are considered important in the assessment of ASD (Kim & Lord 2012). Parents and teachers, as key informants, are considered to provide unique and complementary information about the child's behavior, since they see the child in different contexts and have different perspectives (van der Ende et al. 2012).

Despite the potential additional value of information obtained from parents and teachers in the assessment of ASD, only a few studies have examined the two together.

Objectives: To examine the association of parent and teacher reports on ASD screening questionnaires, with clinician administered gold-standard diagnostic instruments.

Methods: One hundred and thirty-five children and adolescents (23 girls), aged 5-18 (M=10.89, S.D.=3.46) attended an Israeli tertiary clinic (Bait-Echad Center) for an ASD diagnostic assessment. Participants' parents filled out the Childhood Autism Spectrum Test (CAST; Scott et al., 2002) and teacher completed the Social Responsiveness Scale (SRS-2; Constantino & Gruber, 2012). Participants were assessed by clinical psychologists, using the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2012) and the Autism Diagnostic Interview-Revised (ADI-R; Lord et al., 1994).

Results: Four Linear regression analyses were conducted with ADOS-2 Calibrated Severity Score (CSS), and ADI-R Social Interaction, Communication, and Restricted, Repetitive Behavior (RRB) scores as dependent variables. For all regressions, participants age and gender were entered on the first block and parent-reported CAST and teacher-reported SRS-2 scores were entered on the second block.

ADOS-2 CSS were predicted only by teachers' SRS-2 Total scores (β=.26, p<.01; total model R^2=.10). ADI-R Social Interaction scores were predicted only by parent CAST scores (β=.50, p<.001; total model R^2=.26). Similarly, ADI-R Communication scores were predicted only by parent CAST scores (β=.49, p<.001; total model R^2=.23). Finally, ADI-R RRB scores were predicted jointly by gender (β=.17, p<.05, Males>Females, t[130]=2.08, p<.05) and parent CAST scores (β=.37, p<.001; total model R^2=.16).

Conclusions: The findings indicate the unique value of parent and teacher report in their prediction of different components of the diagnostic assessment. Parents report was predictive of the ADI-R, as they provide invaluable information on the child's development over time. On the other hand, teachers' report was predictive of the ADOS-2 CSS scores, as they regularly observe how the child interacts with other children in the school setting and have the opportunity to compare the behavior of the child with that of many other children, which may allow them to better distinguish between typical and atypical behavior. Gender differences in the prediction of participants' RRB highlight the importance of adapting existing diagnostic instruments to represent RRB manifestations in females.

415.091 *(Poster)* Parent-Reported Internalizing, Externalizing, and Dysregulation Behaviors during ASD Screening: A Latent Profile Analysis of Young Children Diagnosed with ASD

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Background: Early detection of autism spectrum disorder (ASD) has included use of both ASD-specific and broadband screening tools to identify children with ASD. Though studies have followed developmental profiles of children once they receive a diagnosis, limited work has examined constellations of emotional, behavioral, and regulatory problems that parents report prior to children's diagnosis. Grouping children based on ASD symptomatology (i.e., ASD risk status) and co-occurring emotional, behavioral and regulatory problems may inform the range of resources that would benefit children with ASD and their families.

Objectives: To identify latent profiles of young children diagnosed with ASD based on parent-reported non-ASD symptom screening data from the Brief Infant-Toddler Social and Emotional Assessment (BITSEA).

Methods: Data were drawn from a multi-stage screening trial in partnership with Early Intervention. Participants were 556 children (ages 14-33 months; 80.3% male) whose parents completed a BITSEA at an early screening stage and subsequently received a diagnosis of ASD (ADOS average Calibrated Severity Score [CSS] = 8.25). Families resided in an urban area in the US Northeast; a majority were Latinx (46.9%) and had a primary parent with more than a high school education (57.7%). Latent profile analysis (LPA) was conducted to identify latent subgroups. Classes were based on patterns of BITSEA internalizing, externalizing, and dysregulation problems subscales, with ASD items removed. Chi-square analyses were used to determine differences among classes.

Results: A four-class solution was identified to best fit the data (See Table and Figure 1). Class 1 represented children with low scores on all scales (20.3% of sample). Class 2 represented children with a single elevation in the externalizing scale (6.3% of sample). Class 3 represented low-to-medium internalizing, externalizing, and dysregulation behaviors (51.3% of sample). Class 4 represented medium-to-high internalizing, externalizing, and dysregulation behaviors (22.1% of sample). Chi-square analyses revealed a significant association between class membership and indicators of parent education ($\chi^2(3)=10.12$, p=.02) and household federal poverty level (FPL), ($\chi^2(3)=12.71$, p=.01). A higher percentage of children in Class 2 had parents with less than a high school education (56.3%) as compared with children in other classes. A higher percentage of children in Class 1 lived in households >185% FPL (54.2%) as compared with children in other classes. Family race, ADOS CSS, restricted and repetitive behavior scores, and the Mullen Scales of Early Learning composite were not associated with class membership.

Conclusions: An acceptable class structure based on indicators of internalizing, externalizing, and dysregulation behaviors emerged for children with ASD. Parent education and household poverty level were associated with the four identified classes. Although a minority of the sample fit into Class 2 (6.3%), characterized by high externalizing and low internalizing and dysregulation symptoms, this group is of clinical importance, as parents may need additional support to manage their children's elevated activity, impulsivity, aggression and defiance. Similarly, parents raising children in Class 4, a profile characterized by elevated symptoms across the three domains assessed (22.1% of sample) may benefit from additional support. Notably, approximately 25% of children had significant challenging behaviors independent of ASD symptoms.

415.092 *(Poster)* Pathway from Community Pediatric Provider Evaluation Referral to Treatment for Autism Spectrum Disorder (ASD): Where Do Families Get Off Track?

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Background: Universal toddler screening can detect many cases of ASD younger than the national average (Robins et al., 2014). However, in order to maximize the benefits of universal screening, community pediatric providers (providers) must consistently refer positive-screen toddlers for an ASD evaluation. Providers report many barriers to making ASD evaluation referrals, one of which is family reluctance to participate in the evaluation process (Robins et al., 2019). Providers may be reluctant to refer a toddler for an evaluation if they believe the family will ultimately refuse or have difficulty participating in the evaluation and treatment process.

Objectives: Determine family retention rate at each stage of the ASD evaluation process, from initial provider referral to family adherence to treatment recommendations in a large multi-site study.

Methods: Providers referred toddlers (n = 133) for an ASD evaluation as part of an RCT designed to evaluate how detection strategies in primary care impact the age of diagnosis and treatment onset, and subsequent outcomes for a diverse sample (e.g., traditionally underrepresented groups and lower-resourced families). Study coordinators called referred families directly to schedule an initial ASD evaluation. Families were considered "unable to contact" for scheduling if they did not respond after three phone calls and a letter mailed to their home address. Retention rate was calculated by percentage of adherence for families at each stage who 1) agreed to schedule an ASD evaluation after referral, 2) attended and completed the ASD evaluation, and 3) subsequently participated in treatment if the toddler was diagnosed with ASD.

Results: Community referred families exhibited a fairly high retention rate at every stage of the ASD evaluation to treatment process. Only 6% of families refused the diagnostic evaluation and 11% of families were "unable to contact". Ten percent of families failed to attend their scheduled evaluation appointment and decided not to reschedule. Thirteen percent of families whose toddlers received an ASD diagnosis declined treatment from our study team. Ultimately, almost 2/3 (approximately 63%) of families whose toddlers were identified at-risk during a pediatric check-up in a participating community practice participated in the entire process, from scheduling an ASD evaluation to treatment.

Conclusions: Many possible barriers may impede a provider from making a referral for an ASD evaluation. Parent response to this referral, specifically reluctance to complete an evaluation, has been cited as one possible deterrent. Our data indicate that after referral the majority of families ultimately participated in not only the evaluation process, but also accepted the recommended treatment plan. It should be noted that providers and families were enrolled in a research study, which may have increased willingness to refer for, as well as complete, an ASD evaluation. In addition, providers were supported throughout the screening process, and families received support for scheduling the evaluation, paying for the evaluation, and the wait-time for the evaluation was minimal, all of which likely contributed to the completion of the evaluation process.

415.093 *(Poster)* Patterns of Special Education Eligibility and Age of First Autism Spectrum Disorder (ASD) Eligibility Among US Children with ASD

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Background: Age of ASD identification remains later than desired at 36 months despite increased public health initiatives and awareness (Baio et al., 2018). Research on when children are first identified with autism spectrum disorder (ASD) typically has focused on clinical diagnoses. However, some children are identified after they enter elementary school (Yeargin-Allsopp et al., 2003). For young children, use of the non-specific Developmental Delay (DD) special education category has increased over time for children with ASD (Rubenstein et al., 2018), even though this category may not be adequate in describing the needs of children with ASD.

Objectives: Using data from the CDC's Autism and Developmental Disabilities Monitoring (ADDM) Network, we compared age of first ASD identification for children with ASD who had records from school sources only and those who had records from (a) both school and non-school sources and (b) non-school sources only. Next, we compared information contained in educational evaluations that resulted in DD eligibility and evaluations that resulted in ASD eligibility.

Methods: ADDM utilizes systematic record review to identify and describe children with ASD. ASD identification was defined as the presence of a clinical diagnosis or ASD special education eligibility noted in records. Children with records from schools only, from school + non-school sources, and non-school sources only were compared across age at first ASD identification and age of first comprehensive evaluation. Medians are presented to reduce the impact of outliers; significance tests were conducted using the Kruskal-Wallis test to detect significant differences in median age.

Results: Six ADDM sites that had access to records from both educational and health sources were included. The study sample included 20,461 evaluations from 3,206 8-year-olds identified as ADDM ASD cases in surveillance year 2014. Children with ASD with records from school settings only had significantly later median age of ASD identification (76.5 months) than children with records from school and non-school sources (51 months) or non-school sources only (48 months; p<.001). Age of first evaluation was also later: 56.5 months compared to 37 and 40 months (p<.001). Overall, evaluations that resulted in ASD eligibility included an ASD-specific measure 40% of the time. For children who first qualified under DD eligibility and later received ASD eligibility, their initial evaluations for DD eligibility contained an ASD-specific measure 22% of the time.

Conclusions: Children with school records only were evaluated and identified later than those with non-school records, which highlights the need for outreach efforts to identify and address barriers to access to both school and non-school services. Evaluations resulting in DD eligibility infrequently included ASD-specific measures that may have documented needs relevant to individualized education plans and services for children who ultimately were identified as ASD eligible. The American Academy of Pediatrics guidelines on administration of ASD-specific measures can be considered within school evaluations since they are a critical component of identifying children with ASD and defining their individual treatment needs.

415.094 *(Poster)* Pediatric Provider Reported Concerns for Autism Spectrum Disorder in a Racially and Socioeconomically Diverse Sample of Young Children

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Background: Screening is important for early detection of ASD and has been shown to reduce disparity in age of first diagnosis for children of color (Herlihy et al., 2014). Pediatric providers have an important role in facilitating the detection of ASD, and referral for assessment can be crucial for timely diagnosis. Despite recommendations for universal screening, screening rates in primary care remain low to moderate in many regions of the United States. Accurate, timely referral relies in part on provider expressed concern for ASD risk, particularly in practices with low screening compliance. Thus, it is important to understand potential differences in provider concern and how well concern predicts diagnosis that may contribute to diagnostic disparity.

Objectives: This study considers the impact of a child's race, family income, and age on the frequency and accuracy of provider reported concern for ASD.

Methods: Participants were 134 toddlers ages 12.2-41.07 months evaluated as a part of a larger study on the early detection of ASD. Data was collected from three sites in the United States. Children were screened with one of several validated developmental screeners, and providers completed a Provider Concern Questionnaire (PCQ) to document any concerns for ASD. Children who either screened positive on a developmental screener or were identified on the PCQ were offered a no-cost diagnostic assessment. Participants were divided into two samples; Black (n=40) or White (n=94), based upon parent report of the child's race. To determine provider accuracy, responses on the PCQ were compared to the results of diagnostic assessment.

Results: Of evaluated children, 32.1% (n=43) received an ASD diagnosis. Providers expressed concern for ASD in 62.8% (n= 27) of these cases and 36.6% of cases overall. Binary logistic regression and chi-square analyses revealed no significant relationship between provider accuracy and the demographic variables (race, income, age). Providers were accurate in their concern in the majority (71.6%) of cases. For frequency of provider concern, binary logistic regression revealed no significant effect of race or income. Analysis did reveal a significant effect of age on frequency of concern for ASD (p<.001). Frequency of concern and age were positively correlated (r =.342, p<.001) with a moderate effect size. Providers expressed ASD concern for 61.2% of evaluated children aged 18-months or older compared to 20.9% of children younger than 18-months.

Conclusions: Results revealed that neither race nor family income influenced the frequency or accuracy of reported pediatric providers' concern for ASD. Age was significantly positively correlated with frequency of concern but not accuracy. This may be because pediatric providers are more reluctant to identify concern in very young children, or because behaviors are more readily identifiable in slightly older children. When providers do express concern, however, they are often accurate, even at young ages. A limitation to these findings is that healthcare providers had the option to provide a referral for no-cost diagnostic assessment. Rates of provider referral may be different in typical care settings where such evaluations are not readily available.

415.095 *(Poster)* Phenotypic Resemblance between Autism Spectrum Disorder and Schizophrenia Spectrum Disorder

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Background:

Autism spectrum disorder (ASD) is characterized by abnormalities in social interaction and communication, whereas schizotypal personality disorder (SPD) is a schizophrenia spectrum disorder (SCZ) characterized by social and interpersonal deficits. The debate about the phenotypic distinction between ASD and SCZ persists nearly 70 years after "autism" was first described as the self-absorbed and withdrawn behaviors that were characteristic of adults with schizophrenia.

Objectives: The objectives of this review were to: 1) comprehensively review the empirical support for the phenotypic similarities and differences between ASD and SCZ and 2) suggest data-driven classification of ASD and SPD.

Methods: A systematic database search was conducted of the academic literature comparing ASD and SPD or SCZ. The search was limited to journal articles and postgraduate theses published in English during the past decade. Search terms (title, abstract and key word) were establish synonyms for ASD, SCZ, and SPD. CINAHL, Cochran Library, Embase, Medline, Proquest, PsychInfo, PubMed, Science Direct, Scopus and Web of Science were searched.

Results:

Despite differences in clinical presentation and age of onset, data provide empirical support for a conceptual overlap in diagnostic criteria and symptomology between both disorders, especially on the mild ends of the spectra. The data suggest negative symptoms of SPD share a strong relationship with ASD social and communication difficulties, and the main differences between ASD and SPD are positive features (i.e., hallucinations and delusions).

Conclusions: The majority of studies demonstrate that when using a dimensional approach, SPD features and behaviors cannot be easily differentiated from ASD features and behaviors. The broad overlap between schizotypal and autistic traits is primarily driven by interpersonal difficulties, but there is still some overlap in positive and disorganized symptoms as well. Although deficits common to both spectra may not necessarily share the same underlying cause, the resemblance in clinical phenotypes calls into question the notion that the disorders exist on separate spectra and suggests, instead, that they should be conceptualized dimensionally.

415.096 *(Poster)* Psychometric Evaluation and Adaptation of the Autism Traits Questionnaire in Mainland China

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Background: The Autism Spectrum Quotient questionnaire (AQ) was developed to assess autistic traits in the general population (Baron Cohen., 2009). Despite of being widely used across the globe, the AQ-Child has not been adapted into Mandarin Chinese.

Objectives: Research has suggested potential differences in the manifestation of autistic traits cross-culturally. Thus, it is necessary to systematically examine the psychometric performance of AQ among children who reside in a region hosting 1/5 of world population, namely, Mainland China.

Methods: Chinese AQ-child was first obtained through a translation and back-translation procedure. Pilot testing was administered with parents of 30 Typical developed children. The measure was further revised based on feedback from the pilot testing to maximize linguistic and cultural appropriateness. A total of 756 TD children' data was collected using the revised AQ translation.

Results: Item analysis identified 8 items with high double load. A total of 22 poor-performing items were removed from the following analysis, resulting in 28 items and 7 factors in the subcategories of

Social Skill items (item 11, 17, 38, 44, 48), Attention to Details (item 29, 30, 33, 42, 45, 49) ,Types of Interest(item 6,9,19,41) , Imagination (item 24,40,50), Attention(item 4,16,34) and Compulsivity(item 15,25,39). In addition, confirmatory factor analysis suggested good fit of 7-factor construct ($\chi 2/df = 1.61$, RMSEA = .03, CFI = .92, NFI = .81). However, internal consistency within each factor measured by Cronbach α coefficient did not produce satisfactory overall reliability (0.76、0.63、0.62、0.45、0.38、0.40, and 0.14).

Conclusions: The Chinese translation of AQ-child failed to produce similar AQ construct as produced in Western context. Potential behavioral sampling bias may exist cross-culturally and we call for further studies in this field.

415.097 *(Poster)* Psychometric Properties of the Eyberg Child Behavior Inventory in Children with Autism Spectrum Disorder Receiving Community Mental Health Services

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Background: The Eyberg Child Behavior Inventory (ECBI) has been used to assess co-occurring challenging behavior in children with ASD[1-6]. To date, only one published study has conducted a detailed examination of the psychometric properties of the ECBI in ASD[7]. However, the sample was predominantly Caucasian (74%) and young. In response, our group previously examined the factor structure of the ECBI in an ethnically-diverse sample of children with ASD receiving publicly-funded outpatient and school-based mental health services. The factor structure in the sample was best explained by a two-factor model of *Dysregulation* and *Attention/Hyperactivity*.

Objectives: The aim of the current study was to conduct further psychometric analysis of the identified *Dysregulation* and *Attention/Hyperactivity* factors.

Methods: Data were drawn from the baseline assessment of families participating in the community effectiveness trial of "An Individualized Mental Health Intervention for ASD (AIM HI)"[5]. Caregivers self-reported child challenging behaviors using the ECBI and the Social Skills Improvement System (SSIS). Cognitive functioning was assessed with the Differential Ability Scales (DAS-II) or Weschler Abbreviated Scale Intelligence (WASI-II) and co-occurring psychiatric conditions were assessed using an adapted version of the MINI parent intervention version. The sample (n=201) included 84% males, with a mean age of 9.12 (SD = 2.44). Approximately 80% of the children were from an ethnic minority background. Composites reflecting mean item scores for items on the *Dysregulatio*n and *Attention/Hyperactivity* factors were calculated. Cronbach's alpha values were computed to assess internal consistency of each scale. Convergent and divergent validity were assessed by examining the correlations between each scale and theoretically related and unrelated variables including the SSIS Problem Behavior scale and Full-Scale IQ. Discriminant function analyses were used to assess discriminative validity by examining the scales' ability to discriminate between diagnostic groups (ODD, ADHD, Mood, and Anxiety).

Results: Both *Dysregulation* and *Attention/Hyperactivity* demonstrated good internal consistency (a = .89 and .86, respectively). Strong convergent validity with the Problem Scale of the SSIS and its five corresponding subscales (r = .18 to .80, p < .001), as well as strong divergent validity with Full Scale IQ (r = -.03 to -.10, n.s.) were demonstrated. Good discriminant validity was demonstrated as well. Diagnostic groups differed on *Dysregulation* and *Attention/Hyperactivity* for ODD, ADHD, and Mood disorders, but not for Anxiety. Linear Discriminant Functions were significant with medium-to-large effect sizes for ODD and ADHD. For ODD, *Dysregulation* carried more of the weight (= .854) compared to *Attention/Hyperactivity* (= .249). For ADHD, *Attention/Hyperactivity* carried more of the weight (= .787) compared to *Dysregulation* (= .311).

Conclusions: Psychometric analyses of the ECBI in an ASD sample using the previously identified *Dysregulation* and *Attention/Hyperactivity* factors demonstrated good internal consistency, convergent/divergent validity, and discriminant validity. Next steps will include examining clinical factors (e.g. number of co-occurring diagnoses, ASD symptom severity) associated with these scores as well as the AIM HI intervention effects over time. Results may inform best practices for providers using the ECBI to assess challenging behaviors among community samples of children with ASD and co-occurring mental health conditions.

415.098 *(Poster)* Reliability and Criterion-Related Validity of the Asessment of Basic Language and Learning Skills-Revised

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Background: The *Assessment of Basic Language and Learning Skills–Revised* (ABLLS-R; Partington, 2010) is a comprehensive, observation-based, criterion-referenced assessment tool assessing skill attainment in basic behavior, language, social, self-care, and academic skills. The ABLLS-R has two primary uses: (a) specifying and quantifying critical domains of skill development (i.e., repertoires) associated with deficits in autism spectrum disorder (ASD) and/or intellectual disability (ID), and (b) Individualized Education Program (IEP) development, goal setting, and progress monitoring. Two prior studies examined aspects of ABLLS-R reliability and content validity (Partington, 2016; Usry, 2015). However, no study has examined relationships between ABLLS-R scores and scores from more traditional psychometric instruments intended to measure the same or similar constructs. Lack of such criterion-related validity evidence has limited its potential for wider use as an outcome measure in research and practice contexts.

Objectives: The objectives of the present study were to examine the internal consistency reliability and criterion-related validity of the ABLLS-R in a sample of students with ASD and/or ID.

Methods: Data were collected from a sample of 68 students with ASD and/or ID and substantial functional impairments between the ages of four and 12 years (M = 7.2, SD = 1.9). The sample was 72.1% male, 82.4% ASD (17.6% ID/non-ASD), with a mean IQ of 45.9 (SD = 15.3). Participants were evaluated with the ABLLS-R by either a special education teacher or staff psychologist. Correlations were generated between the ABLLS-R scores and scores from four external criterion measures (i.e., DAS-II [Elliott, 2007], PPVT-IV [Dunn & Dunn, 2007], EOWVT-4 [Martin & Brownell, 2011], and ABAS-II teacher ratings [Harrison & Oakland, 2003]) that were administered during the same time period. Cronbach's alpha internal consistency estimates were obtained for the ABLLS-R domains, while convergent and divergent relationships (i.e., Spearman's *rho* correlation coefficient comparisons) were examined between the ABLLS-R domains and scores from the criterion measures. Specific hypotheses were tested by examining theoretically convergent vs. divergent median correlation comparisons for statistical significance using the R-based cocor package (Diedenhofen & Musch, 2015). Only a limited number of targeted statistical comparisons were possible due to the limited sample size. However, all available descriptive correlations between the ABLLS-R and criterion instruments are reported.

Results: Internal consistency results across the 25 ABLLS-R domains ranged from .78 to .98 (Mdn = .92). Relationships between 23 of the 25 ABLLS-R domains, referred to as repertoires, and criterion measure scores were examined in groups of theoretically convergent vs. divergent coefficients. Median convergent coefficients ranged from .24 to .67 (Mdn = .47), while median divergent coefficients ranged from .15 to .46 (Mdn = .33). All correlations, correlation comparisons, and comparison effect size estimates will be reported.

Conclusions: The current study examined the reliability and criterion-related validity of the ABLLS-R, providing broad preliminary evidence of internal consistency, convergent validity, and divergent validity for several of its domains—either as a group or individually. Future research should investigate the ABLLS-R factor structure and provide targeted estimates of criterion-related validity, for specific domain scores, in larger samples.

415.099 *(Poster)* Ruling out ASD Is Easier Than Ruling It in, after a Brief Encounter with an at-Risk Toddler

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Background: Clinicians' initial diagnostic impressions of patients have significant implications for accurate final diagnoses of ASD (Hedley et al., 2016), yet the literature raises questions about the accuracy of clinician impressions of ASD compared to the final diagnosis (Gabrielson et al., 2014). Clinicians demonstrate increased confidence in their impressions when positively identifying ASD vs. ruling ASD out (McDonnell et al., 2018), but this has not been explored in terms of initial impressions, made after brief interactions with very young children.

Objectives: This study aimed to: 1) Explore clinicians' diagnostic impressions made within the first 5 minutes of meeting a toddler; 2) Investigate the relationship between accuracy and confidence in their initial impressions.

Methods: Participants were children (n=255, aged 12 to 53 months) referred for an ASD evaluation as part of multi-site studies screening toddlers for ASD during primary care check-ups (see Table 1 for sample demographics). Five minutes after the initial introduction, evaluating clinicians were asked to record if they believed the child would meet criteria for ASD or not following a complete evaluation, and how confident they were, on a scale of 1-5, regarding their initial classification. Each child was evaluated by one experienced senior clinician (psychologist who is research reliable on the ADOS-2), and one junior clinician (advanced trainee in a clinical discipline).

Results: There was substantial agreement between senior clinicians' initial impressions and final diagnosis (κ=.641, p<.001) and moderate agreement between junior clinicians' initial impressions and final diagnosis (κ=.531, p<.001). Clinicians' first impressions were highly consistent with the final diagnosis when the final diagnosis was not ASD (Senior clinician: 95.27%; Junior clinician: 93.02%). When the final diagnosis was ASD, senior clinicians more consistently reported impression of ASD (64.37%) compared to junior clinicians (58.14%). Clinicians' confidence in the accuracy of their impression was significantly higher for children not diagnosed with ASD, compared to children with final ASD diagnosis, both for senior clinicians (t(224)=6.00, p<.001) and junior clinicians (t(221)=4.49, p<.001). Clinicians' confidence was also significantly higher when their impression accurately matched the final diagnosis compared to when there was a mismatch between the impression and final diagnosis for senior (t(224)=-4.84, p <.001) as well as junior clinicians (t(201)=-7.34, p<.001).

Conclusions: Within the first 5 minutes of meeting a toddler at risk for ASD, clinicians' impressions of children's diagnoses often matched children's final diagnoses following a diagnostic assessment. The impressions were especially consistent with the final diagnoses for children who did not receive an ASD diagnosis, indicating that clinicians are generally able to rule out ASD in typically developing children and children with developmental disabilities within the first 5 minutes of the encounter. All clinicians indicated higher confidence when there was a match between their impression and final diagnosis, compared to mismatch, perhaps indicating their uncertainty. Lower concordance between the initial impression and the final diagnosis for toddlers with ASD indicate challenges to identifying symptoms of ASD in a brief, initial observation, and points to the importance of conducting a comprehensive evaluation.

415.100 *(Poster)* Screening for Autism Spectrum Disorder in Females with Polish Social Communication Questionnaire, SCQ – the Importance of Sex-Specific Formulated Questions for Parents/Caregivers

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Background: Sex/gender has a significant impact on the symptomatology of autism spectrum disorder (ASD) henceforth autism. ASD characteristics demonstrate in females in the distinctive ways from males with this disorder. Cultural and social aspects may also impact the autistic characteristics presented by autistic females. Symptoms of ASD present in the early developmental period in the majority of cases. However this condition can be diagnosed in adolescence or adulthood too. It is especially true for ASD females when social demand exceed limited capacities and learned strategies used to camouflage or mask the difficulties. The ASD standardised assessments to identify females with autism are still under-explored in Poland, as in other countries of Central and Eastern Europe. The researchers postulate that the screening assessments need sex-specific formulated questions for parents/caregivers.

Objectives: To investigate whether differences between Polish females and males with autism (ASD) exist based on the responses provided by Polish parents/caregivers to Polish *Social Communication Questionnaire, SCQ, "Lifetime"* and *"Current"* forms with main focus on variables within unusual interests and sensory abnormalities.

Methods: The study included 91 Polish participants, 30 females and 61 males with no intellectual disability, IQ average and above, with no profound communication difficulties. Study groups were divided based on age: children (3-11 y.o.), adolescents (12-17 y.o.) and adults (20-37 y.o.). Recruited participants were from Mental Health Services and Autism Clinics in Pomeranian, Carpathian and Wielkopolskie voivodeships in Poland. Co-occurring psychiatric conditions are extremely common among people with ASD thus patients (n=34) with any additional conditions e.g. anorexia nervosa, mutism, epilepsy, depression, schizophrenia, tic disorders and the others also qualified for this study. Parents provided information on the author-reviewed Polish research translation of SCQ - Current and Lifetime. The results were analyzed and compared between two sexes and the age groups.

Results: ASD boys presented more special, unusual interests than ASD girls while there was no difference in this area for both sexes for ASD adults. The intensity of these special interests however were significantly higher for adult males with autism than ASD females. No differences were found in the area of unusual sensory interests between ASD boys and girls and the results were equally significant in this area for this age group with autism. Sensory difficulties tended to decrease with age in ASD adult women.

Conclusions: Parents of ASD young girls may not report the special interests of their children in SCQ as the themes may not be viewed as unusual and traditionally linked to autism. The study raises questions about parent-report screening measures where the examples in questions are male-oriented e.g. maps, dinosaurs, timetables, traffic lights etc. Parents of females may be biased while completing such questionnaire with no supervision. Retrospective interview from parents of ASD adults can be burdened with a recall bias too. The results contribute to further understanding of ASD in females.

415.101 *(Poster)* Screening for Developmental Deceleration across Domains: A New Strategy for Early Autism Detection

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Background: Emerging research from high-risk cohorts suggests that many children later diagnosed with ASD show early *developmental deceleration* – or slowing of developmental progress – and that this pattern is sometimes evident before clear autism symptoms emerge. Research from our lab demonstrated that developmental deceleration can also be detected in a low-risk, general population sample using the Survey of Well-being of Young Children (SWYC), a broadband screening tool recommended by the American Academy of Pediatrics (AAP) to screen for developmental delays. While we found that a pattern of generalized developmental deceleration indicates a significantly elevated risk for ASD, it is not yet clear whether this pattern is present across all developmental domains or driven by any specific domain(s) (e.g., communication, motor).

Objectives: Determine whether early developmental deceleration is (1) observed in specific domains and (2) associated with elevated risk for ASD.

Methods: Children from ten Children's Hospital of Philadelphia (CHOP) primary care sites were administered the Ages and Stages Questionnaire–Third Edition (ASQ-3) at 9, 18, 24, and 30-month well-child visits, according to AAP guidelines. Children with at least one ASQ-3 who received care at CHOP through ≥4 years were included in this study (*N*=8,124). This cohort was racially (68.1% non-white) and socioeconomically (50.4% public insurance/Medicaid) diverse, and received an average of 1.5 of the three recommended developmental screenings. ASD prevalence was 3.1%.

Results: Growth mixture models (GMM) identified distinct developmental trajectories of ASQ-3 scores from 9-30 months, with separate models run for each of the five ASQ-3 domains. GMMs identified four Fine Motor classes, five Communication and Problem-Solving classes, and six Gross Motor and Social classes.

Final models for Communication, Social and Problem-Solving domains each identified one or two classes characterized by decreasing ASQ-3 scores from 9-30 months, which were associated with increased risk for ASD. For example, children with typical and borderline Communication skills at 9 months and a significant decrease from 9-30 months had an 11.4% and 25.0% risk of ASD respectively (compared to 3.1% rate in the entire cohort). Models also revealed that children with low scores at 9 months that were stable over time also had an elevated ASD risk (Gross Motor: 16.8%, 16.9%, Fine Motor: 19.4%, Social: 34.1%, Problem-Solving: 25.4%).

Conclusions: Children with developmental deceleration in social, communication, and problem-solving skills appear to be at elevated risk for ASD, suggesting that screening for trajectories in these domains may detect more at-risk children than screening at a single timepoint. In addition, deficits in any domain that emerge early and persist may also indicate ASD risk. Findings from the Social domain were of particular interest, as over a third of infants with clear deficits at 9 months that persisted were later diagnosed with ASD. While these developmental patterns were not perfectly predictive of ASD, the positive predictive values of developmental deceleration and early, persistent deficits were at or above those of autism-specific screening tools (Guthrie et al., 2019). Thus, repeated screenings with broadband developmental tools may be a fruitful avenue for earlier and more sensitive ASD detection.

415.102 *(Poster)* Self-Management of Daily Life Tasks for Adolescents with ASD without Intellectual Disability

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Background: Managing the tasks and responsibilities of daily life is a key feature of transition into adulthood. However, youth with autism spectrum disorder (ASD), including those without intellectual disability (ID), have poorer daily living skills compared to typically developing peers (Pugliese et al., 2014). Limitations in managing daily life tasks may contribute to the poor outcomes seen in this population (Roux et al., 2015). The Pediatric Evaluation of Disability Inventory – Computer Adaptive Test - ASD (PEDI-CAT-ASD): Responsibility Scale (Haley et al., 2012) targets this domain of function. The instrument operationalizes the shift in management of daily life tasks from caregivers to youth. Because the domain items require application of cognitive and social knowledge and skills, it may be especially useful to understand the challenges youth with ASD face in daily life.

Objectives: Our aim was to describe the transfer of responsibility in this population across a period of significant developmental change. We hypothesized that adolescents with ASD without ID would demonstrate below average levels of responsibility in comparison to typically developing peers.

Methods: This is a secondary analysis of PEDI-CAT-ASD data of adolescents (ages 14-22) with ASD without ID (n = 125). Part of the sample was from the PEDI-CAT-ASD development study and the remainder is from an ongoing study examining factors related to post-high school outcomes for youth with ASD. Parents completed the Responsibility domain reporting on their youth's level of responsibility for daily life tasks. We examined the distribution of norm-referenced scores and Fit scores to describe our sample.

Results: The PEDI-CAT-ASD is sensitive to the range of variation seen in this population. Overall, youth performed below expected levels based on their intellectual level. T-scores for the sample ranged from <10-51, (50 is average for age). 46% of the sample fell in the significantly delayed range (T-score ≤30). An additional 40% of youth were in the borderline delayed range. Notably, 61% of youth age 18 and older were significantly delayed, compared to 38% ages 14-17, indicating that as youth grow older and expectations for responsibility increase, the discrepancy in performance compared to peers widens. The PEDI-CAT-ASD item maps identify the areas where youth are having difficulty. For example, an 18 year old with a T-score of 30 is not yet taking full responsibility in many common life tasks, including planning and following a weekly schedule or informing school or work when absent.

Conclusions: Inability to manage daily responsibilities may impact an individual's success in adulthood. The findings from the PEDI-CAT-ASD are consistent with other literature and provide detailed and precise information about the daily life tasks in which youth show difficulty. In comparison to traditional assessments (e.g. VABS-III), PEDI-CAT-ASD captures an individual's ability to coordinate multiple functional skills to carry out tasks in their daily lives. The findings demonstrate that many youth with ASD without ID demonstrate significant delays in taking over management of daily life tasks. If this challenge is not addressed, it may create significant barriers to success in work and independent living post-high school.

415.103 *(Poster)* Self-Reported Executive Functioning Challenges in Autistic Youth Compared to Attention Deficit/Hyperactivity Disorder Youth

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Background: Previous research suggests that self-report in a variety of clinical conditions enhances assessment of internal states (Verhulst & van der Ende, 1992; Robins, Fraley and Kruger, 2009, Keith et al., 2019; Barkley et al., 1991). Parent report on autistic youth indicates global executive functioning (EF) problems, with peak deficits in flexibility and metacognition (Granader et al., 2014; Wallace et al., 2016). In spite of the importance of gauging inner experiences, self-reported EF challenges in ASD have yet to be fully investigated. We previously reported (Clinton et al., 2019) that parent-report and self-report from autistic youth show similar peak problems with flexibility and metacognitive issues. Autistic youth report a lower overall level of EF problems than their parents report, however. ADHD represents another developmental disability that is associated with significant EF problems (e.g., Gioia et al., 2002).

Objectives: Investigate whether autistic youth report an equivalent level of EF problems as youth with ADHD report on the BRIEF-2, and if the pattern of problems the two groups report are distinctive.

Methods: BRIEF-2 self-report data were compared between a sample of 203 autistic youth (148 male, 55 female, ages 11–18 years, *M* FSIQ=97.6, *SD*=18.9) and a sample of 109 ADHD youth without comorbid medical diagnoses (62 male, 45 female, ages 11-18.0 years, *M* FSIQ=94.5, *SD*=13.3) using repeated measures ANOVA. Follow-up independent samples t-tests were used to compare differences in peak EF problems between groups, corrected for multiple comparisons using the Bonferroni method.

Results: A main effect of diagnosis on BRIEF subdomain scores (F=4.26, p=.04) suggests that autistic youth reported significantly greater EF problems than did ADHD youth. Examination of subscales indicated autistic youth reported greater problems on the Self-Monitor (p<.001), Emotional Control (p=.001) and Shift (p<.001) subscales, than the ADHD youth. Both ASD and ADHD youth reported elevated and equivalent levels of problems on the Metacognition Indices, including subscales of Working Memory, Task Completion, Planning and Organizing, and Inhibition.

Conclusions: Autistic youth report overall greater EF problems than ADHD youth, and specifically greater problems with self-monitoring, emotional control, and flexibility on the BRIEF-2. Both groups report similar difficulties with inhibitory control and metacognition. These self-report findings indicate that autistic youth report significant levels of EF problems, even when compared to youth with ADHD; moreover, their profile is distinctive and consistent with parent and clinician observed patterns of EF weaknesses in ASD. These findings highlight the importance of utilizing self-report from autistic youth to better understand their EF profiles and inform intervention.

415.104 *(Poster)* Sensory Reactivity in a Sample of 12-Month-Old Siblings of Children with ASD: Factor Structure of the Sensory Experiences Questionnaire

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Background: Studies suggest that 70-90% of children with, or at high risk for, autism spectrum disorder (ASD) display atypical sensory reactivity, including hyporeactivity, hyperreactivity, and/or sensory seeking behaviors. The Sensory Experiences Questionnaire (SEQ) Version 2.1 is a 43-item parent-report measure of sensory reactivity appropriate for children as young as 5 months. Although frequently used to characterize sensory symptoms for at risk children, to date, there has been limited factor analytic research exploring the theorized factor structure of the scale, and none for populations limited to infants.

Objectives: 1) To conduct confirmatory (CFA) and exploratory (EFA) factor analyses of the SEQ Version 2.1 using data from a sample of 12-month-old children to evaluate whether the theorized factors are supported in this sample, and 2) to determine whether the factor structure of the scale is consistent across different ASD risk and diagnostic groups.

Methods: Children were participating in the Infant Brain Imaging Study (IBIS)—a prospective, longitudinal study of infants with either high or low familial risk of developing ASD, denoted by either the presence or absence of a first degree relative with ASD, respectively. Parents completed the SEQ Version 2.1 for their child at 12 months of age. ASD diagnostic evaluations were subsequently conducted at 24 or 36 months, yielding three groups: low risk without an ASD diagnosis (LR-Neg; n=122), high risk without an ASD diagnosis (HR-Neg; n=242), and high risk with an ASD diagnosis (ASD; n=72). Factor analyses were conducted using M*plus*8. CFA was used to fit the theorized 3 factor latent variable model and an EFA with 1, 2, 3, 4, 5, and 6 factor model solutions was tested using geomin rotation. In both models each analysis was stratified by risk-diagnosis group and all indicators were treated as categorical.

Results: CFA results for the posited three factor model resulted in poor to marginal model fit for the three groups (CFIs from .59-.84). EFA results identified non-social-sensory seeking and non-social-hyperreactive factors for all three groups. A third factor, social-hyporeactive was identified for the ASD group ($M\beta$ = .61) and HR-Neg group ($M\beta$ = .66), but not for the LR-neg group ($M\beta$ = .34). See Figure 1.

Conclusions: Characterizing the features of sensorimotor behaviors for both low and high-risk infants is essential to a fuller understanding and early diagnosis of ASD. Examining the factor structure of the SEQ may help identify specific sensory profiles in subgroups of children, both in terms of age and ASD risk. Such profiles can be used to further our understanding of ASD phenotypes in early development. Future research would benefit from examining whether and how the factor structure of the SEQ evolves over the course of the developmental lifespan and how the nature of SEQ symptoms may predict long-term outcomes for children with ASD.

415.105 *(Poster)* Sex Differences in Autism Phenotype and Adaptive Functioning: Does Intellectual Disability Play a Role?

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Background: Although 30-50% of individuals with Autism Spectrum Disorder (ASD) also have an intellectual disability (ID) (CDC, 2018; Charman et al., 2011), most individuals who have co-occurring ASD and ID are excluded from research (Russell et al., 2019). Recent studies have indicated sex differences in the behavioral phenotype of girls with ASD (for review, see Lawson, 2019). However, many of these studies excluded individuals with co-occurring ID, or did not include a representative sample.

Objectives: The aim of this study was to examine sex differences in ASD presentation and adaptive functioning in children with and without ID. Considering previous literature, we hypothesized that there would be main effects of sex differences in specific autism symptom domains and adaptive functioning. We also hypothesized that the sex differences would be larger in those without ID, resulting in an interaction effect between sex and ID.

Methods: The sample included 606 children (123 female, 483 male, mean age: 9.69 y.o.) diagnosed with ASD, who were enrolled in the Autism Treatment Network Registry Call-Back Study. We examined autism phenotype characteristics using the Autism Impact Measure (AIM) and its five domains: Repetitive Behavior, Communication, Atypical Behavior, Social Reciprocity, and Peer Interaction (Mazurek et al., 2018). Adaptive functioning was examined using the Vineland Adaptive Behavior Scales, Second Edition (Vineland-II) domains: Communication, Daily Living Skills (DLS), and Socialization (Sparrow et al. 2005). Analyses of the outcomes were evaluated using a Factorial ANOVA to compare the main effects of gender, ID, and the interaction of gender and ID.

Results: Male and female participants were not statistically different in age. Results indicated a main effect of ID on the AIM Repetitive Behavior, Communication, Social Reciprocity, and Peer Interaction domains, but not on the AIM Atypical Behavior scale or the AIM total score. Gender was not a significant predictor of either the total score or any subdomain, and none of the interactions of gender and ID were significant (AIM total: Total: $F(1,454) = 0.63$, $p = .43$, Repetitive Behavior: $F(1,476) = 0.20$, $p = .65$; Communication: $F(1,471) = 0.002$, $p = .97$; Atypical Behavior: $F(1,472) = 0.10$, $p = .74$); Social Reciprocity: $F(1,471) = 2.03$, $p = .15$; Peer Interaction: $F(1,474) = 1.29$, $p = .26$). On the Vineland-II, all of the subdomains showed significant main effect of ID, but not any main effects of gender, or the interaction between gender and ID (Communication: $F(1,499) = 1.81$, $p = .18$; DLS: $F(1,499) = 0.76$, $p = .38$; Socialization: $F(1,499) = 1.38$, $p = .24$).

Conclusions: Contrary to previous literature and our hypotheses, we did not find sex differences in specific types of ASD symptoms or adaptive functioning. There were also no statistically significant interaction effects between sex and ID with any of the outcomes. It is essential to further examine evidence of sex differences in ASD and to ensure the inclusion of individuals with ID.

415.106 *(Poster)* Sex Differences in Toddler ASD Screening

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Background: Sex differences in the diagnostic rate of autism spectrum disorder (ASD) remain one of the most consistent findings in the literature (e.g. Wing, 1981, Fombonne, 2009). Despite these unequivocal findings, few studies have examined whether sex differences are also apparent in screening and diagnosis early in life. Previous work in toddlers with ASD have found few or no apparent sex differences in symptom presentation (Lawson, Joshi, Barbaro, & Dissanayake, 2018; Reinhardt, Wetherby, Schatschneider, & Lord, 2015), highlighting a critical period to examine sex differences in screening results. This study explores whether screening tools are identifying males and females with ASD at similar rates for potential downstream implications of receiving early intervention.

Objectives: This study aimed to explore sex differences in toddlers screened for ASD in: 1) Risk levels in initial screening for ASD using the Modified Checklist for Autism in Toddlers, Revised (M-CHAT-R); 2) M-CHAT-R Follow-Up (M-CHAT-R/F) scores, warranting evaluation; and 3) M-CHAT-R/F psychometric properties.

Methods: Data from multiple screening studies were aggregated to maximize statistical power. Across all studies, toddlers (N=18701; males=9594, females=9107) were screened for ASD during primary care check-ups at community pediatric providers (M=20.62 months, SD =3.16) using the M-CHAT-R/F (Robins, Fein, & Barton, 2009). Of these children, 400 attended an autism evaluation (M=24.86 months, SD=6.24) from a positive screen or provider referral.

Results: The proportion of males and females screened who scored in the low, medium, and high risk range on the M-CHAT-R significantly differed (X^2 (2, n=18,701) = 57.43, $p < .001$); females were less likely to score in medium or high risk groups (Table 1). Females also were less likely than males to screen positive on the structured Follow-Up, and therefore were invited in for evaluations at a lower rate (33.9% vs. 40.4%; (X^2 (1, n = 1038) = 4.55, p =.03; Table 1). Positive predictive value (PPV) was significantly lower for females than males (.386 vs .586; X^2 (1, n = 329) = 11.94, p =.001), but negative predictive value was higher for females than males (.999 vs. .997; X^2 (1, n=17,616) = 7.09, p=.008). No significant sex differences emerged for sensitivity (X^2 (1, n = 204) = .005, p =.943) or specificity (X^2 (1, n=17,741) = 1.77, p =.183) of the M-CHAT-R/F (Table 2).

Conclusions: Sex differences are evident starting from the first stages of identification in toddlers whose parents complete standardized screening at check-ups. Females were more likely to score at low risk for ASD, and were subsequently less likely to be invited for an evaluation than males. The M-CHAT-R/F detected ASD and nonASD in males and females equally (i.e., sensitivity and specificity), highlighting a strength of the tool. However, screen positive females were less likely to be diagnosed with ASD than males (i.e., PPV), which may reduce confidence that a positive screen in a female warrants referrals for evaluation and intervention. Future studies should examine whether items in the M-CHAT-R/F should be weighted differently or removed from scoring to improve the confidence in a positive screen result in females.

415.107 *(Poster)* Sex and Chronological Age in Relation to Sensory Processing in ASD

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Background: Current estimates suggest that the ratio of boys to girls with autism spectrum disorder (ASD) diagnoses is approximately 4:1. Sex differences have also been reported in levels of symptomatology, with girls on average exhibiting more severe symptoms than boys. Few studies, however, have explored sex differences in the presentation of sensory processing issues in ASD, a very common issue that has been recently included as a diagnostic criterion. We aim to address the question of whether there are sex differences in sensory processing issues in ASD across development.

Objectives: This project explores the differences in sensory processing between autistic girls and boys across development from early childhood to early adulthood. We expect to see greater issues across all sensory processing domains in girls relative to boys, in line with sex differences observed in other symptomatology. We also expect to see improvements in sensory processing issues as age increases. Finally, we predict a sex*age interaction such that autistic girls exhibit fewer improvements in sensory processing throughout development when compared to autistic boys.

Methods: Parents of 339 participants from the Province of Ontario Neurodevelopmental Disorder Network (Girls=72, Boys=267, Age range=2-22, Mean age=10.24) completed a questionnaire on sensory processing, the Short Sensory Profile (SSP). Sex differences in sensory processing were initially assessed using t-tests for each SSP subscale, while initial age-related changes were assessed using correlations between sensory processing and age. The primary analysis consisted of linear regressions predicting each sensory processing subscale based on sex, age, and the interaction term between sex and age.

Results: Significant sex differences were found specifically in *Underresponsive/Sensory Seeking* in which girls displayed more severe symptoms (see Table for all regression statistics). Developmental changes were observed in the symptom severity of *Underresponsive/Sensory Seeking*, which became more severe with age, as well as of *Low Energy/Weak*, which became less severe with age. Non-significant sex*age interaction terms indicate similar developmental trajectories for boys and girls.

Conclusions: Sex differences were observed in sensory processing patterns but were restricted to *Underresponsive/Sensory Seeking* and as expected, girls were found to have more severe symptoms. Given the prominent sex difference across other symptom domains within ASD, we were surprised ubiquitous and larger effects were not observed throughout the sensory processing symptoms. Regardless of sex, there were opposing age-related changes in sensory processing, with *Low Energy/Weak* improving with age as expected, but with, *Underresponsive/Sensory Seeking* tending to increase in severity with age.

415.108 *(Poster)* Sex/Gender Modulates the Relationship between Social Communication and Motor Skills in Autism Spectrum Disorder

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Background: Although not included in the diagnostic criteria, autism spectrum disorder (ASD) is significantly associated with extensive alterations in motor performance, with a noteworthy effect size of 1.20 (Fournier et al., 2010). These difficulties generally occur in the first years of life (Bhat et al., 2012) and may even precede the socio-communicative deficits (Sacrey et al., 2018). They also tend to increase with age (Freitag et al., 2007) and to impact individuals' adaptive functioning and life quality (Bremer and Lloyd, 2016). Despite the reported sex/gender bias in the prevalence of the disorder, the impact of sex/gender differences on ASD-related motor abnormalities remains often overlooked. Examining clinical manifestations and motor profiles, as well as their interaction in boys and girls with ASD, may have significant implications for the development of adequate assessment and treatment strategies for patients with ASD.

Objectives: To explore possible differences in the motor profile of boys and girls with ASD using standardized neuropsychological tests and kinematic analysis of a simple upper limb movement. To examine how clinical symptoms and motor skills are interrelated in each sex.

Methods: One hundred ten children with ASD (89 boys, 21 girls), ages 2 through 11 years, and 98 typically developing (TD) children (72 boys, 26 girls) matched by age participated to the study. We assessed motor proficiency using the Movement Assessment Battery for Children—2, the Beery-Buktenica Developmental Test of Visual-Motor Integration and an abbreviated battery of tests from NEPSY-II. In addition, 3D kinematic data of a reach-to-drop movement were collected by a motion-capture system. Lastly, parents filled the Developmental Coordination Disorder Questionnaire and the Social Responsiveness Scale. Data were analyzed using a 2x2 analysis of covariance (independent factors: sex/gender, diagnosis; covariate: IQ). Moreover, Pearson's correlations were computed between the severity of ASD symptom measures and motor functioning.

Results: As expected, children with ASD (both boys and girls) performed significantly worse than TD group in almost all motor abilities investigated. We observed a significant sex/gender by diagnosis interaction for the NEPSY-II imitating hand positions sub test and for kinematic features related to movement planning, with girls with ASD obtaining better performances than boys. Lastly, a significant positive correlation between motor coordination and socio-communicative abilities was observed for all TD children and in boys with ASD, but not in girls with ASD.

Conclusions: The present study adds to a growing body of evidence documenting sex/gender differences in children with ASD. Our findings suggested that sex/gender might play a significant role for specific motor domain in ASD, such as imitation of hand postures and movement planning. Furthermore, this study provides intriguing evidence that sex/gender could modulate the relationship between social communication and motor skills. Overall, the present findings highlighted the need for more sex/gender specific diagnostic and intervention strategies in ASD.

415.109 *(Poster)* Similarities and Differences in Executive Functioning Profiles of ASD and ADHD

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Background: Many children with autism spectrum disorders (ASD) and attention deficit hyperactivity disorder (ADHD) have executive functioning (EF) impairments (Demetriou et al., 2017; Pennington & Ozonoff, 1996). Studies comparing EF profiles across diagnoses have mixed results. A recent review indicated ASD children had greater deficits in flexibility and planning while ADHD children demonstrated greater deficits in response inhibition (Craig et al., 2016). In contrast, other findings suggest that response inhibition, working memory, and flexibility are more impaired in ASD and that there are no differences in planning (Corbett et al., 2010; Simrud-Clikeman et al., 2010). Understanding similarities and differences in EF across diagnoses can inform research and practice by identifying common underlying factors as well as differentiating factors that may be unique to autism. If profiles are similar, interventions targeted at teaching specific EF skills in ADHD could be modified for ASD, and vice versa.

Objectives: To compare EF domains between children with ASD and children with ADHD in a clinic-referred sample using the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000).

Methods: The BRIEF parent form was completed for 20 children with ADHD (5-15 years; 17 males, 3 females) and 36 children with ASD (5-18 years; 26 males, 10 females) in a community clinic. All children also completed the Stanford Binet Intelligence Scales 5th Edition (Roid & Pomplun, 2012).

Results: Children with ASD had significantly elevated scores on the BRIEF Initiate domain (M = 72.28, SD = 10.06) compared to children with ADHD (M = 65.4, SD = 11.97), and the Plan/Organize domain (ASD: M = 72.44, SD = 13.47; ADHD: M = 63.65, SD = 14) ($p < .05$). Groups did not differ on Inhibit, Shift, Emotional Control, Working Memory, Organization of Materials, Monitoring, Behavior Regulation, Metacognition, and Global domains. Children with ASD were older (M = 11.42, SD = 4.25) than ADHD children (M = 7.65, SD = 3.3) ($p < .05$). Groups did not differ by gender or IQ.

Conclusions: Our results indicate that children with ASD have more difficulty initiating tasks, planning, and organizing than children with ADHD. These results support findings that planning is particularly impaired in ASD (Craig et al., 2016; Bramham et al., 2009) and also suggest initiating tasks is particularly difficult in ASD. Given the age difference between groups, it is possible that these relative deficits emerge at a later age and therefore weren't seen within the ADHD group. ASD and ADHD share many similarities in their EF abilities, suggesting that EF deficits in domains of inhibiting, shifting, working memory, material organization, and monitoring may not be diagnosis-specific. Interventions targeting these skills could be applicable to both populations. Future directions may involve investigating EF similarities and differences in children with comorbid ASD and ADHD as well as exploring cognitive mechanisms specific to ASD that contribute to deficits in initiating and planning/organizing. Collection of the BRIEF 2nd edition is ongoing and future aims include exploring EF profiles using the updated measure and comparison to the current findings.

415.110 *(Poster)* Social-Communication Subgroups in ASD: Individual Differences in Peer Interactions

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Background: While individuals with ASD are characterized by impaired social communication skills and repetitive patterns of behavior, interests and activities, they are diverse in their symptom manifestations and severity) Eldevik, Hastings, Jahr, & Hughes, 2012; Hayward, Eikeseth, Gale, & Morgan, 2009(. These deficits are more noticeable during peer interaction, as opposed to interactions with adults. But individual differences in peer-engagement and the heterogeneity in high-functioning ASD (HFASD; IQ > 75) are not yet well explored. Thus information gathered via direct observation is critical for comprehensively assessing these children's social-interactive skills.

Objectives: The current study set out to examine the contribution of IQ, adaptive skills, and social impairment to the explanation of individual differences in the social-communication profile of preschoolers with HFASD during peer engagement. We also explored the classification of within social-communicative subgroups via peer interaction.

Methods: Fifty pre-schoolers, aged 3-6 years, with HFASD participated in the study. Our measures included the "Autism Peer Interaction Observation"-APIOS (Shefer & Bauminger-Zviely, 2016). The APIOS is comprised of a 3-hour observational procedure assessing pre-schoolers' social-communication abilities during spontaneous peer interactions spanning various preschool activities (e.g., indoor and outdoor free play, mealtime). The APIOS includes 9 categories and 17 subcategories for adaptive social functioning (e.g., nonverbal communication, functional and complex social behaviors, prosocial behaviors, social and imaginary play, conversation) rated by the observer along a 4-point scale from 1 (typical) to 4 (very atypical). To evaluate adaptive skills and social capabilities, the Vineland and SRS-2 were completed by teacher reports. To assess cognitive functioning and symptoms severity, the Mullen and the ADOS-2 were used.

Results: All children were HFASD, yet they showed different abilities in peer interaction**.** Children with HFASD were classified into three subgroups (see Figure 1): children who showed a severe social –communication deficit on APIOS behaviors (n=12); children who showed a mild social-communication deficit (n=11); and children who showed a mixed profile that reflected mild difficulties in most APIOS social-communication categories, with a moderate to severe deficit in pro-social behavior and imaginary play (n=27). The subgroup with the most severe social –communication deficit on APIOS behaviors also had lower general IQ and verbal IQ scores than the subgroup with mild social communication deficit. Furthermore, the severe subgroup's non-verbal IQ was lower than average range. All three subgroups showed below average social functioning on the VABS-II social skills, though the mixed subgroup had better social functioning in comparison to the severe subgroup. More impaired social symptoms were also seen for the severe subgroup in comparison to the mild subgroup on the Social Affect and Interaction variable of the SRS-2.

Conclusions: Significant subgroup differences (severe/mild APIOS profile) within HFASD were found on IQ scores, social and communication skills on the VABS-II and the SRS-2, with the mild subgroup outperforming the severe subgroup. This value is important in order to better identify targets of intervention.

415.111 *(Poster)* Sources of Distress: A Behavior Focused Assessment of Psychiatric and Medical Conditions in Individuals with ASD

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Background: Individuals with autism spectrum disorders (ASD) who have low verbal ability regularly have difficulty communicating their sources of distress, discomfort or frustration. Often times these individuals communicate their needs indirectly through irritability and problem behavior. These behaviors can create a substantial barrier in their capacity to access appropriate medical care, participate in their community, and maintain residence with their parents or other caregivers. To address the needs of this population, medical providers must develop facility in translating observable behaviors to appropriate treatment protocols.

Objectives: The primary objective of the current project is to convert parent and caregiver social capital (e.g. resources and knowledge) into improved health outcomes for adolescents and adults with ASD or other developmental disabilities. In addition, this project seeks to improve medical provider efficiency via a carefully designed and sequenced delivery of questions that focus on known behaviors associated with specific psychiatric and medical conditions in this population.

Methods: The current study will evaluate results from a parent/caregiver assessment. This assessment examined participant's reasons for seeking medical treatment, present medication use, and mental health diagnosis history. The assessment targets several psychiatric and medical/physical conditions known to contribute to distress or maladaptive behaviors in individuals with non-verbal or limited verbal abilities. Psychiatric conditions targeted in the measure include Depression, Self-Injurious Behavior (SIB), Anxiety, Mania, and Psychosis. Medical/physical conditions include Sleep, Gastrointestinal (GI), Sensory, and Dental. Descriptive statistics are reported. In addition, results were disaggregated by sex and evaluated for statistical significance using the Mann-Whitney U test.

Results: The current study reports on descriptive data from parent/caregiver assessment results in a sample of 38 (male=28, Female=10) individuals with ASD or other developmental disorders. The average age was 21.4 year (SD=12.89). In this sample, study participants sought help for a variety of concerns with agitation, aggression and moodiness as most prominent (See Table 1). Results showed that use of Antidepressant and Antipsychotic medication was high in this sample (both at 65.8%) and previous diagnosis of bipolar disorder was lower in females (10.0%) than males (17.9%). Data for each of the assessed conditions are reported in Table 2. With respect to psychiatric conditions identified in the current sample, high occurrences of depression (81.7%) and anxiety (94.7%) were present. In contrast, lower levels of psychosis (28.9%) were found relative to other conditions assessed. The current study found high levels of Sleep (60.5%) and GI (76.3%) concerns. The study also found relatively high levels of Dental (28.9%) concerns. Dental concerns are particularly noteworthy given that these are not routinely explored in psychiatric visits.

Conclusions: The current project documents initial results of a measure designed to support medical providers in caring for minimally verbal adolescents and adults with ASD or developmental disorders. These findings highlight the need to assess a variety of psychiatric and medical/physical conditions in medical visits. Given the current reliance on anti-psychotic medications for treating agitation and aggression in the population, the current findings underscore the need to appropriately assess the individual to properly plan medical treatment.

415.112 *(Poster)* Speech Characteristics of Young Children with ASD

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Background: Social communication difficulties may be apparent in speech recordings of children with ASD. Previous manual and automated analyses of speech recordings from children with ASD have revealed a variety of abnormalities in both prosodic features of speech such as pitch and energy, and in features of conversation structure such as the length of speech segments and the number of responses. For example, children with ASD have been reported to exhibit excessive pitch variability, which may be related to excessive neural variability that has also been reported in ASD. Here we used signal processing techniques to analyze recordings of speech from ADOS assessments that were part of the initial ASD diagnosis. We quantified several prosodic and structure characteristics in individual children and examined their relationship with ASD severity.

Objectives: To quantify speech abnormalities in 2-7-year-old children from recordings of their initial ADOS assessments and determine their relationship to ASD severity.

Methods: Audio recordings of 65 children with ASD (57boys), 2-7-years-old, were extracted from ADOS assessments that were performed at the National Autism Research Center of Israel (www.autismisrael.org). The recordings were manually annotated to identify segments of the child's speech and the clinician's speech during the ADOS assessment. Vocal islands of the child's speech were then identified by their energy and a variety of prosodic features including pitch, energy, jitter, formants, and spectral slope were calculated in 40ms windows within each of the vocal islands. The mean and variance of each feature was computed across the vocal islands of each child. In addition, we quantified the total number of speech segments, their average length, and the number of segments where the child responded to the clinician. Each of the measures were correlated with individual ADOS scores.

Results: Significant negative correlations were found between the social affect scores of the ADOS assessment and measures of speech structure including the total number of vocal islands (r=-0.37, p=0.002), their rate (r=-0.39, p=0.001), and the number of responses (r=-0.41, p<0.001). Significant positive correlations were found between the repetitive and restricted behavior scores of the ADOS and the magnitude of energy variability (r=0.27, p=0.027), mean pitch (r=0.28, p=0.026), and pitch variability (r=0.36, p=0.004).

Conclusions: These results demonstrate that recordings of the child's interaction with the clinician during the initial ADOS assessment hold important information regarding the children's ASD severity that can be extracted using speech processing techniques. Furthermore, specific features are associated with specific symptoms domains as demonstrated by selective correlations with either social or repetitive and restricted behaviors scores. These results highlight the potential clinical utility of speech analysis for estimating ASD symptom severity at very young ages.

415.113 *(Poster)* Stability of the Mullen Scales of Early Learning As a Clinical Outcome Assessment for Clinical Trials in Phelan-Mcdermid Syndrome

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Background: Phelan-McDermid Syndrome (PMS) represents a common single-gene cause of autism spectrum disorder (ASD) and intellectual disability (ID), making the cognitive domain a critical target for treatment. Clinical trials in PMS are hindered by limited knowledge about the stability of cognitive assessments in the absence of treatment changes during typical clinical trial periods.

Objectives: To investigate the stability of the Mullen Scales of Early Learning (MSEL) over a 12-week interval in children with PMS compared to children with idiopathic ASD (iASD) and ID. Greater variability is expected in the more heterogeneous iASD group.

Methods: Eleven children with PMS (6 females, m= 6.8 years) and 11 children with iASD and ID (2 females, m= 6.4 years) between the ages of 2-12, were evaluated using the MSEL at baseline and week 12. Data was collected as part of a larger study examining the stability of a battery of clinical outcome assessments (COAs). The MSEL measures early cognitive development across five scales: Visual Reception, Receptive Language, Expressive Language, Fine Motor, and Gross Motor. The MSEL is validated in children from birth to 68 months, and is commonly used in older children with ID. Intraclass Correlation Coefficients (ICCs) were calculated to examine absolute agreement in raw scores between baseline and week 12 for each MSEL scale.

Results: In the PMS group, ICCs were significant (p's <.001) for all scales except the Gross Motor scale (p=.057). ICCs for individual scales were as follows: Visual Reception ICC = .99 (95% Confidence Interval (CI) [.94, 1.00]), Receptive Language ICC =.97 (95% CI [.89, .99]), Expressive Language ICC = 1.00 (95% CI [.99, .1.00]), Fine Motor ICC = .99 (95% CI [.97, 1.00]), and Gross Motor ICC=.65 (95% CI [-.24, .90]).

In the iASD group, ICCs were significant for all scales (p's = .025 (Gross Motor) - <.001). ICCs for individual scales were as follows: Visual Reception ICC = .93 (95% CI [.77, .98]), Receptive Language ICC =.85 (95% CI [.47, .96]), Expressive Language ICC = .91 (95% CI [.65, .98]), Fine Motor ICC = .86 (95% CI [.47, .96]), and Gross Motor (n=7) ICC=.82 (95% CI [.11, .97]).

Conclusions: The MSEL is highly stable over a 12-week interval in individuals with PMS. Greater variability was observed in an iASD group reflecting gains made during the study period. In both groups, results indicated that the Visual Reception scale, a proxy of nonverbal cognitive functioning, is highly stable. The Expressive Language scale showed the greatest stability in the PMS group, although not in the iASD group as evidenced by a large CI. Gross motor skills were most variable for both groups. Overall, results suggest improvement in MSEL scores in the context of PMS clinical trials may be considered a meaningful indicator of treatment response. Data collection is ongoing to further examine the stability of the MSEL and other COAs in larger samples.

415.114 *(Poster)* Stigma As a Moderator for the Relation between Race and ASD Diagnoses

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Background: Past research has indicated that minority racial and ethnic groups in the United States face more barriers to accurate and timely autism spectrum disorder (ASD) diagnoses than their white counterparts (Mandel et.al., 2009). Research attributes this finding to cultural factors, different presentation of symptoms in minority children, and high stigmatization in minority communities of developmental delays and disorders (Mandel et.al., 2009).

Objectives: This research project is designed to determine if stigma moderates the relation between race and the time lapse between symptom onset and ASD diagnosis.

Methods: Data were collected from 152 parents of children with an ASD diagnosis. Parents were asked to report at what age their child began showing signs of ASD and what age the child was officially diagnosed with ASD. The age reported was converted to months if the parent reported in years, then a new variable was added by subtracting the age in months at time of symptom onset from age in months at time of diagnosis. Parents also completed a demographic questionnaire, including the child's race which was dichotomized as white and non-white. Finally, parents completed the Affiliate Stigma Scale which measured their own affective, behavioral, and cognitive stigma. The Total Stigma Scale score was used, with higher scores representing more stigma.

Results: An independent samples t-test indicated that the time lapse between symptom onset and diagnosis did not significantly differ between white and non-white participants. Furthermore, the time lapse between symptom onset and diagnosis did not significantly relate to the Total Stigma Scale score. However, a moderated multiple regression analysis indicated that the stigma score moderated the relation between race and the time lapse between symptom onset and diagnosis when comparing white participants (n = 123, M = 21.63, SD = 17.36) to non-white participants (n = 29, M = 17.66, SD = 18.86) p = .02. A post-hoc plot was conducted to examine the nature of the interaction (Figure 1), discussed further below.

Conclusions: These data suggest that race and stigma do play a significant role in how long it takes a child to receive an ASD diagnosis, but the findings are counterintuitive. Although neither race nor stigma individually related to the time lapse between symptom onset and diagnosis, their interaction was significant. Unexpectedly parents of minority children who reported experiencing higher levels of stigma also reported the shortest time lapse between symptom onset and diagnosis. Potential explanations for this finding could be over-pathologizing minority children's behaviors or possibly lower socioeconomic status providing access to free early intervention for minority children, either of which may have led to earlier diagnosis. Further research in this area is warranted to establish if this finding is replicated and to determine what may contribute to these varying outcomes.

415.115 *(Poster)* Study on Sensory Hypersensitivity in 5-Year-Olds with or Suspected of ASD Characteristics -Based on a Study Group of Parents and Childcare Workers Aiming for Reasonable Accommodation at School-

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Background: Research is being conducted on the relationship between infants' ASD characteristics and sensory hypersensitivity(Bromley,et al.2004). In recent years, Japan has begun to consider support tailored to sensory hypersensitivity. However, how to share information about how to use ASD characteristics and hypersensitivity for reasonable accommodation at school is still insufficient.

Objectives: The purpose of this study is to examine the ideal way of support aimed at reasonable accommodation at school for ASD characteristics and sensory hypersensitivity of a 5-year-old child.

Methods: We conducted a survey of infants' sensory hypersensitivity perceived by parents and childcare workers, and shared information between parents and childcare workers. The Japanese version of the SP Sensory Profile was used as an evaluation tool for sensory hypersensitivity. Next, we held a study meeting with parents and childcare workers who were in charge of each child how parents would tell school teachers about their children's sensory hypersensitivity when they at school. The subjects of the survey were four parents of five-year-old children attending kindergarten and two childcare workers in charge of the infants. This research has been approved by the Research Ethics Committee of Meisei University. There are no conflicts of interest in this study.

Results: The ratings of 4 parents and 2 childcare workers differed (Figure 1). We realized that infants appear differently in group life and at home as sensitive. Next, parents examined how to communicate to school teachers at the time of enrollment, and they gave consideration to obtaining photos inside and outside the school in advance as a measure of sensitivity to visual information. In addition to clarifying who can be relied upon when in trouble, we also examined how to rely on those who can be relied on for young children. Through these considerations, parents were able to obtain a method that would prevent their children from becoming anxious when transitioning to school. This effort has also helped parents feel safe.

Conclusions: The reasons why parents and childcare workers are differently evaluated are the individual factors of individual subjects and environmental factors such as homes and gardens. (Sasaki, et al. 2019). This time, there were differences in the results of parents and childcare workers in all four cases. As an environmental factor, it was speculated that the appearance of infants in the homes and the gardens are different. For this reason, it is speculated that when parents communicated only the appearance of infants in their homes to school teachers, it is difficult for teachers at school to know what to show in group life. In addition, we found it important to convey information about sensory hypersensitivity to teachers when transitioning to school. In the future, it will be necessary to introduce content of sensory hypersensitivity to the support program at the time of transition to school, and to consider reasonable accommodation methods for school children.

415.116 *(Poster)* The Associations between Age at Diagnosis, Motor Skills, and Severity of Autism Spectrum Disorder

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Background: Research shows that as children with autism spectrum disorder (ASD) age, they may demonstrate different severity scores in relation to communication, socialization, and daily living skills (Baghdadli et. al., 2011). Motor skills are another area of adaptive functioning that are commonly delayed in children with ASD and could also be related to age. Additionally, research suggests overall severity of ASD changes as children age (Clark, Barbaro, & Dissanayake, 2017).

Objectives: It is hypothesized that children's age at diagnosis will be positively correlated with motor abilities and negatively correlated with overall severity of ASD. This relationship is expected due to some participants receiving prior diagnoses and services.

Methods: The sample included 87 participants diagnosed with ASD (males n =67, females n = 20) with an average age of 49.03 months (SD = 19.89 months). Data was collected over a three-year period from a community-based developmental assessment clinic. Participants consisted of 29.9% Caucasian, 28.7% Latino, 20.7% Black, 11.5% Biracial, and 3.4% Asian individuals. The remaining 1.1% of the sample selected 'other' in relation to ethnicity. Participants were assessed utilizing the *Vineland Adaptive Behavior Scales, Second and Third Edition, Parent/Caregiver Rating Form (Vineland-II, 3)* and the *Autism Diagnostic Observation Schedule, Second Edition (ADOS-II).*

Results: As hypothesized there was a significant negative correlation found between child's age at diagnosis and severity of ASD (r = -.533, p< 0.0001). However, contrary to hypotheses, age at diagnosis was not significantly correlated with motor skills (r = -.147, p = .175).

Conclusions: Older children in this sample appear to have lower severity of ASD. This relationship could be due to older children having prior diagnoses and services potentially improving some symptomatology. Age at diagnosis may not have been correlated with motor skills due to the Vineland -II and 3 not assessing children's motor skills after a specific age.

415.117 *(Poster)* The Clinical Global Impressions-Severity (CGI-S) Scale: Measuring Severity of Social Communication Impairment Among Minimally Verbal Children with Autism

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Background: Minimally verbal children with autism (MV) have been shown to respond to intensive interventions targeting joint attention (JA) (Mundy, Sigman, & Kasari, 1990). However, there is a dearth of valid assessment instruments that are specifically designed for MV children (Kasari et al., 2013). One promising approach to address social communication measurement among this population is the Clinical Global Impressions- Severity Scale (CGI-S; Guy, 1976). The CGI-S was originally used as a brief, observation-based, clinician-rated tool to measure the global severity of psychiatric disorders within NIMH clinical trials (Busner & Targum, 2007). Its protocol considers information from a variety of naturalistic contexts to yield a more accurate assessment of functioning. The CGI-S structure has been validated with existing instruments measuring symptomatology of complex disorders such as schizophrenia (Haro et al., 2003) and bipolar disorder (Spearing et al.,1997), but has not yet been validated in an autism population.

Objectives: This present study aimed to explore the validity of the CGI-S scale, a rating instrument designed to better assess social communication within MV children.

Methods: Participants included 54 MV children (M_{age}=6.05 years) in an intervention study whose purpose was to improve unique, spontaneous language.

At the beginning of treatment study, CGI-S ratings were conducted by blinded interventionists and were scored on a 1-7 scale. Higher ratings indicated more severe social communication impairment. To yield meaningful interpretations, CGI-S scores were dichotomized into two groups: the "less-severe" group (ratings 1-5) and "more-severe" group (ratings 6 & 7).

Nonparametric Wilcoxon rank-sum tests were used to determine if there was a statistically significant difference between "less-severe" and "more-severe" CGI-S groups across the Early Social Communication Scale (ESCS) and Repetitive Behavior Scale- Revised (RBS-R) scores. Next, two logistic regressions were used to model the odds of getting a "less-severe" CGI-S rating for every additional increase in specific JA behaviors as measured by ESCS variables after controlling for repetitive behaviors.

Results: Rate of JA initiations and percent of JA responses both differed significantly across groups (W=171, p=0.003, r=0.41; W=124, p< 0.001, r=0.50). Alternatively, RBS total scores did not differ significantly between the groups (W=224.5, p= 0.10).

Logistic regressions indicated a one unit increase in the frequency of JA initiations increased the odds of belonging to the "less-severe" group by a factor of 1.19, 95% CI (1.04-1.44). Additionally, a one percent increase in responses to JA bids increased the odds of belonging to the "less-severe" group by a factor of 1.07, 95% CI (1.03-1.12).

Conclusions: This CGI-S was the first instance a global impression framework had been applied to an autism population to measure social communication, which is often the primary target area for improvement in early behavioral interventions (Howlin et al., 2009). Accurately assessing the social communication skills before the start of intervention is an important first step to determine if a child is making appropriate progress within that mode of treatment. Ultimately, this study suggests the CGI-S could be used as a clinically meaningful and easily interpretable adjunct measure of social communication for MV children.

415.118 *(Poster)* The Development and Psychometric Evaluation of the Theory of Mind Inventory-Self Report-Adult Measure (ToMI-SR-Adult)

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Background: Although self-report is being more widely used to assess a variety of characteristics in autism spectrum disorder (ASD) (e.g., anxiety, depression, systemizing, internalizing), self-assessment of social cognition remains a woefully understudied topic. This study reports on the development and preliminary psychometric evaluation of a new self-report measure to assess social cognition in autistic adults: The Theory of Mind Inventory: Self-Report - Adult (ToMI-SR-Adult). The ToMI-SR-Adult consists of 60 statements intended to tap the most advanced aspects of social cognition (e.g., metalinguistics, humor, deception, empathy, emotion blends) as they are presented in real world samples of behavior. The content of the ToMI-SR-Adult was guided by the social cognition literature in typical development and autism and refined through statistical analyses to retain the best performing items.

Objectives: Our objective was to evaluate the psychometric properties of the ToMI-SR-Adult in a sample of typically developing (TD) and autistic (ASD) adults who were diverse in their autism severity and diagnostic comorbidity.

Methods: An international sample of 300 fluent English speakers (111 with ASD and 189 TD; ages 18 - 72) completed the ToMI-SR-Adult online. From this sample, 80 cases were systematically excluded to create ASD and TD groups matched on sex and socioeconomic status. The ASD group was comprised of 111 adults (56 males; 55 females) from nine countries/regions. The TD group was comprised of 109 adults (54 males; 55 females) from five countries/regions.

Results: For the combined (ASD and TD) groups, Cronbach's alpha was .98 and was not improved by removing any items, suggesting that all contributed to the assessment of a unitary construct. When examined separately, the ASD and TD groups evidenced an alpha of .97 and .95 respectively, again indicating a high degree of internal consistency. Contrasting-groups validity was also performed to examine group differences (ASD vs. TD) at the composite score and item level. Significant between-group differences in the expected directions were found for all comparisons at $p < .001$. Moreover, effect sizes (Cohen's d) ranged from 0.60 to 1.86 which are medium to very large. Analyses for accuracy of classification revealed that 92.72% of females and 82.14% of males with ASD were captured by the measure. Positive predictive validity was 83.61% for females and 80.70% for males. Negative predictive validity was 91.84% for females and 81.13% for males. The overall accuracy of identification was 87.27% for females and 80.90% for males. Finally, we examined receiver operating characteristics and area under the curve. The ToMI-SR-Adult achieved a value of 0.95 for females and 0.89 for males. The overall value was 0.92 which is considered excellent.

Conclusions: We found preliminary support for the reliability and validity of the ToMI-SR-Adult. This justifies further development and validation of the measure and supports the notion that autism does not preclude self-awareness and that often, autistic adults may be the best judges of their own subjective social-cognitive experiences.

415.119 *(Poster)* The Effects of Gender and Race/Ethnicity on DSM-5 Criteria of Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) occurs more frequently in males than females (Kogan et al., 2009; Lai et al., 2015; Rynkiewicz et al., 2016). Previous research suggests that males and females may have different symptom presentations based on endorsed DSM criteria for ASD (Hiller et al., 2014). In addition, there are racial/ethnic disparities in parent reported concerns of ASD (Donohue et al., 2019) and age of diagnosis (Dickerson et al., 2017; Ratto et al., 2015). A better understanding of how race/ethnicity and gender may influence diagnosis and presentation of ASD could inform screening, referral, and assessment processes.

Objectives: This study sought to identify potential differences in the likelihood of meeting DSM-5 criteria for ASD based on gender (i.e., males and females) and race/ethnicity (i.e., White or racial/ethnic minorities). Further, we examined whether gender or racial/ethnic differences emerged in presentation of symptoms among children who received a diagnosis of ASD, focusing on restricted, repetitive behaviors or interests (Category B), as endorsement can vary within diagnosis for these behaviors.

Methods: A retrospective analysis of deidentified data included 1,444 children and adolescents who were referred for and completed an interdisciplinary evaluation for autism spectrum disorder at an academic medical center in the Midwestern United States (mean age = 6.37 years, SD = 4.16). The sample was primarily White (66.4%; 33.6% racial/ethnic minority) and male (73.5%; 26.5% female); 58.7% of the sample received a diagnosis of ASD. Chi-square tests were used to identify differences in presence of symptom criteria based on race/ethnicity and gender. Standardized residuals were examined to determine group differences.

Results: Among all individuals referred for evaluation (regardless of eventual diagnosis), race/ethnicity was significantly related to likelihood of meeting individual DSM-5 diagnostic criterion for autism, including deficits in nonverbal communication (A2; $p = .001$) and stereotyped behaviors (B1; $p < .001$). Specifically, a significantly lower proportion of racial/ethnic minorities did not meet criteria for A2 or B1 compared to Whites. In addition, a higher proportion of racial/ethnic minorities met criteria for B1 compared to Whites. Regardless of eventual diagnosis, gender was significantly related to meeting criteria for insistence on sameness (B2;$p = .001$) and restricted interests (B3; $p < .001$). Specifically, a significantly higher proportion of females did not meet criteria for B2 compared to males, and a significantly lower proportion of females met criteria for B3 compared to males.

Looking more specifically at children who received a diagnosis of ASD, there were no significant differences by race/ethnicity for any of the Criteria B symptoms. However, gender was significantly related to meeting criteria for RRB symptoms, such that a higher proportion of females with an ASD diagnosis did not meet criteria for either B2 ($p = .004$) or B3 ($p = .001$) compared to males with ASD.

Conclusions: Findings from this study demonstrate differences in DSM-5 symptom presentation based on race/ethnicity and gender. Our findings are consistent with previous research that males and females differ in ASD symptom presentation and suggest implications for referrals, assessment, and diagnosis of ASD in diverse groups of children.

415.120 *(Poster)* The Efficacy of a DSM-5 Specific Symptom Checklist in Identifying Children with an Autism Spectrum Disorder (ASD) Diagnosis Using Cluster Analysis

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Background: ASD screening tools infrequently correctly identify those with true ASD. For example, although the M-CHAT has an excellent negative predictive value (~100%), its positive predictive value for ASD specifically is as low as 26.3%. Additionally, the wait time for formal ASD diagnostic assessment has grown, with families typically waiting 3.5 years for a diagnosis. Therefore, it is important to improve screening processes to more accurately identify those truly at risk for ASD.

Objectives: Evaluate the efficacy of a DSM-5 specific ASD symptom checklist.

Methods: Data were reviewed from 320 ASD evaluations at a midwestern children's hospital (mean child age=65 months, SD=25). Upon initial referral, caregivers completed an intake questionnaire including sociodemographic information and a 24-item DSM-5 symptom checklist (e.g., "*Trouble looking people in the eyes/making eye contact, Not showing interest in interacting or making friends with other children, Difficulty with change in routine, Sensory sensitivity to noises, smells, touch/texture"*. Parents rated each item *never, sometimes, often,* or *very often*. Zero-17 months later, in-person evaluations were completed, including clinical interviews, the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2), Adaptive Behavior Assessment System, 3rd Edition (ABAS-3), and Social Communication Questionnaire (SCQ). Statistical analyses were conducted using SPSS 26. For questionnaire data reduction, Principal Component Analysis (PCA) and symptom clustering using DSM-5-based scores were each used. Two-step cluster analysis was implemented separately for each set of scores. If more than one cluster was identified, clusters were compared on age, sex, race, interval between intake and evaluation ("time"), provision of ASD diagnosis (and severity level), and ADOS-2, ABAS-3, and SCQ scores. Dichotomous variables were compared using Chi-square tests, and continuous variables were compared using Mann-Whitney U tests after examining variable distributions using Shapiro-Wilk's analyses.

Results: The sample was predominantly male (78.8%) and Caucasian (80%). 55.6% received an ASD diagnosis. PCA identified five separate components, but usage of component scores indicated one cluster; therefore, those components provided no meaningful discriminating information. Two-step cluster analysis using DSM-domain scores identified two clusters (Cluster 1 n = 113, Cluster 2 n = 207) of fair-good quality (0.5). These clusters did not differ significantly by sex, race, ASD level, age, time, and ADOS-2 scores (p's=0.14-0.997). Cluster 2 had significantly higher parental education, ABAS-3 and SCQ scores, and more children with ASD (Cluster1 = 54%, Cluster 2 = 56%). However, the effect size was very small (Cramer's $V = 0.011$), rendering this difference clinically meaningless.

Conclusions: Neither statistical nor theoretical groupings of caregiver-completed DSM-5 symptom checklists produced unique clusters that differed on ADOS-2 scores. While theoretically-derived domain scores produced groups that significantly differed regarding ASD diagnosis, the effect size was extremely small. This suggests that, despite a need for more sensitive screening tools, even explicitly asking caregivers questions based on DSM-5 diagnostic criteria does not improve diagnostic accuracy and does not appear to be a suitable substitute for behavioral observations and formal assessment by trained clinicians. Identification and/or development of sensitive and specific screening tools remain an important area of research to facilitate more accurate and efficient diagnosis.

415.121 *(Poster)* The First Five Minutes with a Toddler on the Spectrum: When Do Clinicians Know It's Autism, and What Makes Them Sure?

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Background: Diagnosing clinicians report that autism is immediately apparent in some, but not all, children ultimately diagnosed (de Marchena & Miller, 2017; McDonnell et al., 2019). Clinicians' initial diagnostic impressions have significant implications for accurate final diagnoses (Hedley et al., 2016); however, little is known about the differences between children whose autism is and is not immediately apparent. In addition, very little is known about how confident clinicians are in these critical first impressions, and why.

Objectives: The objectives of this study were: (1) to compare toddlers with autism whose diagnosis is vs. is not immediately apparent, and (2) to investigate predictors of expert clinicians' *confidence* in their initial diagnostic impression.

Methods: Participants (n=87) were toddlers with autism, referred for an evaluation as part of primary care screening studies. Evaluating clinicians with expertise diagnosing autism in toddlers recorded their immediate diagnostic impression five minutes into the evaluation, which typically included greeting the parent and child and observing the child during consent or developmental testing. Clinicians recorded (1) if they believed the child would meet criteria for autism or not following a complete evaluation, and (2) their confidence, on a scale of 1-5, regarding that impression.

Results: First impressions were accurate 64% of the time (i.e., True Positives); 36% of the time (i.e., False Negatives), clinicians initially believed the child did *not* have autism, but ultimately diagnosed autism. Autism severity (p=.01), child age (p=.03), and clinician confidence (p=.02) were higher in the True Positive group vs. False Negative group; groups were comparable on race and sex ratio, M-CHAT score, and developmental level (Table 1).

Predictors of clinician confidence were tested by entering child characteristics and clinician first impression into a regression, with the interaction between first impression and ADOS-2 scores as a second step (Table 2). In Model 1 (p=.006), adaptive behavior skills and race were independent predictors: clinicians were more confident in their first impressions when children were more delayed, and when children were White. In Model 2 (p=.002), the interaction between ADOS-2 scores and first impression group was also significant; for True Positives, clinicians were more confident when children had higher ADOS-2 scores, $r(55)$=.32, p=.02, whereas for False Negatives, ADOS-2 scores were unrelated to confidence, $r(28)$=-.16, p=.41.

Conclusions: For the majority of toddlers ultimately diagnosed with autism, expert clinicians accurately suspected an autism diagnosis within the first five minutes. For about a third of cases, the diagnosis did not become clear until more data was gathered during the evaluation. Clinicians were more likely to immediately suspect autism in older, more symptomatic toddlers, but clinicians' first impressions were equally accurate across sexes. Clinicians were more confident in their first impressions when children were more delayed. Race uniquely appears to be related to the *confidence*, but not the *accuracy* of clinicians' first impressions. The True Positive and False negative groups were also quite similar, suggesting that clinicians' first impressions may be driven by subtler, more nuanced child factors that were not specifically tested here, such as vocal prosody or motor behavior.

415.122 *(Poster)* The Impact of Executive Functioning on Adaptive Behavior in Children with ASD

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Background: Adaptive behavior deficits are well-documented in children with autism spectrum disorder (ASD; Lee & Park, 2007), and greater deficits are noted in children with comorbid attention-deficit/hyperactivity disorder (ADHD) symptomology (Yerys et al., 2019). Given that executive functioning (EF) skills are one component of ADHD symptomology and are teachable, it is important to examine their impact on adaptive behavior in children with ASD (Bertollo & Yerys, 2019). Previous research has shown that EF abilities are strongly related to adaptive behavior in ASD (Gardiner & Iarocci, 2018), and explain the variability in adaptive behavior above and beyond combinations of age, sex, Nonverbal IQ, Full Scale IQ (FSIQ), and ASD symptomology (Bertollo & Yerys, 2019; Pugliese et al., 2015). To date, studies have either examined the predictive role of broad ADHD symptoms on specific adaptive behavior subscales (Uljarevic et al., 2019), or have examined the role of EF specifically, compared to broad behavioral measures (Gardiner & Iarocci, 2018). Given the nuances within EF and adaptive behavior, it is important to further examine the relationships between specific domains within each, as this could have clinical implications.

Objectives: The aim was to explore the utility of the Behavior Rating Inventory of Executive Functioning (BRIEF) in predicting differences in adaptive behavior (measured by the Vineland Adaptive Behavior System, Second Edition [VABS-II]) in a sample of children with ASD. It was hypothesized that global EF deficits would explain variability in adaptive behavior, above and beyond age, FSIQ, and ASD symptom severity. Exploratory analyses investigated EF subdomains.

Methods: Fifty-two children with ASD, ages 6 to 12 years (M=9.68,SD=1.86) and with FSIQs from 51 to 129 (M=92.79, SD=19.53) were assessed on measures of EF (BRIEF) and adaptive behavior (VABS-II). Hierarchical regression examined the relationship between EF (Global Executive Composite) and individual differences in adaptive behavior (Adaptive Behavior Composite), after accounting for age, FSIQ, and ASD symptom severity. Exploratory hierarchical regression examined the role of Metacognition and Behavioral Regulation.

Results: As hypothesized, EF skills explained variability in adaptive behavior, after controlling for age, FSIQ, and ASD symptom severity (β = -0.34, *p*= 0.01). Greater difficulties in EF indicated lower adaptive functioning. Neither Metacognition (β = -0.25, *p*= 0.09) nor Behavioral Regulation (β = -0.11, *p*= 0.46) contributed significantly individually.

Conclusions: The results show that parent-reported EF skills can predict adaptive functioning abilities in a diverse sample of children with ASD. Since EF skills can be taught through direct instruction, this suggests that interventions designed to improve executive functioning abilities may be an important component of adaptive functioning skill building, regardless of whether a child has ADHD symptoms. While neither of the EF domains was a significant contributor to adaptive functioning overall, results may have been limited by the sample size. Further investigation with a larger sample could help to illuminate the potential contribution of these individual domains and findings could be used to further tailor therapies.

415.123 *(Poster)* The Impact of a Previous Diagnosis on Parental Reporting of Adaptive Functioning

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Background: When a child obtains a diagnosis from a health provider in order to ensure their child receives the necessary services, parents may sometimes overreport symptoms or behaviors. Parental objectivity is important when a child is being formally assessed for a developmental disability. Although several of the assessments utilized in the diagnostic process of autism spectrum disorder (ASD) are based on parental report, it should not be the sole tool used in diagnosing. In truth, a combination of parental report measures and direct observation is recommended (Falkmer, Anderson, Falkmer, & Horlin, 2013).

Objectives: The current study investigated whether having a prior diagnosis would impact parental report of adaptive functioning. It was expected that the individuals who possessed a prior diagnosis would obtain a lower Adaptive Behavior Composite (ABC) score as measured on the *Vineland Adaptive Behavior Scales, Second or Third Edition Parent/Caregiver Rating Form (Vineland-II, 3)*.

Methods: Participants included 227 children (Males n = 175, Females n = 52) evaluated at a community-based developmental assessment clinic, over the span of three years, which is the reason why certain participants received the *Vineland-II* or *Vineland*-3. Ages of participants ranged from 19 to 253 months (μ= 69.04 months) and they were assessed using the *Vineland-II or Vineland-3* and whether or not the child possessed a previous diagnosis prior to the evaluation. The sample consisted of 30.4% Caucasian, 26.9% Latinx, 18.9% African American, 11.9% biracial, and 2.6% Asian Americans participants. It is important to note that 2.2% selected 'other' in relation to ethnicity. All participants were at-risk for ASD, as determined by a phone screening method. However, not all participants were ultimately diagnosed with ASD.

Results: As hypothesized, there was a significant difference between the *Vineland's* ABC scores between individuals who possessed a previous diagnosis (μ = 73.49, *s* = 13.01) and those who did not (μ = 78.63, *s* = 13.31), t(225) = 2.938, p = .004).

Conclusions: These results suggest that the responses from parents/caregivers yielded lower ABC scores on the *Vineland* when their children had a previous diagnosis of ASD. These results should be interpreted with caution considering that parents may unintentionally be overreporting behaviors on the *Vineland* scores to ensure their child receives the necessary services. Such findings are crucial as they can help to determine how different sources of information should be considered in the evaluation process.

415.124 *(Poster)* The Influence of the ADOS-2 E-Codes on the Assessment and Classification of Autism Spectrum Disorder

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Background: Though individuals with autism spectrum disorder (ASD) experience similar core symptoms, the presentation of behavioral phenotypes vary significantly (Gotham, Risi, Pickles, & Lord, 2007). The ADOS-2 is a "gold standard" observational assessment to determine the classification of ASD. The final section of the ADOS-2 consists of E-codes, targeting behaviors consistent with anxiety, overactivity, and tantrums/aggression. Little research has been conducted to explore the role of the E-codes in the assessment of ASD.

Objectives: This study explored whether significant differences exist on the E-codes between children who qualify for ASD and those who do not on the ADOS-2, and to test whether clinical observations of behaviors during the ADOS-2 related to parent reports (i.e., Child Behavior Checklist).

Methods: Participants included children (*n* = 347, 72.6% male, *M* = 6.30 years *SD* = 3.33) who received screening for ASD. Participants were assessed using the ADOS-2. Chi-square analyses were conducted comparing the ADOS-2 E-codes for anxiety, tantrums/aggression, and overactivity from Modules 1, 2, and 3 by ASD classification (ASD versus non-Spectrum). Correlations were conducted between E-codes and behavioral measures (e.g., CBCL).

Results: Module 1. Within overactivity, there was a significant difference on scores of 2 between ASD groups, $X^2(1)=11.18$, $p=.001$. Score of 2: All (100.0%) classified as ASD. Module 2. Within Anxiety, there was a significant difference on scores of 0 between ASD groups, $X^2(1)=7.20$, $p=.007$. Score of 0: 34.9% classified as ASD versus 65.1% as non-spectrum. No significant differences were observed between ASD groups on Module 3. Across modules, no significant differences were found within Tantrums/Aggressions. No significant correlations were observed between Module 1 Overactivity and Module 2 Anxiety with CBCL Externalizing and Internalizing scales, respectively.

Conclusions: Results indicate differences on E-codes for Modules 1 and 2 between ASD classification groups. On Module 1, children who met criteria for ASD were more likely to show markedly high levels of activity (i.e., overactivity); in fact, all 17 participants who scored a 2 were classified as having ASD. This may point to the variability in ASD symptom presentation and/or the presence of a phenotype associated with ADHD. On Module 2, children who did not meet criteria for ASD were more likely to show marked signs of anxiety compared to those with ASD. As some symptoms of anxiety appear similar to symptoms of ASD (e.g. lack of eye contact, social withdrawal, nervous fidgeting), our findings may reflect the parental concerns that prompt a screening for ASD. Results also revealed no significant correlations between parent-reported symptoms on the CBCL and direct observations on E-codes for Modules 1 or 2. This has important implications for the source of information and time limits for behavioral observations on the ADOS. Although preliminary, these findings point to some important differences in E-codes for children who meet criteria for ASD, compared to children who do not, in the domains of anxiety and hyperactivity. Further analyses may help to interpret scores on the ADOS-2 E-codes, and suggest other behavioral concerns (e.g., ADHD, behavior problems, anxiety) that should be assessed.

415.125 *(Poster)* The Presence (or not) of Parent Concerns before Universal Autism Screening in Primary Care

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Background: The US Preventive Services Task Force indicated that for ASD screening to be recommended for all children, more evidence is needed about whether screening identifies children before they are of concern to parents or providers. Since publication of the Task Force report, several large-scale primary care studies have reported relatively low sensitivity of the M-CHAT-F and M-CHAT-R/F, the most widely used parent report screening tools. While troubling, universal screening with imperfect measures could still contribute to earlier detection and intervention, if at least some children accurately screen positive before their parents or providers are concerned. In ASD, many parents report in retrospect that they were concerned about their child long before the diagnosis was made. Unfortunately, there is very little prospective research on whether and when parents actually raise concerns to their primary care providers, which limits our ability to understand how parent concerns can contribute to early detection. This type of research is especially limited in low-risk, population-based primary care settings with a universal screening program in place.

Objectives: We set out to determine the extent to which parents raised any concerns to their primary care providers before the child screened positive through universal ASD screening.

Methods: We reviewed 25,999 children from a universal screening program who were followed to at least age 4 years (Guthrie et al., 2019). From this population, we identified 176 children who both screened positive on the M-CHAT-F and were later diagnosed with ASD (an additional 278 with ASD screened negative). We categorized parent concerns into the following groups: ASD-specific, Development (speech, motor, general development); Behavior (sensory, emotion dysregulation, unusual behaviors); or No Concerns. We also determined whether the concerns were resolved before age 15 months, or were present between the ages of 15 months and the age of first M-CHAT-F administration.

Results: Of the 176 children with ASD who screened positive, 22% had No Concerns documented in the electronic health record at the time of screening (13% had no concerns since birth). 39% had non-ASD-specific concerns about both Development and Behavior; 26% had concerns about Development only; 13% had concerns about Behavior only. Only 12% of parents were specifically concerned their child might have ASD before screening. When parents were specifically concerned about ASD, they were also concern about Development, Behavior, or both; and often had an older sibling already diagnosed with autism (representing 8 of the 10 known infant siblings). Across individual concerns, the most common were speech delay (59%), sensory dysfunction (40%), gross motor delay (35%) and repetitive behaviors (25%).

Conclusions: Despite imperfections in the M-CHAT-F, our results suggest universal autism screening did identify children before they were of concern to their parents. Work is underway to examine parent concerns in children with ASD who screened negative, as well as children with ADHD and Language delay from this same cohort of 25,999 (and will be presented). Understanding the type and timing of concerns parents raised during primary care will help us improve early detection and intervention for children with ASD.

415.126 *(Poster)* The Relationship between Anxiety and Sensory Subtype in School-Aged Children with Autism

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Background: Anxiety disorders and sensory issues are common in children with Autism Spectrum Disorder (ASD; Green & Ben-Sasson, 2010). Previous studies have identified that anxiety is closely associated with the severity of sensory symptoms (Uljarević, Lane, Kelly & Leekam, 2016). Recently, several groups have identified patterns of sensory symptoms in ASD referred to as sensory subtypes (Ausderau et al. 2014; Lane et al. 2014). In Lane's sensory subtype model, subtypes are posited to be related to two latent constructs – sensory reactivity and multi-sensory integration (Hand et al. 2017). Understanding of the relationship between sensory subtypes and their latent constructs with co-morbid symptom sets such as anxiety, may assist in identifying the most optimal approach to intervention (Lane, Molloy & Bishop, 2014). To date, there is no research examining the relationship between anxiety and sensory subtype in school aged children with ASD.

Objectives: This study aims to further examine the relationship between anxiety and sensory subtype in autism by focusing on school-aged children, and utilising both parent report and physiological measures.

Methods: The data utilised in this study was drawn from a larger study investigating the effectiveness of the Alert Program on self-regulation in children with ASD. The screening and baseline data collected as a part of the Alert Program study was analysed and utilised. Participants were children aged from six to twelve years with ASD and an IQ>70 (n=19) and their caregivers. Caregivers completed the Short Sensory Profile (Dunn, 1999) to establish sensory subtype and the Spence Children's Anxiety Scale (Spence, 1998). Respiratory Sinus Arrhythmia (RSA) and impedance (IMP), were collected via a seven-lead electrocardiogram (ECG) during a clinician administered sedentary sensory assessment.

Results: There was no correlation found between sensory reactivity and the average RSA score (r= -0.07, p= 0.77). We did, however, observe a strong and significant negative correlation (r= -0.56, p= 0.02) between average RSA score and multi-sensory integration. A moderate but non-significant association was also observed between sensory reactivity and anxiety (r= 0.42, p = 0.08). Despite the past literature identifying that cardiac measures are an appropriate reflection of anxiety (Chalmers, Quintana, Abbott & Kemp, 2014; Sharma, Balhara, Sagar, Deepak & Mehta, 2011), no relationship was found between RSA and scores on the Spence Children's Anxiety Scale (r= -.15,p= .58).

Conclusions: We found preliminary evidence to support the relationship between physiological arousal and sensory symptoms consistent with subtypes where difficulties are focused in multi-sensory integration. Contrary to expectations, there was no relationship, however, between physiological arousal and sensory reactivity or parent-reported anxiety. Further research is needed to confirm this finding in a larger sample.

415.127 *(Poster)* The Role of Lightness in Color Discrimination Among Adults with Autism

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Background: There is a growing body of evidence that Autism Spectrum Disorder (ASD) entails diverse vision alterations, which, in turn, may lead to many behavioral symptoms of ASD. A handful of studies have focused on color vision, reporting unanimously atypical color discrimination in this group. Despite its importance in visual perception, very little is known about the role of lightness in color vision in ASD. This study aimed to examine whether color discrimination in varying lightness is atypical among adults with ASD.

Objectives: Our objective is to address the following research question: does lightness discrimination capability differ in ASD as compared to TD counterparts? Considering prior studies, we hypothesize that the ability to discriminate colors differing in lightness is hampered among individuals with ASD. We operationalize the question via three tests, each addressing one of the following sub-questions: (1) Does the finest threshold in lightness discrimination differ between these two groups? (2) Does the presence of multiple stimuli varying in lightness affect lightness discrimination ability? (3) Is discrimination ability affected by motion in the stimuli?

Methods: A computer-based test battery with three test blocks was developed for carrying out this study. The blocks consisted of (1) single static stimuli for estimating lightness discrimination threshold, (2) multiple static stimuli for measuring the effect of the presence of other stimuli with similar lightness, (3) cardinal motion stimuli for measuring the ability to detect motion determined by variation in lightness. Six colors were tested, namely, red, green, blue, yellow, cyan and magenta. 15 adults with Asperger syndrome (AS) and 15 typically developing adults (TD) were recruited and administered the test during fall 2018. Three of the participants in the former group were also diagnosed with ADHD. Mann-Whitney U tests were conducted on number of errors, size of errors, and reaction time. Spearman's rank correlation tests were performed on current and AS diagnosis age.

Results: This study found (1) that the AS group performed as well as the TD group in most tested color categories; (2) significant positive correlation between reaction time, size of errors and age in the red color category in the AS group; and (3) in the blue color category, individuals with ADHD outperformed the others in the AS group, and in some cases even those in the TD group.

Conclusions: While it is common for autism assessment studies to focus on children, our study focused on adults, and a wider than usual age span (22 to 54). Our analysis reveals that autism may lower the ability, as age advances, to discern differences in lightness in the red color category. Also, our study included participants with both AS and ADHD. The data revealed that ADHD may mitigate the otherwise poorer performance in lightness discrimination in the blue color category. This latter finding is interesting in light of previous results (Banaschewski et al., 2006) showing that individuals with ADHD perform poorly in chromatic (as opposed to lightness) discrimination tests in the blue-yellow color axis.

415.128 *(Poster)* The Social Skills Improvement System (SSIS) – Teacher Report in Children with ASD Compared to a Clinical Non-ASD Sample

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Background: The *Social Skills Improvement System* (*SSIS)* is a norm-referenced measure that is often included in comprehensive evaluations for autism spectrum disorder (ASD; Gresham & Elliott, 2008). The *SSIS – Teacher Report* provides information regarding children's social skills and problem behaviors within a classroom setting, and directly links the assessment results to intervention tools (Gresham, Elliott, Vance, & Cook, 2011). Despite its many benefits, the utility of the *SSIS – Teacher Report* for differentiating children with autism from other clinical vulnerabilities has yet to be studied.

Objectives: To examine differences between teacher-reported social skills and problem behaviors on the *SSIS* between children with ASD and an age-matched clinical sample.

Methods: Participants included 61 elementary school-aged children who received a comprehensive evaluation for ASD through a university-affiliated autism center (M_{age} = 7.4 years). 33 children received a diagnosis of ASD (54.1% of sample). The remaining 28 children either received no diagnosis (17.8%), or received a diagnosis of ADHD (60.7%), anxiety (17.9%), or OCD (3.6%). As part of the evaluation, teachers completed the *SSIS* (Gresham & Elliott, 2008). The Social Skills domain consisted of seven subscales: Communication, Cooperation, Assertion, Responsibility, Empathy, Engagement, and Self-Control. The Problem Behaviors domain consisted of five subscales: Externalizing, Bullying, Hyperactivity/Inattention, Internalizing, and Autism Spectrum. Behavioral levels were assigned to indicate whether each child was below average, average, or above average on each domain and subscale. Independent samples t-tests and Mann-Whitney U tests were conducted to examine group differences on overall domains and subscales, respectively.

Results: Means for both diagnostic groups were in the below average range on social skills (ASD: M = 80.9; non-ASD: M = 84.0) and above average range on problem behaviors (ASD: M = 115.9; non-ASD: M = 117.0). There were no differences between the ASD and non-ASD groups on overall social skills ($t(57) = -.84$, $p = .40$) or problem behaviors ($t(58) = -.25$, $p = .80$). Children with ASD had significantly lower assertion compared to the non-ASD group ($U = 627$, $z = 2.71$, $p < .01$), but did not differ on the other six social skills subscales (p's > .01). There were no differences between groups on the five problem behaviors subscales (p's > .01).

Conclusions: Compared to the *SSIS* standardization sample, teachers reported on average reduced social skills and elevated problem behaviors in children referred for an ASD evaluation. With the exception of assertion, teachers did not perceive differences in the social skills or problem behaviors of children with ASD and other clinical vulnerabilities. These findings suggest that while the *SSIS – Teacher Report* may be sensitive to social and behavioral difficulties that prompt an ASD evaluation in school-aged children, it may lack diagnostic utility. Furthermore, our finding that teachers report reduced assertion in children with ASD warrants further research, given the role of assertion in bullying prevention (Smith & Low, 2013).

415.129 *(Poster)* Toe Walking in Young Children with Autism

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Background: Toe walking in particular has been a motor finding long associated with Autism Spectrum Disorder (ASD), affecting 20% to 63% of children compared to 5% in the general population. Few studies have looked at the relationship between age of diagnosis, autistic characteristics, and severity in children with ASD who toe walk compared to those who do not.

Objectives: To assess prevalence rate of toe walking in a clinical population of young children receiving an initial ASD diagnosis and the association of toe walking with age of ASD diagnosis, clinical features, and autism severity, in an ethnically diverse population.

Methods: Review of all children receiving an initial diagnosis of ASD from 2003 to 2012 at a University Affiliated Developmental Center. Data included demographic and clinical characteristics, including autistic characteristics, based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) and Childhood Autism Rating Scale (CARS). Toe walking was based on observation during pediatric neurodevelopmental evaluation. Statistics included chi-square, t-test and non parametrics and logistic regression

Results: We identified 512 children, M/F 400/112, 16% White, 47% Hispanic, 26% African-American, 38% bilinguals. Toe walking was observed in 155 children (30%). In terms of demographics, children with toe walking were more likely to be diagnosed with ASD earlier (33±13 m. vs. 42±16 m. $p<0.001$), and to be referred by the pediatrician than family or other agencies (referral source: pediatrician 45%, family 34%, other agencies 21% $p=0.007$) . In terms of clinical characteristics, children with toe walking were more likely to be preoccupied with parts of objects (55% vs. 39% $p=0.005$), to have more hypersensitivities to smell, touch and taste (19% vs.10% $p=0.03$) and the CARS total score was higher (36±5 vs. 34±5 $p=.001$) than in children without toe walking. Children with toe walking were more likely to lack interest to share (62% vs. 43% $p=.001$) and to present delayed language skills (87 % vs. 76 % $p=0.01$) than children without toe walking, but this association did not remain significant after adjusting for age. There were no differences in adaptive behaviors or cognitive testing between the groups. The association between toe walking and preoccupation with parts of objects and hypersensitivities remained significant after adjusting for age.

Conclusions: In this sample, children with ASD who engaged in toe walking were diagnosed earlier, more likely to be referred by their pediatrician, and demonstrated greater severity of social impairment. In this diverse population toe walking may serve as a clearly observable sign that helps children find their way to an earlier diagnosis. The association with autism symptom severity and sensory sensitivities may help to identify a meaningful clinical subgroup of children with autism for further study from etiologic and treatment perspectives.

415.130 *(Poster)* Towards a Data Driven Approach to Screen for Autism Risk at 12 Months of Age

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Background: While measures have been developed to screen for ASD in the second or third year of life, e.g. M-CHAT, there remains need for development of cost-effective screening measures (e.g. parent report) for identifying elevated ASD risk during the autism prodromal period in the first year of life. Currently available tools to screen infants at 12 months of age are limited either by sample size and/or screening accuracy (e.g. sensitivity). In addition, none of these studies to date, have employed a cross validation (CV) approach to prediction to accurately estimate how the stated values of performance (e.g. sensitivity) will generalize to an independent dataset.

Objectives: This study aimed to develop a classifier for infants at 12 months of age based on a parent-report measure (the First Year Inventory; FYI v2.0), to: (1) classify infants at elevated risk, over and beyond that attributable to familial risk status for ASD; and, (2) serve as a starting point to refine an approach for risk estimation in population samples.

Methods: A total of 237 subjects from a prospective, longitudinal study of infants at high familial risk for autism from the Infant Brain Imaging Study (IBIS) with complete FYI data participated in this study. Subjects were divided into two groups; 54 high familial risk (HR) infants later diagnosed with ASD (HR-ASD) and 183 HR infants not diagnosed with ASD at 24 months of age (HR-Neg). The FYI is a 63-item parent questionnaire that was designed to identify 12-month-olds at risk for ASD.

Analytical approach: We used Random Forest machine learning algorithm to develop a classifier based on the raw scores of the individual FYI items. To construct and test the accuracy of the classifier, we conducted 5-fold cross validation (CV) stratified by diagnosis (HR-ASD vs HR-Neg) and repeated 50 times.

Results: The FYI had an estimated sensitivity of 0.71 (95% CI: 0.50, 0.91), i.e. 71% of infants with ASD were correctly classified as ‘at-risk’ for ASD at 12 months of age, specificity of 0.72 (95% CI: 0.49, 0.91). Other measures of predictive accuracy are presented in Table-1.

Conclusions: Measurement of risk at age 12-months is complicated by the variable timing and pattern of emergence of clinically observable behaviors. However, even on the background of these complicating factors, we report higher than previously reported sensitivity. In addition, we demonstrate that the positive predictive value of the classifier (0.44) provides a 91% increase in the number of infants correctly identified as ASD positive, compared to the percentage of those identified solely by high familial risk status (~23%).The classifier demonstrates the potential to improve current screening for ASD risk at 12 months of age in infants already at elevated familial risk for ASD, increasing opportunities for clinical surveillance and research on intervention during the prodromal period in the development of ASD symptoms. In addition, these findings serve as proof-of-principle that parent-report measures combined with machine learning approaches may be clinically useful for screening ASD risk, prior to emergence of the defining diagnostic characteristics, in the general population.

415.131 *(Poster)* Tracking the Influence of Basic Research on Applied Research: A Pilot Study of Research Funded in the US to Improve ASD Identification

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Background: While concerns about ASD's prevalence and delays in diagnosis have mobilized significant investments in research in the US, recent reports indicate persistent gaps in timely and accurate identification. In presentations last year at IMFAR, we used a research roadmap to capture potential progress from basic to applied research, and to imagine downstream impacts on practice, policy, and outcomes. Application of this roadmap to all major, competitive research grants funded in the US between 2008 and 2015 and focused on improving ASD identification revealed that only 14% of funding was directed to applied research. These findings also raise important questions about the potential impact of the significant investments in basic research. How often do scientists undertaking basic research expect their work to have important implications for clinical practice? Can we trace a path from their findings to specific applied research projects, and increased clinical knowledge?

Objectives: To pilot methods for documenting the routes by which basic research influences applied research, through analyses of basic research funded to improve ASD identification, and publications which result.

Methods: We downloaded information from the Autism Research Database on all projects addressing ASD identification between 2008 and 2016 . We coded principal aims from each grant description according to type of research (Basic, Applied, or Other) and Focus (Improved clinical identification or Other). For projects with aims exclusively involving Basic Research, we also selected those stating implications for improved clinical identification.

To trace the knowledge impact, we are undertaking literature searches followed by abstract/full-text reviews to identify relevant publications; i.e., peer-reviewed publications that describe original research produced by Principal Investigators (PIs) of projects listed above that report findings specifically linked to principal aims. For this pilot, we are identifying all relevant publications for Applied Research projects, and 20 Basic Research projects with at least one relevant publication. We document routes of influence by aligning grants and relevant publications of PIs undertaking basic research with those in their own applied research or that of their collaborators. Then we evaluate evidence that findings of basic research shaped the focus or design of related applied research.

Results: Of 426 projects between 2008 and 2016 funded for almost $300 million to address questions of screening and diagnosis, fewer than 30% had applied research aims or stated implications for improving clinical identification of ASD. PI's of basic research appear more likely to influence the subsequent work of a collaborator than to integrate related basic and applied research aims into a single project or their own successive projects. Consistent with earlier reviews presented at IMFAR, significant publication gaps and lags limit the knowledge impact. Analyses to date suggest that the impact of specific basic research projects on the genesis of other, potentially related applied research projects is very difficult to clearly document.

Conclusions: By documenting how basic research might shape applied research to result in new clinical knowledge, these methods can help policymakers set funding priorities to maximize the impact of investments in research.

415.132 *(Poster)* Updates for a "Hands-on" Developmental-Behavioral Pediatric Rotation: Teaching Pediatric Residents to Diagnose Autism in Primary Care

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Background: The AAP has rightly adopted guidelines wherein pediatricians are encouraged to "screen-and-refer" children for ASD at 18- and 24-months of age. However, without also giving pediatricians explicit competence and ownership over being able to diagnose ASD within practice when clearly discernible symptoms are present, this wide-scale identification of general neurodevelopmental risk—and reliance upon specialty tertiary care diagnostic centers—creates a bottleneck for patients and providers alike. When asked about barriers to providing this type of care, pediatricians report factors such as lack of clear tools, discomfort, difficulty navigating follow-up services, and uncertainty around communicating with families and other providers. Pediatricians-to-be within our residency program reported an overall lack of hands-on, applied learning opportunities to strengthen their competence in recognizing ASD in young children and caring for these patients. Thus, if we do not provide wide-scale training in the basics of ASD recognition, diagnostic triage, and post-diagnostic care coordination to future pediatric medical providers, then "screen-and-refer" will continue to lead to lengthy waits for diagnostic confirmation and service initiation, maintaining the current mean age of diagnosis as after four years of age, and postponing access to the early intervention services.

Objectives: To provide updates and new data assessing a service system intervention for training residents in within-practice ASD diagnosis and care. To assess feasibility/acceptability of integrating enhanced curricular components within our existing developmental-behavioral pediatrics (DBP) rotation.

Methods: Our curriculum was designed to improve upon previously passive shadowing experiences within young child ASD clinics by integrating procedural, physician-tailored training in within-practice diagnostic identification and care coordination. In addition to multiple web-based procedural learning activities (including an interactive tutorial teaching administration/scoring of the Screening Tool for Autism in Toddlers and Young Children [STAT]), residents were required to actively participate in evaluations under direct supervision of an attending provider. Using online completion metrics and pre/post-rotation surveys, we analyzed data on completion of curriculum components and changes in comfort level for a range of practice behaviors.

Results: Of the first 90 residents to complete the enhanced rotation activities, 91% completed new training requirements and 85% performed STAT activities during their DBP rotation. Participants reported increased comfort with identifying symptoms/risk for ASD, distinguishing between ASD and other concerns, and making a formal diagnosis. They also reported increased comfort providing feedback about diagnostic decision and effectively connecting families with services. After exposure to new curriculum, 94% of residents reported that they felt comfortable providing primary care for children with ASD, which was an increase from 59% pre-rotation. Updated results will be reviewed in depth.

Conclusions: In line with other residency training programs across the country, DBP rotations often present very few opportunities for active resident participation that would translate into skills relevant for future independent practice. This represents a tremendous training gap that, in turn, is also an opportunity for service system intervention. This project reflects the first step in advancing incorporation of ASD training into pediatric residency programs, thus increasing access to services and information for children with concerns for ASD and their families.

415.133 *(Poster)* Using the ICF Core Sets to Describe Functioning for Young Children with, or at Risk of, Neurodevelopmental Conditions; A Case Study

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Background: The World Health Organization's International Classification of Functioning, Disability and Health (ICF) and its associated "Core Sets" for neurodevelopmental conditions (NDCs) are valid and established frameworks for understanding functioning for people with autism and other NDCs. Existing assessment of functioning tools do not holistically or comprehensively assess functioning for individuals with NDCs. The ICF Core Sets for autism, attention deficit hyperactivity disorder and cerebral palsy ('ICF Core Sets for NDC') have not been operationalised into clinical assessments. Young children (<six years) may not yet have a formal NDC diagnosis and a broad assessment may be more applicable.

Objectives: To use the ICF Core Sets to describe functioning for young children with, or at risk of, NDCs.

Methods: To describe functioning using the ICF Core Sets for NDC, a case study design was chosen to triangulate qualitative and quantitative information from multiple sources. The sources used to collect information about each child included a parent-reported card sort, semi-structured observations, standardised tools, and case history. The items from the comprehensive ICF Core Sets for NDCs were used as the framework to integrate the data and describe the overall functioning of the child using the existing ICF rating scales on a Documentation Form and caregiver-reported strengths. These items covered body functions, activities and participation, and environmental factors. Data were analysed using descriptive statistics (medians and ranges) and calculating relative weaknesses / strengths through comparing ratings. Assessments were completed for a sample of n>17 Australian children aged under 6 years with various NDCs.

Results: Preliminary results suggest that approximately 30% of items from the comprehensive ICF Core Set for NDCs were considered not applicable to at least one child, however, less than 5% of items were found not applicable to all children. Ratings were also compared to the relevant diagnosis-specific Core Set (if available) for validation purposes. Preliminary analysis did not indicate any clear themes in relation to body functions. The activity and participation chapters where the most difficulties were reported emerged as 'interpersonal interactions and relationships' and 'community, social and civic life', whilst relative strengths were associated with 'mobility' and 'learning and applying knowledge'. The 'services, systems and policies' chapter of environmental factors presented the greatest barrier for the children in the preliminary analysis, whilst the 'support and relationship' chapter was the strongest reported facilitator for functioning (these items had the widest range of scores, both as facilitators and barriers, suggesting this area is very variable depending on the individual).

Conclusions: This project has made important first steps in translating the WHO's ICF and ICF Core Sets into clinical practice and being able to describe functioning comprehensively and holistically for young children with NDCs. However, more work is needed to refine and develop the tool before it is ready for widespread clinical use.

415.134 *(Poster)* Validating the Contextual Assessment of Social Skills in Children with Autism Spectrum Disorder

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Background: The Contextual Assessment of Social Skills (CASS; Ratto et al., 2011) is an observational assessment initially validated for verbal older adolescents and young adults with ASD (ages 16-22). It consists of two loosely structured three-minute conversations with different naïve confederates; in the first, the confederate demonstrates interest and engagement in the conversation, while in the second s/he acts bored and disengaged. Conversations are coded from videotapes. While a few published studies have used CASS procedures with younger ages, it has not yet been formally validated for children.

Objectives: To evaluate CASS as a measure of social skill in children with ASD across a range of ages.

Methods: CASS was administered to 47 children with ASD and 34 typically developing (TD) children, aged 7-17. Groups were matched on age [$M(SD)_{ASD}$=12.2(2.9); $M(SD)_{TD}$=11.4(3.0); p=.22], sex (M:F_{ASD}=44:14; M:F_{TD}=24:10, p=.97), and verbal cognitive ability [$M(SD)_{ASD}$=105.0(12.3); $M(SD)_{TD}$=104.9(12.7), p=.98]. Original procedures from Ratto and colleagues were followed with a few exceptions: (1) confederates were young adult research staff and thus not peers, as training child peers to administer the task with fidelity was impractical; (2) confederates were not required to be of the opposite sex; (3) the prompt to initiate conversations was modified slightly to be appropriate for children. Interested and Bored conditions were coded by two raters trained to 80% agreement with developer Ratto on training videos before rating study videos. 20% of study videos were coded by both raters for reliability analyses and consensus. Primary analyses focused on four codes: Asking Questions, Topic Changes, Overall Involvement, and Overall Quality of Rapport, which were each analyzed via 2x2 mixed ANOVA.

Results: See Table for codes, reliabilities, and means. Interrater reliability (*ICCs)* generally fell in the good to excellent range, particularly for primary variables. Overall internal consistency was good for the Interested condition (α=.81) and acceptable for Bored (α=.77). Significant group (ASD/TDC) by condition (Interested/Bored) interactions (ps<.01) emerged for Asking Questions and Topic Changes, with the TD group showing greater increases from Interested to Bored than the ASD group. Overall Involvement and Overall Quality of Rapport yielded main effects of group (ps<.001), with TD scoring higher than ASD. Overall Quality of Rapport also yielded a main effect of condition (p<.001); scores for Interested were higher than for Bored. A total score was calculated for each condition by summing z-scores across codes. Higher total scores were associated with lower ADOS-2 Calibrated Severity Scores in the ASD group in both conditions (Interested: r=-.54, p<.001; Bored: r=-.57, p<.001).

Conclusions: The pattern of results for this child sample mirrored findings in the young adult development sample, supporting CASS's utility for assessing social skills in children. CASS discriminated between children with and without ASD across codes, and also demonstrated less change in children with ASD across Interested and Bored conditions, suggesting poorer recognition of and adaptation to different social contexts. Moreover, correlations with ADOS-2 within the ASD group suggest that this 6-minute, ecologically-valid assessment may offer a potent snapshot of ASD symptom severity.

415.135 *(Poster)* Validating the Social Responsiveness Scale for Korean Preschool Children with Autism Spectrum Disorder

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Background: The Social Responsiveness Scale (SRS) has been a widely used screening questionnaire for Autism Spectrum Disorder (ASD) worldwide. Given that SRS was originally developed based on the US population, several studies have investigated its international psychometric properties along with localized best-estimate-cut-off scores.

Objectives: This study aims to examine the psychometric property of SRS in Korea for the first time, and to determine the best-estimate-cut-off scores for diagnosis of ASD in Korean preschool children.

Methods: Children between the age of 10 to 42 months were recruited. Albeit the original SRS preschool version is intended to examine children above the age of 30 months, we also included subjects below the age of 30 months to seek out the validity of SRS in this age group. All subjects were assessed by full diagnostic instruments including the Korean versions of the Autism Diagnostic Observation Schedule (K-ADOS) and the Autism Diagnostic Interview-Revised (K-ADI-R), and diagnoses were ascertained based on DSM-5^{TM} diagnostic criteria by clinical best estimates of a multidisciplinary research team. All children and their parents completed the SRS, the Korean version of Social Communication Questionnaire (K-SCQ), and the Korean version of Childhood Autism Rating Scale (K-CARS). The discriminative validity of SRS was tested by conducting t-test and analysis of covariance to compare the score difference between ASD and non-ASD groups. The convergent validity of SRS with other diagnostic instruments including K-CARS and K-SCQ was examined by using Pearson's correlation. Finally, we conducted a receiver operation characteristic curve analysis to test the sensitivity and specificity of SRS, and to determine the best-estimate-cut-off scores for screening ASD in Korean preschool children.

Results: Among total of 477 children recruited, 181 subjects were diagnosed as having ASD (mean=77.07, SD=27.72), and 296 were classified as non-ASD (mean=37.14, SD=18.61), which include subjects with typical development and with developmental delay. There were significant differences in total scores of SRS between ASD and non-ASD group, and the significance remained in analyses of two subgroups, for children over 30 months and below (Table 1). The differences were significant even after adjusting the subject's age in all groups (Table 1). SRS scores were significantly correlated with K-CARS ($r=0.74$, $p<0.01$) and K-SCQ ($r=0.80$, $p<0.01$) total scores. The significant correlations remained in all subgroup analyses. The best-estimate cut-off scores of SRS to screen ASD in the age group below the age of 30 months was 48.5 (AUC=0.82, sensitivity 74.00%, specificity 73.78%). In the group above the age of 30 months, it was 55.5 (AUC=0.90, sensitivity 83.97%, specificity 84.09%). There was a significant correlation between the SRS scores of all the children and their mother ($r=0.23$, $p<0.01$).

Conclusions: SRS is a valid and reliable instrument to screen and to aid the diagnosis of ASD in Korean preschool children. The validity, however, was weakened in the age below 30 months, thus requiring further verification in larger sample. Notably lower cut-off scores, compared to the original U.S. version, should also be further clarified in a larger sample with a wide age range.

415.136 *(Poster)* Variables Predicting Age of Autism Spectrum Disorder Diagnosis

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Background:

Early diagnosis of autism spectrum disorder (ASD) is crucial, as it leads to early intervention, resulting in superior long-term outcomes. Demographic, environmental, personal, clinical, and familial characteristics have been found to be associated with ASD diagnosis. However, research findings are occasionally inconsistent and most of the studies with a large population did not use direct observation or standard clinical measurements. The present study examined children's personal, familial, and clinical characteristics evaluated with common standard measurements to assess their relative contribution in explaining the variability of age of diagnosis. Identifying variables that are associated with age of diagnosis may help clinicians to identify children at high risk for later diagnosis of ASD.

Objectives: The current study aims to examine the relative contribution of familial (parental age and education, number of siblings, familial hierarchy) personal (sex, cognitive ability, autism severity, adaptive skills) and clinical (medical history, previous diagnosis) variables to the variability of ASD diagnosis age.

Methods: The study included a large cohort of children (n=530, 66 females) diagnosed with ASD, with an age range of 16-120 months. All the children underwent comprehensive assessment that included evaluation of possible ASD using the Autism Diagnosis Interview-Revised (ADI-R; Lord, Rutter, and Le Couteur, 1994), the Autism Diagnostic Observation Scales (ADOS; Lord, Rutter, DiLavore, Risi, S., 1999),clinical judgement based on the DSM IV (APA, 2000) or DSM-5 (2013) ; cognitive assessment using age-appropriate standardized tests; adaptive skills using the Vineland Adaptive Behavior Scales (VABS; Sparrow et al. 1984; Sparrow et al., 2005). In addition, comprehensive medical, developmental and familial histories were obtained from the parents.

Results:

To evaluate the relative contribution of the above variables to age of diagnosis, a hierarchical linear regression analysis was performed with age of diagnosis as a dependent variable. Among the examined personal and clinical variables, later diagnosis age was associated with higher IQ levels, having a previous non-ASD diagnosis, and more severe ASD symptoms, specifically ADOS social affect (SA) and ADI Restricted, Repetitive, and Stereotyped Behaviors (RRIB). Familial variables associated with later ASD diagnosis age were generally having more siblings and older parents. In total, the regression model explained 37.4% of the age of diagnosis variability. Children with a previous diagnosis were diagnosed with ASD an average of 20 months later compared to children with no previous diagnosis. Children with higher IQ (i.e. IQ >70) tended to be diagnosed an average of 17 months later compared to children with IQ <70. Significantly higher ASD severity levels were associated with ADOS Module 3, as compared to Module 2 and Module 1. Participants' gender, birth order, medical history and parental education did not associate with diagnosis age.

Conclusions:

Having a previous diagnosis, higher IQ scores, more severe ASD symptoms and having more siblings and higher maternal age point to later age of ASD diagnosis. In addition, the findings imply different levels of complexity among the ADOS SA modules. Clinicians and parents should be aware of factors which may delay ASD diagnosis.

415.137 *(Poster)* Visual Performance and Nonverbal Reasoning in Autism Spectrum Disorder

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Background: Studies on visual perception in ASD have reported strengths in various detail-oriented tasks compared to non-autistic controls (Happé & Frith, 2006; Mottron et al., 2006). For example, superior performance in visual search is oft-cited as a widely established finding in ASD research. It has been suggested that these visual atypicalities can be attributed to enhanced perceptual functioning (EPF) (Mottron et al., 2006). Mixed findings in the literature have yet to conclude whether enhanced low-level spatial frequency processing may be a source of EPF. Whereas the majority of research indicates that spatial frequency sensitivity is similar in autistic and non-autistic people (Behrmann et al., 2006; Guy et al., 2016; Jonge et al., 2007; Koh et al., 2010; Simmons et al., 2009), a research study from Keita et al. (2014) found increased sensitivity in ASD at 8 cycles per degree (cpd). Another group found that autistic as compared to non-autistic participants performed more accurately in an object recognition task when presented with higher spatial frequency (4 cpd) stimuli earlier (Caplette et al., 2016). One possible explanation for the mixed findings in the literature is that EPF in ASD may not be a characteristic of the entire spectrum, but rather, a characteristic of a sub-set of people who excel at the Wechsler block design subtest (BDT) (Caron et al., 2006; Shafai et al., 2015).

Objectives: To examine how spatial frequency processing is related to BDT performance in autistic and non-autistic adult participants matched on age-, gender-, and IQ.

Methods: We measured contrast sensitivity across a broad range of spatial frequencies (1-24 cpd) using a 2-interval forced choice detection paradigm. Twenty autistic participants (mean age = 23.8 years; SD = 6.36; 6 females) and 20 non-autistic participants (mean age = 27.9; SD = 6.96; 7 females) had their IQs assessed using the Wechsler Abbreviated Scale of Intelligence II (WASI-II) and completed an eye exam by a licensed optometrist. WASI-II full-scale IQ scores in ASD ranged from 87 to 150 (M = 116.15; SD = 15.64) and from 103-136 in controls (M = 115.7; SD = 7.88).

Results: Contrast sensitivity thresholds did not indicate any enhanced spatial frequency processing in autistic as compared to age-, gender-, and IQ-matched non-autistic participants. However, exploratory analysis based on an expected association between BDT scores and EPF revealed a subset of the ASD group with superior sensitivity at 4 cpd. A systematic analysis via BDT score sweeps revealed that the ASD group consisted of two distinct clusters. One cluster, characterized by higher BDT scores, had better sensitivity at 4 cpd than non-autistic participants, while the other, with lower BDT scores had lower sensitivity than non-autistic participants.

Conclusions: These findings suggest that enhanced low-level visual processing is not a source of EPF for all autistic people. Instead, EPF may be a feature of a sub-population of autistic people, specifically those who excel at the block design test. We propose that performance on the BDT may be one factor that helps reveal a distinct sub-type within the heterogenous ASD population.

415.138 *(Poster)* What Happens after a Positive Autism-Specific Screen? Predictors of Completing an Evaluation and Receiving an Autism Diagnosis

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Background: Universal ASD-specific screening with consistent diagnostic evaluation referral for those who screen positive is currently considered to be critical for achieving widespread timely and equitable identification and treatment of ASD. However, these practices are limited both by lack of follow-through on diagnostic evaluation referrals post-screening and by poor accuracy from the screening tools in diverse populations.

Objectives: Families, service providers, and service systems would all benefit from expanded knowledge regarding the following questions that this study addresses: 1) after a positive screen on a universally administered Autism-specific screener, who is most likely to follow-through on a recommendation for a diagnostic evaluation; and, 2) of those who screen positive, who is most likely to be diagnosed with ASD?

Methods: This study was a secondary analysis of data collected in a larger multi-site randomized controlled trial evaluating the impact of family navigation on diagnostic ascertainment and linkage to treatment. Participants included 310 predominantly low-income and racially/ethnically diverse parent-toddler dyads who screened positive on the MCHAT-R/F. Baseline data on family factors and child adaptive functioning were collected at the time of primary care referral for a diagnostic evaluation. Families were followed via electronic medical record review to determine whether they completed a diagnostic evaluation and if so, what diagnoses were conferred. Generalized estimating equations were used to fit models of predictors for each of the two binary primary outcomes: completing the diagnostic evaluation and receiving an ASD diagnosis upon evaluation.

Results: The best-fit model for completing a diagnostic evaluation identified the following significant independent predictors: younger child age at screen, older parent age at screen, lower child communication adaptive functioning, receiving Early Intervention, and non-Hispanic ethnicity. Significant predictors for receiving an ASD diagnosis upon evaluation included: male sex of child, lower child communication adaptive functioning, no use of interpreter for MCHAT-R/F screening, White and non-Hispanic parent race/ethnicity, and no parent history of a depressive or bipolar disorder.

Conclusions: Children whose parents were younger or Hispanic, and who are not yet involved in Early Intervention were least likely to access diagnostic services, possibly due to lower awareness of developmental problems or acceptance of referral for services. Parents of older children with higher communication functioning were also less likely to follow-through on diagnostic care; this may be because parents of such children feel less concerned about their child's development. Families with these characteristics may benefit from interventions aiming to enhance parent engagement and address barriers to care. Findings regarding sociodemographic predictors of receiving an ASD diagnosis corroborated prior research indicating problems with MCHAT-R/F accuracy among minority populations and females. Use of an interpreter for screening predicted decreased likelihood of a true ASD diagnosis, suggesting issues with the language interpretation process within parent checklist screening approaches. Finally, lower communication adaptive functioning skills of the toddlers predicted receiving an ASD diagnosis, suggesting that such information may be useful to collect early in the screening and referral process as part of efforts to increase efficiency of care.

415.139 *(Poster)* The Expert Eye: Autism Experts Read out Autism-Discriminative Information from Visual Kinematics

N. Pretti[1], *A. Crippa*[2], *A. Cavallo*[1,3], *F. Battaglia*[1,4], *C. Ansuini*[1], *S. Panzeri*[5], *M. Molteni*[2], *L. Nobili*[4] *and C. Becchio*[1], *(1)Cognition, Motion and Neuroscience, Istituto Italiano di Tecnologia, Genova, Italy, (2)Scientific Institute, IRCCS Eugenio Medea, Bosisio Parini, Italy, (3)Department of Psychology, University of Turin, TORINO, Italy, (4)IRCCS Istituto Giannina Gaslini, Ospedale Pediatrico, Genova, Italy, (5)Neural Computation Laboratory, Istituto Italiano di Tecnologia, Rovereto and Genova, Italy*

Background: Over the past 20 years, retrospective coding of home videos by experienced examiners has proved useful for assessing qualitative aspects of sensorimotor behavior early in the development of autism spectrum conditions (ASC). However, the specific sensorimotor features detected by experienced examiners are unknown. How sensitive is the expert eye? Are examiners with extensive experience in the assessment of ASC children able to detect kinematic features invisible to non-experts? The present study was designed to provide quantitative answers to these questions.

Objectives: To evaluate the extent to which clinical examiners with an extensive experience in ASC assessment are able to pick-up significant information from subtle differences in movement kinematics.

Methods: Participants were clinical examiners with extensive experience in the assessment of ASC children (ASC experts), clinical examiners with no experience in the assessment of ASC (no ASC experts), and participants with no clinical expertise (controls). ASC-related expertise was defined based on the number of ADOS administered during the previous 12 months (at least 20). All participants completed two tasks: an autism discrimination task and an intention discrimination task. Each task consisted of a series of trials displaying reach-to-grasp actions towards a bottle either with the intent to pour or place. Actions were performed by either TD or ASC children. In the group discrimination task, we asked participants to indicate whether the observed action was performed by a TD or an ASC child. In the intention discrimination task, we asked participants to predict whether the observed action was performed with the intent to pour or to place. For each task, we presented 120 videos selected to contain both group-specifying information and intention-specifying information.

Results: Preliminary results were analyzed in the framework of Signal Detection Theory (SDT). Sensitivity (d') and criterion (c) were computed separately for the Group task and the Intention task in ASC experts, no ASC experts, and controls. While all three groups performed well above chance in the intention discrimination task, only ASC experts were able to discriminate whether observed actions were performed by TD versus ASC children. Preliminary results were analyzed in the framework of Signal Detection Theory (SDT). Sensitivity (d') and criterion (c) were computed separately for the Group task and the Intention task in ASC experts, no ASC experts, and controls. While all three groups performed well above chance in the intention discrimination task, only ASC experts were able to discriminate whether observed actions were performed by TD versus ASC children.

Conclusions: To the best of our knowledge, this is the first study to examine the influence of clinical expertise on the ability to extract discriminative information from action observation in the field of autism research. Our preliminary results demonstrate the potential significance of kinematic readout for clinical expertise and suggest that clinical examiners with extensive experience in assessing ASC develop a selective ability to pick-up ASC-discriminative kinematic features.

Drug Discovery and Development

POSTER SESSION — DRUG DISCOVERY AND DEVELOPMENT
416 - Drug Discovery and Development Posters

416.001 *(Poster)* Assessing the Effects of Fluoxetine, Itraconazole, and Rifampicin on Balovaptan Pharmacokinetics in Healthy Volunteers

M. Derks[1], *C. Wandel*[2], *A. Young*[1], *S. Bolt*[1] *and C. Meyenberg*[2], *(1)Roche Products Ltd, Welwyn Garden City, United Kingdom, (2)F. Hoffmann-La Roche AG, Basel, Switzerland*

Background: People with autism spectrum disorder (ASD) often take several medications. Balovaptan – a novel, potent and selective vasopressin 1a receptor antagonist investigated for the treatment of the core symptoms of ASD – is mainly metabolized by cytochrome P450 3A4 (CYP3A4) and to a much lesser extent by CYP2D6.

Objectives: The objectives of these studies were to assess the potential of balovaptan to undergo CYP3A4- and CYP2D6-mediated pharmacokinetic (PK) interactions with concomitant medications.

Methods: Three phase 1, open-label, two-period studies assessing the effect on the single-dose or steady-state PK of balovaptan and its major plasma metabolites (M2, M3) of a strong CYP2D6 inhibitor (fluoxetine; Study 1; NCT01967979), a strong CYP3A4 inhibitor (itraconazole; Study 2; NCT03579719), and a strong CYP3A4 inducer (rifampicin; Study 3; NCT03586726) were conducted. In all studies, healthy volunteers received balovaptan alone in Period (P)1 and balovaptan in combination with fluoxetine, itraconazole, or rifampicin in P2 (see **Table**). Modulators of CYP3A4 activity (including nutrients/foodstuffs) were restricted within studies. The maximum observed plasma concentration (Cmax) and area under the plasma concentration-time curve (AUC) of balovaptan (and M2/M3) were derived by standard non-parametric/non-compartmental methods from validated liquid chromatography-tandem mass spectrometry analyses of serial blood samples collected in Studies 1 (Day [D]1/P1 and D6/P2), 2 (D10/P1 and D20/P2), and 3 (D10/P1 and D16/P2).

Results: Each study included 14–16 adult volunteers (80–100% male). In Study 1, co-administration of a single dose of balovaptan (12 mg) at D6 of escalated dosing with fluoxetine resulted in a modest 11% increase in balovaptan Cmax (geometric least square means ratio [GLSMR; 90% CI], 1.11 [1.04–1.18]) and 6% increase in balovaptan AUC (GLSMR, 1.06 [0.96–1.16]), and a similarly modest 6% increase in M3 Cmax (GLSMR, 1.06 [1.01–1.12]) and AUC (GLSMR, 1.06 [0.98–1.15]), versus single-dose balovaptan alone. In Study 2, co-administration of itraconazole (200 mg QD) with balovaptan (5 mg QD) for 15 days resulted in approximately 4–6-fold increases in balovaptan Cmax (GLSMR [90% CI], 4.46 [4.06–4.90]) and AUC (GLSMR, 5.57 [5.00–6.21]), versus balovaptan alone; along with approximately 30–40% decreases in M2 Cmax (GLSMR, 0.69 [0.60–0.79]) and AUC (GLSMR 0.68 [0.59–0.78]) and a 40% increase in M3 Cmax (GLSMR, 1.43 [1.32–1.55]) and AUC (GLSMR 1.42 [1.30–1.55]). In Study 3, co-administration of rifampicin (600 mg QD) with balovaptan (10 mg QD) for 10 days resulted in an approximately 90% reduction in balovaptan Cmax (GLSMR [90% CI], 0.14 [0.12–0.15]) and AUC (GLSMR, 0.07 [0.06–0.07]) versus balovaptan alone; along with an approximately 65% decrease in the Cmax and AUC of M2 (GLSMR [90% CI]: Cmax, 0.37 [0.34–0.40]; AUC, 0.34 [0.31–0.36]), and an 80–90% reduction in M3 (GLSMR [90% CI]: Cmax, 0.22 [0.20–0.24]; AUC, 0.13 [0.12–0.14]).

Conclusions: Co-administration of balovaptan with strong inducers or inhibitors of CYP3A4 is likely to significantly alter balovaptan PK and requires caution. By contrast, strong CYP2D6 inhibitors, such as fluoxetine, are less likely to have clinically significant PK interactions with balovaptan.

416.002 *(Poster)* Catching up to the Hype: Strategies to Optimize Collaboration in Cannabinoid Research

***P. E. Cervantes**, G. Conlon, R. Shalev, T. Gomez-Alemany and F. X. Castellanos, Department of Child and Adolescent Psychiatry, NYU Langone Health, New York, NY*

Background: Despite widespread public enthusiasm, we lack rigorous evidence of the potential therapeutic benefits of cannabinoids for autism spectrum disorder (ASD). This is concerning, as the pursuit of cannabinoid treatments is resource-intensive and opaque, given the substantial mislabeling of readily available products and the largely unknown adverse effects and target outcomes. Determining whether cannabinoids will provide therapeutic options targeting core and/or associated symptoms for some or many individuals with ASD and accelerating the typical drug development timeline are urgent priorities. Because the field of cannabinoid therapeutics for ASD is in its infancy, it is uniquely positioned to advance collaborative methodologies that may serve as a model for psychopharmacology broadly.

Objectives: To identify strategies to improve methodology in pharmacological research, including (1) harmonizing outcome measurements across research efforts and (2) integrating the intensive design into intervention trials.

Methods: An analysis of ClinicalTrials.Gov and a review of the literature were conducted to understand current practices and identify promising approaches. First, we analyzed all entries on ClinicalTrials.gov, using the search terms “autism” and “drug,” to evaluate trends in ASD pharmacological research and estimate convergence in strategies. Data collected included trial design, intervention type, primary targets, and outcome measures. Next, inspired by Klein’s (2008) essay in JAMA on “The Loss of Serendipity in Psychopharmacology,” we examined the prevalence of intensive designs (also known as single-case or N-of-1 designs) in ASD drug development and evaluation. A comprehensive literature review was conducted using a variety of search terms to capture terminology differences across disciplines, collecting data on the above-noted variables and on trial results.

Results: We identified 301 ClinicalTrials.Gov entries. The number of registered drug trials posted has increased steadily since inception of the registry, as has the number of complementary and alternative medications studied (e.g., dietary supplements, oxytocin). Most frequent primary behavioral targets included core ASD symptoms (*n*=173), followed by challenging behavior/irritability (*n*=68) and language/communication (*n*=45). Noteworthy was the incongruence in outcome measurement. Although several measures were highly represented (Aberrant Behavior Checklist, *n*=232; Clinical Global Impression Scales, *n*=155) in the search, over 90% of measures evaluating psychiatric/behavioral targets were used in fewer than 10 studies, and a majority were just once or twice. With regard to study designs, literature review revealed the use of intensive designs, while historically always low, has decreased (e.g., 12 studies in 1997-2008, one in 2008-2018).

Conclusions: The lack of outcome harmonization impedes comparison of results across intervention trials and delays the already slow and arduous drug evaluation process. Nascent efforts to enhance harmonization with input from patients and families should be embraced. The near extinction of methodologically rigorous intensive designs is also regrettable, as standard parallel-group approaches are poorly suited for the heterogeneity of ASD. We encourage reconsideration of intensive designs in ASD therapeutics, particularly with respect to determining the therapeutic pros and cons of cannabinoids – a field in which uncontrolled n-of-1 experimentation is occurring rapidly, without safeguards or generalizable information regarding benefits and risks.

416.003 *(Poster)* No Clinically Relevant Effect of Balovaptan on Electrocardiography, Heart Rate or Blood Pressure in Healthy Volunteers

***M. Derks**[1], C. Wandel[2], L. Squassante[2], P. Jordan[2], S. Scoon[1], A. Young[1] and S. Bolt[1], (1)Roche Products Ltd, Welwyn Garden City, United Kingdom, (2)F. Hoffmann-La Roche AG, Basel, Switzerland*

Background: The neuropeptide vasopressin is implicated in modulating the brain circuitry regulating social behavior and the vasopressin 1a (V1a) receptor has emerged as a potential target for treatment of the core symptoms of autism spectrum disorder (ASD). Balovaptan, a potent, selective V1a antagonist in phase 3 development for ASD, has been well tolerated at single doses up to 76 mg and multiple doses up to 52 mg/day.

Objectives: To investigate, as part of a comprehensive safety assessment, the cardiac safety of balovaptan with respect to QT prolongation and other electrocardiography (ECG) parameters, heart rate, and blood pressure.

Methods: This was a single-center, multiple-dose, double-blind, placebo- and positive (moxifloxacin)-controlled, crossover study (NCT03808298) randomizing healthy adult volunteers to one of 12 three-treatment sequences separated by a 13–20-day washout. Treatment A administered a therapeutic balovaptan dose (10 mg/day), and treatment B a supratherapeutic dose (50 mg/day), each for 14 days plus single-dose moxifloxacin placebo on Days 2 and 15; treatments C and D administered balovaptan placebo for 14 days, plus single-dose moxifloxacin 400 mg on Day 2/moxifloxacin-placebo on Day 15 (treatment C), or placebo Day 2/moxifloxacin Day 15 (treatment D). Six sequences included treatments A, B, and C; and six A, B, and D. ECG data were extracted from continuous 12-lead Holter recordings pre-dose and up to 24 hours post-dose on Days 1, 2, 14, and 15 of each period. The primary endpoint was the placebo-corrected change from baseline in the least-squares mean (LSM) Fridericia-corrected QT interval (ddQTcF), derived from a linear mixed model with baseline QTcF as the covariate and gender, period, sequence, time, and treatment as fixed effects. Other endpoints included placebo-corrected LSM changes from baseline in the PR and QRS intervals and heart rate (ddHR), and in mean ambulatory blood-pressure data (systolic [ddSBP], diastolic [ddDBP], and mean arterial [ddMAP] pressure) assessed periodically between 9.00AM and 5.30AM on Days –1 (baseline) and 12. Assay sensitivity was confirmed if ≥1 moxifloxacin ddQTcF from 1–4 hours post-dose was significantly >5 msec (Hochberg-adjusted $p<0.05$).

Results: ECG data were available for 52 placebo/moxifloxacin, 55 balovaptan 10 mg, and 52 balovaptan 50 mg participants. Observed balovaptan plasma concentrations ranged up to 1130 ng/mL. Assay sensitivity was confirmed. There was no clinically relevant effect of balovaptan on ddQTcF at either Day 1 or at steady-state (Day 14), and no apparent time or dose dependency (**Figure**). There were no relevant effects on other ECG parameters (not shown) or on heart rate or blood pressure: steady-state ddHR, ddSBP, and ddDBP are shown in the **Table**; ddMAP on Day 12 was –0.2 mmHg (90% CI –1.65; 1.19) for 10 mg balovaptan, and 0.2 mmHg (–0.97; 1.40) for 50 mg balovaptan. Balovaptan was generally well tolerated, with unremarkable adverse event and laboratory profiles at both doses. There was one discontinuation (neutropenia).

Conclusions: Balovaptan did not show clinically relevant effects on the QT interval, heart rate, or other ECG or blood pressure parameters at multiple doses of 10 mg or 50 mg daily.

Early Development (< 48 months)

PANEL SESSION — **EARLY DEVELOPMENT (< 48 MONTHS)**

209 - Identifying ASD Risk in Infancy: Clinical and Ethical Implications

Panel Chair: Katherine MacDuffie, *Speech and Hearing Sciences, University of Washington, Seattle, WA*

Discussant: Joseph Piven, **Co-senior author, University of North Carolina, Chapel Hill, NC*

Accumulating evidence suggests that brain changes in infants at high familial risk for ASD precede the consolidation of symptoms into diagnosis and allow accurate prediction of which infants will go on to develop ASD. These predictive approaches hold great potential for presymptomatic detection and pre-emptive ASD intervention during a period of rapid brain and behavior development in the first year of life. If replicated, we anticipate that these predictive methods will be incorporated into the clinical assessment of risk and treatment planning for infants with a family history of ASD. Efforts to develop pre-emptive interventions are ongoing, and will be facilitated by predictive approaches that can precisely identify which infants will go on to develop ASD such that only those at highest risk are targeted for intervention. The rapid pace of this research also raises critically-important ethical questions about returning predictive results to parents while the evidence base for presymptomatic interventions is still being built. This symposium will discuss methodological, procedural, clinical, and ethical considerations for presymptomatic identification and treatment for ASD, and identify open questions that remain to be tackled in the next phase of this research.

209.001 *(Panel)* The Presymptomatic Prediction of ASD Using Infant MRI

J. Pruett, **Co-senior author, **For the IBIS Network, Washington University School of Medicine, St. Louis, MO*

Background: Consensus in the field and emerging data suggest that early intervention will improve outcomes in autism spectrum disorder (ASD). Infants who develop ASD begin to manifest disorder-specific behaviors in the second year. As such, there are no first-year-of-life behavioral features that allow for accurate prediction of later ASD. We know from other neuropsychiatric conditions, e.g. Parkinson's disease, that brain-based changes often precede the development of disorder-specific behaviors. With this in mind, it is possible that MRI scans during the presymptomatic period in the first year of life could identify brain-based changes that later contribute to and accurately predict the development of ASD.

Objectives: To test whether multiple independent MRI modalities, in the first year of life in infants at high familial risk for ASD (due to an affected sibling), could produce clinically actionable predictions (e.g., >= 80% positive predictive values) about a later diagnosis of ASD.

Methods: Investigators in the Infant Brain Imaging Study (IBIS) network acquired structural and functional MRI scans from naturally sleeping infants at six and 12 months old, and clinical best estimate diagnosis of ASD was determined at 24 months. Presymptomatic diagnostic outcome prediction utilized fully cross-validated machine learning approaches.

Results: We can predict ASD at 24 months from MRI scans acquired in the first year of life, during the presymptomatic period, using independent MRI modalities – structural MRI scans at 6-12 months and functional connectivity MRI scans at 6 months – with potentially clinically actionable (>= 80%) positive predictive values.

Conclusions: Our predictive outcome classification findings point to the future possibility of randomized, presymptomatic intervention trials for HR infants. These initial results need to be replicated, and we are now funded to do so in a new sample of 250 HR infants, where we will also test the ability of first-year-of-life MRI to predict quantitatively measured levels of later ASD-associated behaviors. The above findings raise important clinical and ethical questions that will be discussed here and in subsequent talks in this panel, concerning: prospects for replication, residual uncertainty, consideration of return-of-results in an ongoing study, extension of positive results from HR infants to the general population, and parent and provider preferences regarding knowledge about accurate predictive information given the current lack of validated presymptomatic interventions. Recruitment for our new study is now underway, and we will provide a brief update about progress.

209.002 *(Panel)* Pre-Symptomatic Prediction of ASD in High Risk Infants with Scalable EEG Methods

S. Jeste *and A. H. Dickinson, University of California, Los Angeles, Los Angeles, CA*

Background: The neurobiological changes associated with autism spectrum disorder (ASD) include alterations in neuronal activity, synchrony and connectivity that begin well before behavioral symptoms emerge (Quesnel-Vallieres et al, 2019).These changes may impact an infant's ability to learn from and engage with environmental inputs, cascading over early childhood into the more complex impairments in social interaction that define ASD (Piven et al, 2018). Measurement of these early brain changes with a scalable, clinically accessible tool—spontaneous (resting-state) electroencephalography (EEG)—can improve timing of risk identification and facilitate closer monitoring and intervention for those infants at highest likelihood to develop ASD

Objectives: (1) To examine EEG patterns of atypical development and predictors of ASD in two distinct risk groups [Tuberous Sclerosis Complex (TSC) and infant siblings], with focus on EEG phase coherence and peak alpha frequency. (2) To place these findings in the context of prior resting-state EEG studies of high-risk infants, discussing methodological and conceptual convergence and variance, and introduce new study designs that may mitigate some of the challenges presented.

Methods: High density EEG was collected as a part of two separate longitudinal studies of development in TSC (ages 12, 18, 24 months) and infant siblings (ages 3, 6, 9, 12 months), with ASD symptoms assessed at 18 months and full diagnostic assessment performed at 36 months. After cleaning using independent component analysis, EEG data were transformed into current source density estimates using a Laplacian transform. Alpha phase coherence and peak alpha frequency were quantified using methods previously published (Dickinson et al, 2018a, 2018b). Two data-driven approaches were applied to examine predictors of ASD, including nonparametric permutation testing, with FDR correction, and support vector regression (SVR) algorithms. Non-parametric Kendall's tau correlation was employed to examine relationships between cognitive function and peak alpha frequency.

Results: Infants with TSC show reduced interhemispheric connectivity compared to controls at 12 months ($p<0.01$), with coherence reduced most significantly in infants who later developed ASD ($p<0.01$). Across all infants and within the TSC group alone, peak alpha frequency at 24 months was associated with verbal and non-verbal cognition at 36 months (0.314, $p=0.020$ for full group, 0.389, $p=0.016$ for TSC group). In infant siblings, significant differences in alpha phase coherence in several networks that represented reduced long-range connectivity and increased frontal cortical connectivity were identified between the ASD+ and ASD- groups as early as 3 months ($R=0.81$, $p<0.01$).

Conclusions: EEG is a promising, scalable method to identify the earliest changes in brain development and function in infants prior to the diagnosis of ASD. Despite heterogeneity in genetic risk and medical comorbidities, EEG changes in long range connectivity can differentiate infants who will develop ASD as early as 3 months, while peak alpha frequency relates to cognitive function. These studies necessitate larger scale collaborations, replication in independent samples, parallel testing of different risk groups, examination of change with early intervention, and concurrent collection of MRI and EEG to understand the structural underpinnings of these functional patterns; ongoing studies to address these challenges will be discussed.

209.003 *(Panel)* Progress in Intervention for Infants with ASD Symptoms

S. J. Rogers[1]*, S. Dufek*[2] *and M. R. Talbott*[3]*, (1)Department of Psychiatry and Behavioral Sciences, The Medical Investigation of Neurodevelopmental Disorders (MIND) Institute, UC Davis School of Medicine, University of California Davis, Sacramento, CA, (2)Psychiatry, University of California, Davis, Sacramento, CA, (3)Psychiatry and Behavioral Sciences, University of California at Davis MIND Institute, Sacramento, CA*

Background: A recent rigorous intervention trial (Whitehouse et al., 2019) found no effects on parent or infant behaviors for symptomatic infants; yet other studies have demonstrated positive parent and infant responses (Steiner et al, 2013; Koegel et al., 2013; Rogers et al., 2014). Studies of symptomatic infants are challenged by the low incidence of such infants in any individual community and lack of validated approaches. Four factors motivate continued study: (1) the plasticity of infant neural and behavioral development, (2) the stress experienced by parents who perceive autism symptom in their infants, (3) the resulting potential alterations in parent-infant interactions, and (4) the promise of effective intervention for minimizing symptoms and supporting development.

Objectives: Provide 1) a brief review of the arguments for and against intervening before diagnosis; 2) a review of published studies involving infants under 12 months; 3) findings from a new single-subject component analysis telehealth infant intervention study.

Methods: A multiple-subject counter-balanced component analysis design to examine effects on parent behavior and infant symptoms of three treatment techniques: Step into the Spotlight, Imitate, and Talking to Baby. Six infants 6-12 months of age exhibiting early signs of ASD and their primary caregiver participated for 3 months. Infants were referred by their parents. Infants were assessed and qualified for the study using a novel telehealth protocol of symptoms administered by parents. Telehealth intervention sessions occurred three times per week for one month. One treatment technique was introduced each week to the caregiver and covered for 3 sessions to allow for caregiver coaching and practice. Interventionists were certified ESDM parent coaches and followed a manualized protocol. Coach's fidelity, caregiver fidelity of implementation (FI) of treatment techniques, and child ASD-specific behaviors were coded from 10-minute caregiver-child dyad intervention video-recorded probes.

Results: Based on initial coding of half the sample, the telehealth assessment approach resulted in high inter-rater agreement on infant symptom presentation and valid assessment of developmental status. Coaches delivered the intervention at 90% fidelity to standards. Caregivers learned each intervention technique to mastery, with interobserver agreement (IOA) of 88% overall. Once learned, parent skills were generally maintained at elevated levels. Parent behaviors regarding each technique tended to remain at baseline until that specific technique was targeted: thus, each technique changed parent behavior in the specific skill area targeted. Parents were highly satisfied with the intervention.

Conclusions: Parents experience great worry and often seek help when they perceive autism symptoms in their infants. This study identified three intervention techniques that contributed independently to improvements in parent intervention skills, the necessary first step to constructing an efficacious parent-delivered intervention. Telehealth procedures provided the opportunity to reach families quickly regardless of distance and to both assess and treat infant symptoms. Infant change demonstrated in single subject studies supports continued efforts to construct effective interventions for this group of infants and parents. Recommending such interventions for nonsymptomatic infants identified with ASD risk based on brain-based or related characteristics raises multiple concerns including ethics, cost, and possible unwanted effects that require careful consideration.

209.004 *(Panel)* Is Presymptomatic Prediction of Autism Spectrum Disorder Ethically Justified?

K. E. MacDuffie[1,2]*, A. Estes*[1] *and B. Wilfond*[2]*, (1)Speech and Hearing Sciences, University of Washington, Seattle, WA, (2)Treuman Katz Center for Pediatric Bioethics, Seattle Children's Hospital, Seattle, WA*

Background: As prior talks on this panel have demonstrated, emerging methods could potentially shift the timing of ASD detection and intervention into the first year of life, accelerating neuroscientific investigations into the early pathogenesis of ASD and enabling targeted enrollment into research trials of presymptomatic interventions. The evidence base for presymptomatic interventions is still being built, however, with consensus on "best practice" for interventions delivered in infancy still likely years away. These circumstances raise an important ethical question for presymptomatic ASD research that has been widely debated in the genomics literature: is disclosure of a predictive diagnosis to parents justified when there is no immediate treatment available? Prior to 2005, international guidelines and position papers on genetic testing offered ambiguous or inconclusive recommendations about whether predictive testing should be offered for childhood-onset disorders with no proven intervention (Borry et al., 2006).

Objectives: The goal of the current project was to review current recommendations from the genomics literature for predictive testing in children and evaluate their applicability to the brain-based prediction efforts described in this panel.

Methods: A review of international consensus statements/guidelines on predictive genetic testing in children was conducted to update a prior review published by Borry and colleagues (2006). Each guideline included in the prior review was revisited and those that had been updated since 2005 were included in the analysis. Statements related to genetic testing for childhood-onset disorders with no proven intervention were extracted; illustrative examples are shown in Table 1.

Results: In the last 15 years, international guidelines and consensus statements have shifted towards allowing parents more discretion in decisions about whether to pursue predictive testing for their children. Parental discretion is advised most strongly in the context of familial disorders, where the uncertainty of whether a child will develop symptoms can be a source of worry and anticipatory distress. Statements in favor of a more discretionary set of policies argue that the benefits of predictive information for families often go beyond strictly *clinical* utility (i.e., enabling access to available, proven treatments) to include a more inclusive and subjective notion of *personal* utility (Garrett et al., 2019).

Conclusions: The results of our literature review suggest that research efforts to develop and evaluate a presymptomatic test for ASD are—in our opinion—ethically justified. The only way to understand the risks and benefits of predictive testing is to study it (Tarini et al., 2011). Our ongoing research efforts aim to understand the perspectives of parents, to whom will fall decisions about whether to pursue presymptomatic testing for a given child. Further work to incorporate perspectives of other stakeholders (clinicians, adults with ASD, disability advocates) on predictive testing is warranted. Resulting evidence will inform future deliberations about whether predictive testing for ASD offers sufficient benefit to justify widespread clinical use.

PANEL SESSION — EARLY DEVELOPMENT (< 48 MONTHS)
210 - New Avenues of Research Reveal Novel Genomic, Functional and Structural Knowledge about Early ASD Brain Development

Panel Chair: Eric Courchesne*, Neuroscience, UC San Diego Autism Center of Excellence, San Diego, CA*

Discussant: Eric Courchesne*, Autism Center of Excellence, Neurosciences, University of California, San Diego, La Jolla, CA*

ASD begins in fetal life and disrupted molecular and neural development continues into the first years. It is therefore of the utmost importance to elucidate the neural functional and structural patterns of developmental change and the underlying molecular dysregulations at the earliest stages of postnatal life, namely, in infants, toddlers and young children with ASD. That knowledge would then enable discovery of early-age neurofunctional and genomic biomarkers that accompany symptom onset, convey prognostic clinical and treatment information, and indicate disorder subtypes and the role of gender. Research and knowledge in this vital area has accelerated in recent years and much new work is underway in many laboratories. Here we present four important examples of investigations using novel designs, methods and concepts to advance genomic, functional and structural knowledge of ASD across early development. Successful work by a variety of investigators in this field enables future research to improve early identification and intervention, reduce uncertainty in objectively identifying subjects for inclusion in treatment trials, and identify brain-behavior and genomic-imaging subtypes to allow for individualized treatment.

210.001 *(Panel)* Altered Resting-State Functional Connectivity Networks in Preschool Age Males and Females with Autism Spectrum Disorder

J. K. Lee[1]*, C. W. Nordahl*[1]*, S. Ozonoff*[2]*, M. Solomon*[1]*, D. S. Andrews*[1] *and S. J. Rogers*[1]*, (1)Department of Psychiatry and Behavioral Sciences, The Medical Investigation of Neurodevelopmental Disorders (MIND) Institute, UC Davis School of Medicine, University of California Davis, Sacramento, CA, (2)Psychiatry and Behavioral Sciences, University of California at Davis, MIND Institute, Sacramento, CA*

Background: Little is known about how Autism Spectrum Disorder (ASD) manifests during early childhood, a period of rapid brain development. Initial evidence in males suggests the early presence of altered amygdala resting-state functional (rsfMRI) connectivity, but alterations in other rsfMRI networks have not been examined within this age group. Much less is known about rsfMRI alterations in females with ASD, or the degree to which alterations in ASD are sex specific.

Objectives: To examine diagnostic and sex differences in amygdala rsfMRI connectivity and in ten rsfMRI connectivity with ten canonical brain networks (Smith et al., 2009) in a cohort of males and females with ASD and typically development (TD) in early childhood.

Methods: Resting-state functional connectivity was examined in 156 ASD (50 female) and 78 TD children (38 female) aged 2 to 6 years during natural sleep. Diagnostic assessments for ASD were carried out by expert clinicians using the ADOS and ADI-R. Resting state images were preprocessed using the Configurable Pipeline for the Analysis of Connectomes (C-PAC; Craddock et al., 2013). Volumes with frame-wise displacement greater than .25 mm were scrubbed. Whole-brain connectivity maps with left and right amygdala seeds were computed. Dual regression (Beckmann et al., 2009) was also performed to estimate participant-specific connectivity maps with canonical rsfMRI networks (Smith et al., 2009). Two analytical strategies were employed. First, multivariate distance matrix regression (MDMR) assessed global diagnostic differences across each network. Second, univariate general linear models identified focal regions with significant mean connectivity differences within each network with cluster-based correction for multiple comparisons using Gaussian Random Field theory ($Z > 2.70$, pGRF<.005).

Results: MDMR analysis revealed significant diagnostic group differences across sexes in several networks, including the default mode, left frontoparietal, and right frontoparietal networks (Figure 1, A, B, and C). However, sex-specific diagnostic differences in left amygdala and cerebellar rsfMRI connectivity networks were observed (Figure 1, D and E). Univariate analysis revealed similar diagnostic differences across sexes between left and right amygdala and the superior temporal sulcus and supramarginal gyrus, as well as with multiple canonical networks, including medial/occipital visual and left and right frontoparietal networks. However, sex-specific diagnostic differences were observed for the left and right amygdala, and in connectivity with several canonical networks, including the cerebellar, sensorimotor, frontoparietal networks.

Conclusions: Altered network connectivity differences were observed in ASD across multiple networks in both males and females with ASD at the age of first diagnosis. However, networks also exhibited sex-specific diagnostic differences.

210.002 *(Panel)* Neural Correlates Underlying Reduced Social-Emotional Speech Engagement in Toddlers with ASD

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Background: It is well-established that typically developing (TD) babies attend to and prefer “motherese”, which is a strongly emotional mode of speech used by parents towards infants and toddlers in nearly all cultures. Saint-Georges et al. (2013) state that motherese “is part of an interactive loop {between mother and infants} that may play an important role in infants’ cognitive and social development.” Motherese enhances joint social attention, language acquisition, and affect and emotion development and regulation. Behavioral preference for motherese may be markedly deficient in infants with ASD. Absent, however, are fMRI studies of motherese that coincide with initial clinical signs of ASD in infants and toddlers. Here we analyze fMRI activations in ASD toddlers responding to neutral, moderately prosodic, or motherese speech and compare them to TD subjects.

Objectives: We investigated fMRI responses to speech with varying levels of social-emotional prosody from typical to motherese in ASD and TD toddlers and whether functional activation to different levels of prosodic speech is behaviorally relevant.

Methods: We scanned 27 ASD toddlers (23 males, 29.07±9.65 months, range 14–55 months) and 17 TD toddlers (11 males, 26.12±6.47 months, range 17–38 months) during natural sleep while presenting the following paradigms: Typical Prosody, Moderate Prosody, and Motherese (recorded female voices reading phrases from storybooks or typical infant-directed utterances presented in a block design; different paradigms exhibit increasing levels of emotional intonation). ASD and TD groups were equivalent on age and gender. For each paradigm, multi-echo fMRI data from separate runs were collected. Structural scans were also obtained from participants.

Data preprocessing was performed using the ME-ICA approach with meica.py tool (Kundu et al., 2013) in AFNI (Cox, 1996); functional images were normalized to an age-matched toddler template (Shi et al., 2011). Head motion was quantified with framewise displacement (Power et al., 2012) and didn't show group differences across tasks. GLM analyses were conducted using SPM12 (https://www.fil.ion.ucl.ac.uk/spm/software/spm12/). Percent signal change (Speech > Rest) was calculated for each task based on language regions from Neurosynth (i.e., bilateral temporal regions) (Yarkoni et al., 2011). For all three paradigms, we examined group differences in brain activation and characterized the relationship between brain activation and social abilities as measured by the Vineland Adaptive Behavior Scales (Sparrow et al., 2005).

Results: In TD toddlers, strong bilateral temporal responses were observed for all levels of prosody; brain activation and social abilities were positively related in the Moderate Prosody and Motherese tasks (see Figure). Compared to TD, ASD toddlers showed hypoactivation to all speech stimuli (Cohen's d ranging from 0.73–1.05) and absence of correlations with social abilities (see Figure).

Conclusions: Consistent with the literature that motherese enhances joint social attention, language acquisition, and affect and emotion development and regulation, we found that Moderate Prosody and Motherese enhanced temporal cortex activation in TD is in strong concordance with social ability. The absence of this at the early age of clinical onset in ASD may be a biomarker of foundational dysregulation of social-emotional development that could underpin development of associated social cognitive functions.

210.003 *(Panel)* Different Large-Scale Associations between Blood Leukocyte Gene Expression and Surface Area or Cortical Thickness in ASD Toddlers with Good Versus Poor Early Language Outcome

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Background: Understanding of the 'living' biology behind heterogeneous types of autisms (ASD) is the next frontier for autism research (Courchesne et al., 2019, *Molecular Psychiatry*). In prior work, we found that ASD good versus poor early language outcome subtypes show distinct types of large-scale associations between distributed neural systems response to speech measured with fMRI and widespread gene expression patterns in blood leukocytes (Lombardo et al., 2018, *Nature Neuroscience*).

Objectives: Examine whether there are ASD subtype-distinctive associations between gene expression and neuroanatomical features (e.g., surface area (SA) and cortical thickness (CT)).

Methods: n=76 ASD toddlers (ASD Poor n=38, mean age=29.01 months; ASD Good n=38, mean age=29.02 months) and n=47 typically-developing (TD) toddlers (mean age=25.91 months at MRI scan) were scanned with MRI during natural sleep and donated a blood sample for gene expression analysis. Early language outcome subtype stratifications (ASD Poor vs ASD Good) were made according to past work (Lombardo et al., 2015, *Neuron*). Freesurfer estimated SA and CT from parcels determined based on patterns of regional genetic correlations from prior twin studies (Chen et al., 2013, *PNAS*). Weighted gene co-expression network analysis (WGCNA) clustered blood leukocyte gene expression into 21 gene co-expression modules. Partial least squares (PLS) analysis was utilized to find multivariate associations between module eigengene expression and SA or CT. A permutation test (10,000 permutations) was used to evaluate statistical significance of latent variable (LV) pairs and bootstrapping (10,000 resamples) was used to compute 95% confidence intervals to identify co-expression modules with 'non-zero' associations and bootstrap ratios (BSR) to assess regions of importance to each LV.

Results: For SA, we identified 1 LV pair with a statistically significant association (d=3.99, p=9.99e-5), while for CT there were 2 LV pairs that passed FDR q<0.05 (LV1 d=4.30, p=9.99e-5; LV2 d=3.09, p=9.99e-5). CT LV1 showed significant overlap in the non-zero modules for TD and ASD Good (63%, OR=29.75, p=0.01), indicating common associations for these groups. However, in all other LVs, no statistically significant overlap between-groups existed (<33% overlap, all p>0.26), indicating that there are distinct associations specific to each group. Non-zero co-expression modules of importance to LV1 in SA or CT were mainly restricted to TD and ASD Good groups. However, in CT LV2, the ASD Poor group drove most of the non-zero associations with co-expression modules. Finally, the pattern of association across brain regions for SA and CT LV1 followed anterior-posterior (A-P) and ventral-dorsal (V-D) cortical gradients respectively and recapitulate gradients found in twin studies (Chen et al., 2013). Genes from SA and CT LV1 non-zero modules are also enriched for genes that drive similar A-P or D-V gene expression gradients observed during midgestational periods of prenatal brain development (OR>2.39,p<1.35e-21) (Li et al., *2018, Science*).

Conclusions: Different functional genomic mechanisms in ASD language outcome subtypes are linked to early postnatal neuroanatomical development and overlap with similar mechanisms affecting midgestational periods of prenatal brain development. Early structural and functional brain development in ASD toddlers with poor versus good early language outcome is likely driven by distinctive early biological mechanisms.

210.004 *(Panel)* Salience Network Connectivity in 6-Week-Old Infants Predicts Later Development of Social Attention and Autism Symptomatology

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Background: Infants who develop ASD show altered developmental trajectories characterized by reduced attention to social information and heightened awareness of non-social sensory input.The neurobiological mechanisms underlying these altered attentional biases that may give rise to autism-related symptoms remains unknown. Examining early brain connectivity offers a promising lens for investigation as neuroimaging studies have consistently implicated atypical brain network dynamics in ASD, with recent evidence indicating that 6-month-olds who later develop ASD already exhibit significant differences in whole-brain functional connectivity.

Objectives: To examine functional connectivity in the Salience Network (SN) – an early-emerging neural network involved in orienting attention to the most salient aspects of one's internal and external environment – as well as its association with subsequent ASD symptomatology (i.e., atypicalities in sensory processing, communicative development, and visual social attention to faces) in 6-week-old infants at high (HR) and low (LR) familial risk for ASD.

Methods: 8-min rs-fMRI scans were collected during natural sleep (N=53). Preprocessing was performed using FSL with ICA-AROMA used to correct for head motion. The SN was identified using the right anterior insula as the seed. The Autism Observation Scale for Infants (AOSI,) the Early Social Communication Scale (ESCS), and the Infant/Toddler Sensory Profile (ITSP) were used at 12 months to assess core ASD symptoms, nonverbal social-communication, and sensory sensitivities, respectively. To capture developmental trajectories in social attention to faces, eye-tracking was conducted at 3-, 6-, 9-, and 12-months while infants viewed videos depicting social interactions.

Results: Compared to LR infants, HR infants showed stronger SN connectivity with sensorimotor regions as well as weaker SN connectivity with prefrontal regions associated with higher-level processing and attentional control. Notably, infants with higher connectivity with sensorimotor regions had lower connectivity with prefrontal regions, suggesting a direct tradeoff between attention to basic sensory versus socially-relevant information. In HR infants, greater SN connectivity with primary sensory processing regions predicted higher sensory hypersensitivity whereas stronger SN connectivity with regions involved in implicit learning and reward processing predicted fewer ASD risk markers on the AOSI. In LR infants, stronger SN connectivity with prefrontal regions predicted increased social attention to faces over the first year; similarly, greater SN connectivity with both prefrontal and subcortical regions associated with reward and learning predicted higher rates of initiating joint attention, indicating that normative SN connectivity patterns in early infancy support attention to socially-relevant stimuli, scaffolding the development of social communication skills.

Conclusions: These results demonstrate that aberrant patterns of SN connectivity can be detected in infants at high risk for ASD as early as 6 weeks of age and that these alterations predict subsequent development of ASD symptomatology. Importantly, these findings provide empirical support for recent theoretical frameworks positing that initial deviations in attentional biases and/or sensorimotor processing may account for the emergence of ASD-related behaviors by altering the experience-dependent brain maturation that typically subserve social development. Identifying atypical brain connectivity early in infancy may pave the way for timely interventions that can effectively redirect attention to socially-relevant input and thus stir development along optimal developmental trajectories.

ORAL SESSION — EARLY DEVELOPMENT (< 48 MONTHS)
311 - Early Identification and Development

311.001 *(Oral)* Early Autism Screening in a Community Sample: Preterm Infants on the First Years Inventory 3.1

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Background: Preterm infants are at higher likelihood for an eventual diagnosis of ASD and atypical development across multiple domains. Thus, ASD screening tools that may be used in the preterm population should be tested for factorial invariance (i.e., testing whether latent variables are measured equivalently across groups). Additionally, though standard assessment practice is to use adjusted age for a minimum of 12 months post birth, specific recommendations may vary across measures and should be justified through data analyses.

Objectives: We sought to use confirmatory factor analysis to test whether the First Years Inventory version 3.1 (FYI 3.1) performed equivalently across preterm and full-term infant groups from a community sample.

Methods: We analyzed 27 core items on the FYI 3.1, a parent-report questionnaire designed to identify infants at risk for an eventual diagnosis of ASD. We conducted invariance testing to determine whether social communication (SC) and sensory regulatory (SR) domain items loaded similarly for preterm (n=400) and full-term infants (n=4,568). We ran separate analyses for two preterm infant groups: “9-month” adjusted (8-10 months adjusted; n=219) and “12-month” adjusted (11-13 months adjusted; n=181). We first tested for configural (structural) equivalence across groups as the baseline model followed by metric, scalar, and residual models with varying constraints on factor loadings and thresholds. Model fit was evaluated using chi-square estimates, comparative fit index (CFI), and root mean square error of approximation (RMSEA). CFI>.90 and RMSEA<.08 (Hu & Bentler, 1999) were considered to be good fit. We assessed chi-square differences between invariance models to test whether assumptions of invariance constraints were violated.

Results: Models were invariant at the most restrictive level for 9-month groups: factor loadings, item thresholds, and item residuals were equal across both groups on both domains. There were small but non-significant differences in SC and SR variances and significantly higher mean scores in SC for the preterm group. Factor loadings for 12-month groups were equal, but there was partial invariance (i.e., some parameters were allowed to be unequal) at threshold and residual levels. The model indicated significantly more variance in SC for the preterm group and no significant differences in SC or SR means.

Conclusions: Our results show that parents of preterm and full-term infants in our sample interpreted the FYI’s SC and SR questions similarly. This provides preliminary evidence supporting the use of the FYI 3.1 in the preterm population. The presence of partial invariance for the 12-month group of preterm infants on both SC and SR reflects differences in average levels of responses (on a scale of “never” to “always”) as a function of prematurity, suggesting potential bias in parent responses in the 12-month group. We will examine these response differences and further explore variance in scale scores across adjusted and unadjusted preterm infant groups to determine whether there is an age at which variances are no longer significantly different. That is, through comparisons between variance across preterm and full-term groups, we will determine whether there is an age group for which the use of unadjusted age is warranted.

311.002 *(Oral)* Aberrant Cortical Thickness and Cortical Surface Area in Auditory and Premotor Cortices in Toddlers and Preschoolers with Autism Spectrum Disorders

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Background: Early brain enlargement has been consistently reported in young children with autism spectrum disorders (ASDs), with some initial evidence from longitudinal prospective studies of high-risk infants suggesting that accelerated cortical surface area expansion in the first year of life precedes and underlies brain volume overgrowth. Specifically, early surface area expansion appears to be most robust in regions involved in visual processing. However, given the scarcity of imaging data in young children with ASDs, further evidence is needed to determine whether these findings apply to all sensory modalities.

Objectives: To examine cortical thickness and surface area for primary sensorimotor networks (i.e., visual, auditory, somatosensory, motor) in toddlers and preschoolers with ASDs as compared to typically developing (TD) peers.

Methods: Participants wereyoung children with ASDs (age: 42±14 months, 18-69 months) and TD children (41±14 months, 18-65 months) enrolled in a longitudinal study of early brain markers of autism. ASD diagnoses (or clinical best estimates for youngest participants) were established based on the DSM-5 criteria, supported by the Autism Diagnostic Observation Schedule (ADOS-2). The Mullen Scales of Early Learning were administered to assess visual reception, motor, and language skills. T1-weighted MPRAGE scans acquired in 60 toddlers (32 ASD, 28 TD) during natural sleep were included. Data quality, inspected by multiple raters, was equivalent in both groups. Cortical thickness (CT) and surface area (SA) were calculated using FreeSurfer in 58 regions of interests within visual, auditory, somatosensory, and motor networks from the Human Connectome Project parcellation. Group differences in CT were examined with two-sample t-tests. ANCOVA was used to compare group differences in SA, with total SA as a covariate.

Results: Increased SA was detected in the ASD group in regions involved in higher-order auditory processing, including area TA2 and anterior superior temporal gyrus (STGa) in the left hemisphere, as well as in the right premotor eye field. Increased CT was identified in left STGa, while decreased CT was found in premotor area 6v and cingulate motor area 24d in the right hemisphere (all results at $p<0.05$, uncorrected). Mullen Fine Motor (FM) Age Equivalent (AE) scores were positively correlated with CT of right area 6v in children with ASDs (r=.53), but negatively in TD children (r=-.44), with significant FM by diagnosis interaction, controlling for age (Fig. 1). Similarly, CT of right dorsal area 24d was negatively correlated with Mullen FM AE in TD (r=-.54), but not in ASD (r=-.04) children, controlling for age (Fig. 2).

Conclusions: Increased cortical surface area was detected in young children with ASDs, particularly in higher-order auditory regions and premotor cortex, but not in visual cortices. This was accompanied by increased cortical thickness in higher-order auditory cortex, but decreased CT in premotor/motor cortices. Critically, reduced CT in premotor/motor regions was associated with greater fine motor skills in TD children, but this relationship was reversed or absent in children with ASDs, suggesting an atypical brain and behavioral maturation of motor circuits in the first years of life in ASDs.

311.003 *(Oral)* M-CHAT-R/F Performance in Low Mental Age: Autism Spectrum Disorder Versus Global Developmental Delay

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Background: Existing screening measures, such as the Modified Checklist for Autism in Toddlers, Revised, with Follow-Up (M-CHAT-R/F; Robins et al., 2014), are influenced by developmental stage, and may flag children with significant delays but not Autism Spectrum Disorder (ASD), because their developmental delay precludes the development of age-typical social interaction. Existing diagnostic tools have been shown to classify some children with a mental age under 12 months (low MA) at risk for ASD when their clinical diagnosis was Global Developmental Delay (GDD; Miller et al., 2019). Identification of specific behaviors that lead to true or false positives for ASD in very delayed children may help clinicians better estimate a child's risk for ASD.

Objectives: There is evidence that the ASD-low MA symptom profile is a unique phenotype, and that children in this group should perform differently from GDD groups on screening and diagnostic instruments (Hinnebusch et al., 2017; Miller et al., 2019). The current project aims to identify screening items that differentiate or fail to differentiate children with ASD-low MA from those with GDD.

Methods: Children (n=60) between 12 months and 34 months of age participated in a multi-site study of early detection in ASD. The ASD-low MA group (n=30) had age equivalents <12 months on MSEL language and nonverbal subtests, and met diagnostic criteria for ASD. The GDD group (n=30) consisted of children who met DSM-5 criteria for Global Developmental Delay. The groups were matched on Expressive Language and Visual Reception Mullen Scales of Early Learning (MSL) age equivalents, but were significantly different on chronological age ($F(1,57)=6.128$, $p=.016$) and race ($t(51)=2.432$, $p=.019$). The ASD-low MA group was significantly older (M=20.4 months, SD=5.5) than the GDD group (M=17.6 months, SD=3.0), and fewer GDD families identified as White. Maternal education differences were not significant between the groups ($t(55)=-.376$, $p=.57$).

Results: Chi-square analyses were conducted to identify the percentage of each group that failed each M-CHAT-R/F item (Table 1). Five of the 20 items differed by diagnostic group. These indicated that parents of children in the ASD-low MA group were more likely to indicate that their child does not follow a point, show interest in children, display social smiling, or imitate others, compared to the GDD group. Parents of children in the GDD group were more likely to indicate that their child does not walk, compared to the ASD group. In logistic regressions with race as a covariate, and setting $p<.01$ for multiple comparisons, only following a point (AOR 7.526, 95% CI: 1.659-34.144) and interest in children (AOR 5.889, 95% CI: 1.068-32.458) remained significantly more likely in the ASD-low MA group.

Conclusions: There may be "key" items to differentiate ASD-low MA from GDD when screening children with known significant delays for possible ASD. Following a point, interest in peers, imitation, and social smiling may be the most robust behaviors that differentiate between these two groups when cognitive level is below one year. Current results suggest that these core autism signs are valid diagnostic markers even with very low developmental status.

311.004 *(Oral)* Sex Differences in the Prediction of Language Development By Patterns of Social Visual Engagement in Children with and without ASD

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Background: Autism Spectrum Disorder (ASD) diagnoses are about 4 times more common in males than females. Although research on sex differences in language development in ASD remains limited (Lai et al., 2015), females with ASD but without intellectual disability have been found to exhibit more developmentally-appropriate language skills than males with ASD (Messinger et al., 2015). Studies of early social visual engagement (SVE) suggest that females with ASD demonstrate increased attention to faces relative to ASD males under socially-lean conditions (Chawarska et al., 2016), and point to an association between SVE to faces and expressive language (Young et al., 2009). While TD infants increase attention to mouth over infancy, followed by a return to focus on the eyes by two years (Hunnius & Geuze, 2004; Frank et al., 2011), this pattern of SVE has not been shown in autism. Sex-and diagnosis-based divergences in trajectories of SVE over development may hence explain differential language outcomes in ASD.

Objectives: This study examines sex-based differences in the associations between SVE at the beginning of the first and second years of life, and language development and social disability at the end of the second year of life, in a longitudinally-followed cohort of ASD and TD infants.

Methods: Eye-tracking measures of SVE were collected during early infancy (N_{ASD}=40(10 female), $M_{age,male}$=5.13, $M_{age,female}$=5.08, N_{TD}=93(44 female),$M_{age,male}$=5.15,$M_{age,female}$=5.13) and the second year of life (N_{ASD}=45(12 female), $M_{age,male}$=15.20, $M_{age,female}$=15.28, N_{TD} =80 (34 female), $M_{age,male}$=15.28, $M_{age,female}$=15.12) while children watched scenes of naturalistic caregiver interactions. At 24 months, the Mullen Scales of Early Learning and the Autism Diagnostic Observation Schedule (ADOS) were administered as part of clinical best estimate diagnostic procedures. Eye-tracking measures were quantified as percentage of visual fixation to regions-of-interest (eyes, mouth, body or object), and associations between these measures and language/social ability were tested via Spearman correlations.

Results: Eye-looking during early infancy positively predicted Mullen receptive language scores at 24 months in the TD group regardless of sex (r_{female}=0.2981,p_{female}=0.0494; r_{male}=0.3085,p_{male}=0.0305), while increased mouth-looking during the second year of life was a significant positive predictor of Mullen expressive language scores at 24 months in TD females only (r_{female}=0.3771,p_{female}=0.0279). Patterns of SVE to the face were unrelated to later language in the ASD group, but eye-looking negatively predicted ADOS total scores; this association was driven by ASD females (r_{female}=-0.6728,p_{female}=0.0330; r_{male}=-0.1163,p_{male}=0.5406). In ASD females only, mouth-looking positively predicted ADOS total scores (r_{female}=0.7784,p_{female}=0.0080).

Conclusions: Preliminary results indicate that increased attention to distinct areas of the face during the first two years of life predicts language development in typical development. Notably, sex differences were observed in the strength of the association between SVE and expressive language in toddlerhood. In ASD, visual fixation patterns to the face were related to later social disability in females only. These findings suggest that visual fixation has differential adaptive value in ASD, and by sex. Future work will include the investigation of sex-based trajectory differences in SVE to the face and relationships to later language outcomes.

POSTER SESSION — EARLY DEVELOPMENT (< 48 MONTHS)
417 - Early Development (< 48 months) Posters

417.001 *(Poster)* A Comparative Study of Developmental Trajectories in Minimally Verbal and Verbal Children with Autism from 2- to 4-Years of Age

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Background: Despite approximately 30% of children with autism remaining minimally verbal, there has been a paucity of research examining the early development of this group over time. The window of opportunity to develop spoken language decreases after the age of five, with those children who do not develop verbal language having poorer long-term outcomes. Thus, it is important to understand the very early developmental trajectories of minimally verbal children in order to target interventions on individuals with the greatest need.

Objectives: The aim in this study was to compare the very early developmental trajectories of minimally verbal and verbal children with autism across a period of two years.

Methods: The community-based cohort comprised 72 children (22 female) diagnosed with Autism Spectrum Disorder, with baseline assessments conducted at 2 years of age (M = 25.55 months) and follow-up assessments undertaken two years later, at 4 years (*M* = 49.78 months). Minimally verbal was defined as having a very small (< 20 functional words) repertoire of spoken words or fixed phrases that are used communicatively; 23 children were classified as minimally verbal at follow-up (32%; Minimally Verbal Group). All children were assessed with the Autism Diagnostic Observation Schedule and the Mullen Scales of Early Learning at baseline and follow-up.

Results: A 2 (Group: Minimally Verbal; Verbal) x 2 (Time: Baseline; Follow-up) repeated measures ANOVAs revealed that while the Verbal Group significantly increased their verbal developmental quotient (VDQ) from baseline to follow-up, VDQ remained stable in the Minimally Verbal Group. In contrast, the ANOVA showed that Non-verbal DQ in the Verbal group remained stable over time while it decreased in the Minimally Verbal Group. As well as having lower DQ's, the Minimally Verbal Group also had significantly higher symptom severity scores, with both groups showing a significant decrease in Social Affect symptoms over time. Restricted and Repetitive Behaviours (RRBs), on the other hand, increased in both groups from ages 2- to 4-years, with no group difference in RRBs.

Conclusions: Children who were minimally verbal had different developmental trajectories to their verbal peers. They made fewer gains in cognition over time, and had more severe social affect symptoms, although, like the verbal group, these symptoms decreased over time. As expected for their young age, both groups showed few RRBs at age 2, which increased by age 4 years. The findings indicate that minimally verbal children require targeted intervention to increase their language abilities and prevent loss of non-verbal skills in order to facilitate positive long-term outcomes.

417.002 *(Poster)* A Profile of Children with Early Diagnosis of ASD in Puerto Rico

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Background: The PR Health Department has established a uniform evaluation protocol that ensures best practices for ASD early identification and diagnosis. The prevalence of children diagnosed with ASD in Puerto Rico is 1 in 62 for 4- 17 age group and 1 in 125 for 0-17 age group (Marazzi-Santiago.; Rodriguez-Ayuso, I.R., 2014).Public Policy (BIDA Law) has developed strategies such as an Autism Registry that provides demographic and diagnostic data in order to produce an accurate profile of ASD population. In addition, the Autism Registry was created, in order to link families with the services available in the community as well as obtaining information related to the population with ASD that facilitate the planning of services to establish policy post in the future.

Objectives: Provide a profile on socio-demographics characteristics of children with an early diagnosis of ASD in Puerto Rico.

Methods: A statistics revision of the 2018 official report of the Timon Committee for the BIDA Law was done to analyze the ASD population in Puerto Rico. During March 2017 until February 2018, 173 children were assessed. Out of that 156 were diagnosed with ASD. Each yearly report shows an increased number of children with ASD in Puerto Rico. The researchers are completing an actualization of these records at the Puerto Rico Autism Center located in San Juan, a government clinic of the Health Department that provides early detection and intervention of ASD to these young children.

Results: Until February 2018, based in the official report produced by the Autism Registry: 90% of children registered was diagnosed with ASD. 94% of assessed children were between 2 to 3 years of age. Out of the children diagnosed, 84% were male and 16% were female showing a prevalence of 5:1 male to female ratio. Regarding the level of severity reported in the diagnostic impression a 48% presented a level 3 of severity in both areas. Regarding comorbidity, 79% of the children also had a diagnosis of communication delay and 69% had a clinical presentation of a sensory processing disorder. A 30% of the children showed gastrointestinal issues and 31% had low muscular tone. These findings will be compared with the actualization of these records at the Puerto Rico Autism Center in San Juan.

Conclusions: An increasing number of children referred at an early age with high suspicion of ASD in PR, documents the need to provide adequate and accurate assessments. The high prevalence of children diagnosed with ASD increases the need for evidence based early interventions that provides targeted stimulation for a developing brain. This profile emphasizes on the need for further studies such as longitudinal research which evaluates the stability in the diagnostic impression at an early stage in life documenting the early intervention results. Future research can compare this outcome with that of groups of older children who were diagnosed later in their youth will provide valuable information for an accurate ASD profile in Puerto Rico.

417.003 *(Poster)* Associations between Local Cortical Gyrification, Age, and Symptom Severity in Toddlers and Preschoolers with Autism Spectrum Disorders

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Background: Emerging evidence from prospective studies of high-risk infants and from a few studies in young children diagnosed with autism spectrum disorders (ASDs) indicates that neuroanatomical abnormalities, such as increased cortical volume, thickness, and surface area, are present in the first years of life. The local gyrification index (LGI; reflecting the ratio between pial surface and cortical hull) has been suggested to be more sensitive to group differences in cortical morphology than other surface-based measures. In typical development, cortical gyrification – influenced by expansion of cortical layers – increases across early childhood, followed by a gradual decline from adolescence into adulthood. One study reported greater LGI in dorsomedial prefrontal and cingulate cortices, along with an accelerated longitudinal trajectory of increasing LGI in right inferior temporal and inferior frontal gyri in 3-5 years old boys with ASDs, compared to typically developing (TD) boys. Given the scarcity of early childhood data in ASDs, however, further investigation of LGI will be needed for firmer conclusions.

Objectives: To examine cortical morphology, with focus on LGI, in toddlers and preschoolers with ASDs compared to TD children.

Methods: T1-weighted anatomical MRI data were acquired in 38 toddlers with ASDs (mean age: 38.3±12.9 months; range: 17-66 months; 28 males) and 31 TD children (37.6±14.2 months; range: 17-64 months; 17 males) during natural sleep. Clinical best estimates of ASD diagnoses were established according to DSM-5 criteria, supported by the Autism Diagnostic Observation Schedule (ADOS-2). FreeSurfer v.5.3.0 was used for cortical surface reconstruction and to calculate LGI. Vertex-wise analyses were conducted using general linear models to examine group, age, and group-by-age interaction effects on LGI. Vertex-wise correlations also probed associations between ADOS-2 Total scores and LGI within the ASD group. Total brain volume was used as a covariate in all analyses, and results were corrected for multiple comparisons using Monte Carlo simulations.

Results: We observed significant positive main effects of age bilaterally in orbitofrontal regions, along with left precentral and right middle temporal clusters, with LGI increasing with age in both groups. There was also a significant group effect with increased LGI in the ASD group in a cluster extending across the right precentral and postcentral gyri. There were no significant group by age interaction effects. Additionally, LGI was negatively correlated with ADOS-2 Total scores in the ASD group in bilateral clusters extending from the middle to inferior frontal gyri, such that greater LGI was associated with fewer ASD symptoms.

Conclusions: As expected, positive age effects were observed for LGI in this sample of young children with and without ASDs. However, in at least one cluster spanning the sensorimotor cortices in the right hemisphere, LGI appeared to be atypical in children with ASDs, possibly reflecting onset of atypical growth trajectories in infancy. The relationship between ADOS-2 Total scores and LGI suggests that decreased cortical folding in frontal regions may play a role in autistic symptomatology in the first years of life.

417.004 *(Poster)* Associations between Socioeconomic Variables and Language Network Functional Brain Connectivity in Toddlers and Young Children with Autism Spectrum Disorders

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Background: Socioeconomic status (SES) is associated with language and social development in early childhood in typical development (e.g., Johnson et al., 2016). The degree to which these associations are present in children with ASD is less understood. However, previous work from our lab has shown that SES variables positively correlate with language skills in young children with autism, over and above the effect of diagnosis on language skills (Olson et al., 2019). It remains unknown to what extent SES variables are associated with brain correlates of emerging language skills in children with ASD during sensitive periods for language development.

Objectives: To examine associations between socioeconomic variables and brain functional connectivity patterns in language regions in toddlers with ASD.

Methods: 27 young children with ASD (ages 17-45 months, mean age: 31±8 months), a subset of participants enrolled in a longitudinal study of early brain development in autism, completed developmental and diagnostic assessments as well as an MRI scan conducted during natural sleep. Clinical best estimate ASD diagnoses were established based on DSM-5 criteria, supported by the Autism Diagnostic Observation Schedule (ADOS-2). Receptive and expressive language skills were assessed using the Mullen Scales of Early Learning. Caregivers provided demographic information, including household income, parental education, and racial/ethnic identity. Family median income was also estimated based on postal code, a neighborhood-based SES variable. Nine regions of interest (ROIs) were selected from an ALE meta-analysis of language fMRI studies in autism (Herringshaw et al., 2016) and applied as 10mm spherical masks to denoised BOLD time series. Averaged time courses from each ROI were correlated with each other, resulting in a matrix of 36 ROI-ROI connectivities for each participant. Associations between socioeconomic indices and language network functional connectivity were tested with Spearman's correlations.

Results: Income-to-needs ratio was positively associated with functional connectivity between the right superior temporal gyrus (STG, or Heschl gyrus) and left middle temporal gyrus (MTG) ($r = 0.53$, $p = 0.01$). Connectivity between these regions was also positively associated with expressive language, although not significantly ($r = 0.27$, $p = 0.2$).

Conclusions: These findings suggest that functional connectivity between regions involved in speech perception (rSTG) and action perception, as part of mentalizing network (lMTG), is stronger with increased access to resources (i.e., Income-to-needs ratio). This association suggests that for children with autism, experiences associated with low family income in early childhood may be linked with weaker connections between networks involved in understanding others. Future analyses will include a larger sample of young children with and without autism, and analyses controlling for age and other language variables (e.g., bilingualism). These findings highlight the necessity for targeted intervention and effective implementation strategies for children with ASD from low-resource households and communities, and for policies designed to improve learning opportunities and access to services for these young children and their families.

417.005 *(Poster)* Canonical Babbling at 6 and 12 Months Differentiates Infants at High- and Low-Risk for ASD

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Background: Canonical babbling – producing syllables with a mature consonant, full vowel, and smooth transition between them – is an important developmental milestone that typically occurs in the first year of life, and babbling delays have been associated with later delays in word production (Oller et al., 1999). Some studies indicate delayed or reduced canonical babbling in infants at high familial risk for ASD or who later receive an ASD diagnosis (e.g., Patten et al., 2014; Paul et al., 2011). Further study of the development of canonical babbling during the first year of life is necessary to evaluate its utility as a clinically useful bio-behavioral marker of later language and diagnostic outcomes.

Objectives: This study aims to test: 1) group differences in canonical babbling ratio at 6 and 12 months between infants at low familial risk of ASD (LR) or high familial risk who either did (HR-ASD) or did not (HR-Neg) develop ASD themselves, 2) group differences in the onset of canonical babbling at each age, and 3) the cross-sectional relationship between canonical babbling and language ability.

Methods: Participants (n=110) were selected from the multi-site Infant Brain Imaging Study (Table). Two trained and reliable raters segmented children's speech-like vocalizations produced at 6 and/or 12 months during the Communication and Symbolic Behavior Scales (Wetherby & Prizant, 2002) or Autism Observation Scale for Infants (Bryson et al., 2008). Vocalizations were coded for canonical and non-canonical syllables, with discrepancies resolved through consensus.Canonical babble ratio (CBR) was calculated by dividing the number of canonical syllables by the number of total syllables, and infants were considered to have achieved the canonical babbling milestone if CBR>0.15 (Oller et al., 1999). Outliers (CBR>3 standard deviations above the timepoint's mean) were excluded from analysis (2 HR-Neg infants at 6 months). Expressive language was measured using the Mullen Scales of Early Learning standard score (Mullen, 1995).After controlling for site, cross-sectional generalized linear models predicted CBR, with Tukey-corrected pairwise comparisons of estimated marginal means. Odds ratios of reaching the canonical babbling milestone were calculated.

Results: (1) At 6 months, HR-ASD produced a significantly lower CBR than HR-Neg (estimate: -0.04,p<0.01), with no difference from LR (estimate: 0.004, p=0.9). At 12 months, HR-ASD produced a significantly lower CBR than HR-Neg (estimate=-0.06, p<0.01) and LR (estimate=-0.05, p<0.01). (2) Too few infants had achieved canonical babbling at 6 months to calculate an odds ratio (5 total). No significant group differences in the odds of achieving the canonical babbling milestone were detected at 12 months. (3) At 12 months, CBR significantly predicted current expressive language ability, with a small-to-moderate effect size.

Conclusions: Canonical babbling is an important developmental milestone that could serve as a bio-behavioral marker of later language ability and diagnostic outcomes. These data provide preliminary evidence of canonical babbling differences in 6-month-old infants who go on to receive an ASD diagnosis compared to those who do not. With additional annotation (ongoing), we aim to increase our power to detect early differences, and model longitudinal trajectories of growth in canonical babbling.

417.006 *(Poster)* Changes in Psychophysiological Arousal in Toddlers with ASD and TD Toddlers Following Exposure to Parent Social Activities

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Background: Physiological indicators of responsiveness can serve as a quick, objective measure of engagement or give information about an individual's comfort level in a social interaction (Feldman, 2012). Because of the important role that physiological processes play in the development of appropriate socialization and regulation skills, there has been an increased interest in examining these constructs in the ASD population. Emerging evidence indicates that children with ASD have different physiological responses than their TD peers to social stimuli (Lydon et al., 2016). Because of this, it has been postulated that psychophysiology can be used as a characterization strategy, especially as it relates to engagement and socialization. Understanding the specific differences in physiological response between these groups is crucial to be able to characterize children with ASD from their TD peers.

Objectives: This study examined the difference is physiological responses between toddlers with ASD and their TD peers across a set of standardized play situations with and without their parents.

Methods: A sample of 13 participants (8 toddlers with ASD, 5 TD toddlers) and their parents were examined as part of a larger intervention study. Parent and child dyads were presented with a standardized set of toys and asked to engage in three different play scenarios (child playing alone with toys [T1], parent and child playing together with toys [T2], and parent and child playing together without toys [T3]). Dyads were video recorded and data on heart rate (HR) and electrodermal activity (EDA) were collected using non-invasive wristband biosensors. Effect sizes (Cohen's *d*) were calculated to determine the magnitude of difference in physiological response between scenarios for each group due to the small sample sizes and high variability between data in this pilot examination.

Results: Results indicate that, on average, TD children demonstrated larger increases in EDA when transitioned to more social activities (ASD T1 to T2 d=1.77; TD T1 to T2 d= 2.77; ASD T1 to T3 d=3.44; TD T1 to T3 d=6.44). However, similar patterns were not seen across HR data (ASD T1 to T2 d=0.49; TD T1 to T2 d= 0.22; ASD T1 to T3 d=1.06; TD T1 to T3 d=-.41). Changes across situations were not statistically significant when examined with an independent samples t-test, however, additional participants are currently being enrolled in this experimental paradigm, which will yield the needed increase in statistical power.

Conclusions: The present study found that children with ASD have differing EDA responses when transitioned from a solitary play situation to a social one, indicating inherent differences in how they respond in social situations. Though the same patterns were not seen with HR, the sample size of the present study was quite small, so further inspection of these trends is warranted. Through continuing to measure and examine psychophysiological data, researchers may be able to determine more objective measures of engagement that can be utilized to understand the specific social characteristics of children with ASD. Future directions will examine psychophysiology in a larger population, as well as examine this construct as a diagnostic indicator.

417.007 *(Poster)* Characterizing Early Parent Concerns in Infants at Increased Risk for Developing Autism Spectrum Disorder

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Background: The American Academy of Pediatrics encourages primary care providers to listen and respond to parent concerns for autism and developmental delays, with parent concerns alone being enough to trigger further evaluation (Johnson and Meyers, 2007). Prospective studies have shown that parent concerns differentiate children with autism spectrum disorder (ASD) from typically developing children as early as 6 to 12 months of age (Ozonoff et al. 2009, Sacrey et al. 2015), with reported differences in sensory and motor skills at 6 months differentiating high-risk children who did and did not develop ASD (Sacrey et al. 2015). However, little is known about parent concerns prior to 6 months of age or how these very early concerns relate to developmental outcomes.

Objectives: (1) To examine parent concerns at early ages (1.5, 3 months), particularly with respect to motor and sensory domains. (2) To track the developmental outcomes of children for whom parents had the earliest concerns.

Methods: Participants included infants with an older sibling with ASD (familial risk; n = 41) and infants with no family history of ASD (low risk; n=35). At 36 months, toddlers were classified into outcome groups of ASD (n=15), other concerns (n=11), or typically-developing (TD; n=50, 20 familial risk TD, 30 low risk TD) based primarily on information from the Mullen (Mullen, 1995), ADOS-2 (Lord et al., 2012), Vineland-II (Sparrow et al., 2005), and clinical judgment. Parents were asked if they had any concerns about their child at 1.5, 3, 6, 9, 12, 18, 24, and 36 months of age. Statements were subsequently classified into 8 domains adapted from Ozonoff et al. (2009): No concerns, Speech, Social, Restricted and Repetitive Behavior, Motor/Sensory, Medical, Behavior/Temperament, Developmental/Other. Two coders established reliability on 20% of the sample with good to excellent reliability (ICC of .886, with a 95% confidence interval between .830 to .923). The distributions of parent concerns are presented.

Results: Among all parents, medical and motor/sensory concerns were reported most frequently at earlier time points (1.5-9 months), while speech concerns became more prominent starting at 6 months of age (Figure 1). Parents of infants who developed ASD reported a higher percentage of motor/sensory concerns within the first year of life as compared to parents of TD children, with some parents reporting these concerns as early as 1.5 months (Figure 2). Of the parents who reported concerns about their infant at 1.5 months (n=10), 5/10 of the children were characterized as having neurodevelopmental atypicalities at 36 months of age (2 ASD, 3 other concerns).

Conclusions: Our findings are consistent with the literature that atypical sensory and motor behaviors may be prodromal signs of ASD (Yirmiya and Charman, 2010). Parent report of concerns as early as 1.5 months may indicate additional risk for atypical development, particularly among infants who are already at heightened risk for ASD. Clinicians should take heed of these very early parent concerns, especially in motor and sensory domains.

417.008 *(Poster)* Cognitive Ability Gains Predicted By Adaptive Behaviors in Toddlers with ASD

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Background: Adaptive functioning deficits are prevalent in individuals with ASD throughout the lifespan and evident as early as toddlerhood (Paul, Loomis, & Chawarska, 2014). While adaptive behavior assessments (e.g, Vineland Adaptive Behavior Scale (VABS) increase the clinician's diagnostic accuracy of ASD by 9%, from 75% (fair) to 84%(good) (Tomanik, Pearson, Loveland, Lane, Bryant Shaw, 2007), it is not clear the extent to which adaptive behaviors may affect children's performance on cognitive assessments. Previous studies have found adolescent cognitive skills to predict adaptive functioning skills later on in life, but less is known about the role of adaptive functioning on cognitive development in toddlers with ASD, the aim of this study.

Objectives: This study aims to investigate the relationship between adaptive functioning and changes in cognitive abilities following a parent mediated intervention for toddlers with ASD.

Methods: This study is a secondary analysis of a randomized controlled trial of a parent-mediated social communication intervention (JASPER; Kasari, Gulsrud, Paparella, Hellemann, & Berry, 2015). 86 toddlers (mean age = 31.5 months) and their primary caregivers participated in this study. Toddlers cognitive abilities were assessed with the Mullen Scale of Early Learning (Mullen,1995) at entry and 6 month follow up. Difference scores were calculated on all domains of the Mullen to analyze the change from entry to follow up. Parents also completed the Vineland II adaptive behavior scale parent survey (Sparrow, Cicchetti, & Balla, 2005) at entry only. Linear regression models were used to test the predictive quality of Vineland II scores at entry on the changes in Mullen domains and total score from entry to follow up. The regression models controlled for treatment group assignment.

Results: Linear regressions predicting cognitive change and controlling for treatment group, found that higher Vineland II domains of Daily Living skills ($b = 0.477$, $p < .01$) and Communication ($b = 0.385$, $p < .01$) scores at entry predicted greater changes on average in total Mullen scores from entry to follow up. Examining the individual subscales of the Mullen, Vineland II domains of daily living skills ($b = 0.229$, $p < .01$) and communication ($b = 0.174$, $p < .01$) at entry also uniquely predicted changes in the Mullen receptive language domain at follow up.

Conclusions: Toddlers adaptive functioning, specifically in the domains of communication and daily living skills, predicted change in total Mullen IQ score and Mullen receptive language scores. Toddlers with higher adaptive communication and daily living skills at entry were more likely to have greater gains in overall cognitive abilities and receptive language at follow up. These findings emphasize the importance of adaptive functioning skills and receptive language in toddlerhood. This study also suggests a bidirectional relationship between cognitive abilities and adaptive functioning skills.

417.009 *(Poster)* Comparison of Pre- and Full-Term NICU Infants on ASD Assessment Measures: Are Full-Term NICU Infants an(other) ASD Risk Group?

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Background: Research has established that pre-term infants are at higher risk for ASD. A recent meta-analysis reported a prevalence rate of 7% (Agrawal, et al., 2018). Also, elevated risk scores on ASD assessment measures have been documented in this population (Guy, et al., 2015). Although pre-term births account for the majority of NICU admissions, 48% of NICU admissions are full-term infants (Edwards, 2018), However, little specific attention has been directed to ASD risk in full-term NICU graduates.

Objectives: To compare ASD risk in full- and pre-term high medical risk NICU graduates using scores on the ADOS, AOSI and MCHAT.

Methods: Data from a subset of participants in a longitudinal study of high medical risk NICU infants were analyzed. All participants in the larger study who completed an ADOS at 18 or 24 months of age were included in the current analyses (N=111; 51% male). Twenty-one infants were full-term; and 90 were pre-term (50 were < 33 weeks gestational age (GA), and 40 were 33-36 GA). Assessments of ASD risk included the AOSI at 13 months; the MCHAT at 18 months; and the ADOS at 18 or 24 months of age. All participants were administered the ADOS, and the majority of them also had AOSIs (N=85) and MCHATs (N=74).

Results: The ADOS Toddler Module algorithms were used to calculate the ADOS overall total scores, which in turn were used to determine three levels of concerns for ASD (little or no concern; mid-to-moderate concern; and moderate-to severe concern). In total, 41 infants (37%) scored in the range of some concern, with 21 (19%) scoring moderate-to-severe concern. There were no significant differences in the ADOS level of concern across groups ($X^2_{(4, N=111)}$=6.862, p<0.143). Sex differences in ADOS level of concern were noted ($X^2_{(2, N=111)}$=13.119, p<0.001). The male to female ratio ranged from 2:1 to 4:1 in the groups with concern for ASD. Across assessments, AOSI and MCHAT scores moderately correlated with ADOS severity scores.

Conclusions: High medical risk full-term NICU graduates' scores on ASD assessments presented a level of concern equal to that for pre-term infants. ASD risk in pre-term infants is well studied, but this is less the case for full-term NICU graduates. This preliminary finding has implications for developmental monitoring of NICU full-term infants in relation to detection of ASD risk and timelier intervention

417.010 *(Poster)* Data-Driven Analysis of Two Large Samples of Infants with and without a Familial History of Autism Shows That Atypical Development of Attentional Control Associates with Later Adaptive Functioning, Autism and ADHD Traits

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Background: Despite the heritability of autism, attempts to find a single genetic or cognitive account of autism have largely failed; likely due to heterogeneity within the spectrum, and to high co-occurrence with other conditions, such as ADHD. A more-fruitful approach to understanding the etiology of autism, and the strengths and difficulties shown by autistic people, may be to focus on developmental pathways within particular functional domains; such as those outlined within the Research Domain Criteria. This approach moves beyond diagnostic boundaries to consider intermediate phenotypes; quantifiable processes that are interposed between gene and clinical phenotype and which may contribute to multiple conditions.

Objectives: To investigate early development of attentional control as an intermediate phenotype of autism and ADHD.

Methods: Parent report of attentional control was collected using the Duration of Orienting scale of the Infant Behavior Questionnaire-Revised (10 and 15 months), the Attentional Focus and Attention Shifting scales of the Early Childhood Behavior Questionnaire (25 months), and the Attentional Focus scale of the Children's Behavior Questionnaire (36 months). At 36 months, autism traits were assessed with the Social Responsiveness Scale Preschool Form, ADHD traits with the Child Behavior Checklist for ages 1½-5, and adaptive functioning with the Vineland Adaptive Behavior Scales.

Latent Class Analysis was used to derive data-driven subgroups from attentional control scores at 10-25 months. Subgroups with Attentional Focus scores significantly below the normative score at 36 months were identified as showing atypical development of attentional control. We then tested whether atypical development of attentional control was predictive of more-pronounced autism and ADHD traits, and lower adaptive functioning, at 36 months.

This analysis was run with a discovery sample of 294 UK-based infants (212 with a familial history of autism), and a replication sample of 412 infants (261 with a familial history of autism) from Sweden, Belgium, the Netherlands, and the UK.

Results: In the replication sample, 64% of infants showed a normative profile of increases in attentional control scores between infancy and toddlerhood. Three groups showed atypical development of attentional control: 9% showed plateaued attention development between 10 and 25 months, 13% showed consistently-low attentional control and 5% showed low attentional focus coupled with high attention shifting at 25 months. The remaining 10% showed consistently-high attentional control.

Consistent with pre-registered hypotheses, low attentional control and plateaued attention development groups had significantly (p<.05) higher autism and ADHD traits, and lower adaptive functioning at age 3 years, than the normative class. Infants later diagnosed with autism were more likely than their peers to show plateaued attention development. Nevertheless, the majority of autistic children showed a typical profile of attention development.

Data-driven profiles explained more variance in adaptive functioning and autism and ADHD traits (Cohen's d=.36-.52) than single time-point attention scores (Cohen's d=.01-.11).

Conclusions: This study illustrates the heterogeneity in attentional control development amongst children with and without a familial history of autism. Atypical development of attentional control appears to be an intermediate phenotype of autism and ADHD, which is associated with lower adaptive functioning by age 3 years.

417.011 *(Poster)* Deconstructing Overlap between Quantitative Autistic Traits and Callous Unemotional Traits in Early Childhood

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Background: Studies characterizing early relationships between heritable quantitative autistic traits (QAT) and social domains implicated in other psychopathology can clarify mechanisms specific to the ontogeny of autism spectrum disorder (ASD). Here we attempted to differentiate early manifestations of *asocial* behaviors observed in ASD from *antisocial* behaviors representing callous-unemotional traits (CUT), a feature of disruptive behavioral disorders, in a genetically informative, general population twin sample encompassing the full range of variation in these social domains.

Objectives: A) To quantify early associations between QAT and CUT. B) To characterize relationships between CUT symptom structure and QAT, including testing for genetic influences on CUT symptoms. C) To compare CUT-QAT relationships with relationships between CUT and social motivation, a hypothesized causal factor for ASD, and CUT and externalizing, a behavior commonly associated with elevated QAT or CUT.

Methods: Participants included 111 twin pairs ascertained from the general population and a clinical cohort with ASD (n=16). When children were ages 36-48 months, parents completed the Social Responsiveness Scale, which indexes QAT; a 10-item subset from the Inventory of Callous-Unemotional Traits; and the Child Behavior Checklist, which contains an externalizing subscale. A *Social Motivation* Composite, derived for twins at age 18 months, was comprised of face valid items for social motivation (Chevallier et al., TICS, 2012) selected from parent-report measures including the video-referenced rating scale of Reciprocal Social Behavior, the Modified Checklist for Autism in Toddlers, and the Brief Infant Toddler Social Assessment. Principal component analysis (PCA) examined CUT symptom structure on its own and in conjunction with QAT, *Social Motivation*, or *Externalizing*. Comparison of intraclass correlations between monozygotic (MZ) and dizygotic (DZ) twins tested evidence for heritability.

Results: Higher levels of QAT and CUT were observed in toddlers with ASD ($t(15)=-6.71$, $p<.001$), and QAT and CUT were strongly correlated in twins ($\rho = .523$, $p < .001$, Figure 1). PCA identified three CUT components: "social conscientiousness," "unemotionality," and "shamelessness" (Table 1). In separate PCAs, both QAT and *Social Motivation* showed the strongest loading on "unemotionality," while *Externalizing* primarily loaded on "shamelessness." Higher concordances for MZ versus DZ twins suggested genetic influences for *Social Motivation* and *Externalizing* in both sexes and for "social conscientiousness" and "unemotionality" in males only. "Shamelessness" did not show evidence of heritability.

Conclusions: QAT and CUT, two social dimensions implicated in child psychopathology, show partial phenotypic overlap in early childhood. This overlap is largely attributable to an "unemotionality" component of CUT, demonstrating the distinction between early *asocial* and *antisocial* behavior. Evidence of heritable CUT components specifically in males suggests sex differences in causal influences for this trait overlap. Association of "unemotionality" with QAT and earlier *Social Motivation* is consistent with *Social Motivation's* hypothesized causal role in ASD, while the association of "shamelessness" with *Externalizing* but not QAT supports distinct underpinnings for QAT and disruptive behavior. Future longitudinal, developmental studies quantifying genetic and environmental influences on QAT and CUT could importantly clarify mechanisms specific to ASD versus other disorders entailing social impairment, thereby advancing early assessment and intervention.

417.012 *(Poster)* Development of Early Screening for Communication and Social Skills (ESCoMS) Instrument: Sensitivity and Specificity

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Background: Studies have shown that symptoms of autism begin during infancy and can be identified in those as young as 6 months of age. Early identification of autism features helps facilitate early intervention and provide better outcome. No measures exist for screening for autism spectrum disorders in infancy in the Indian context.

Objectives: We intended to develop a questionnaire to screen infants between 9-18 months for Autism Spectrum Disorder (ASD) using mixed methodology design.

Methods: The study was divided into three phases – 1 Develop items through qualitative methods 2. Discriminant validation and instrument consolidation 3. Explore predictive validation. In this paper we present results of phase 1 and phase 2 (Phase 3 is currently in progress).

Phase 1 included two parts: 1. Collation of items from literature and conducting interviews with professionals 59 from Bangalore and 11 from other parts of the country from different disciplines with over 10 years of expertise in working with children with autism. Broad themes and codes were elucidated from these data. A list of 27 items was finalized. In Phase 2, all these items were administered to children who between 2-5 years, with a clinical diagnosis of autism (n=250) and typically developing children (n=220). Children with autism were drawn from centers across the city. Parents were asked to answer the 27 polar questions based on recollection of the children's behavior when they were below 18 months. The collated data was analysed using Statistical Package for Social Science (SPSS) and Receiver Operating Characteristic Curve (ROC).

Results: All the 27 items were analysed and three items which did not have significant statistical difference between the two groups were eliminated from the final instrument. For the 24 items which were validated, the cut off score was set as 14 with 90% specificity and 90% sensitivity. Further those with any history of regression in motor and cognitive milestones are deemed to be positive regardless of their endorsement of other items.

Conclusions: Literature indicates very late identification of children with autism in India. It is expected that this tool can help identify children at risk for this diagnosis early leading to very early intervention programs that can plausibly improve the prognosis. We are currently exploring the predictive validity of this tool in phase 3 of the study.

417.013 *(Poster)* Developmental Cascades during the First Year after Diagnosis in a Prospective Cohort of Young Children with Autism Spectrum Disorder (ASD)

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Background: The rate at which individuals with ASD develop skills in one developmental domain may affect the rate of acquisition of other domains both directly and indirectly. Furthermore, research suggests that other child- and family-level characteristics, identifiable at time of diagnosis, may support early "head starts" in language and social development among young children. Elaborating these dynamic processes is crucial to developing and tailoring more effective, developmentally sensitive interventions.

Objectives: We aimed to model dynamic interactions between social competence (SOC) and structural language (LANG) trajectories and determine how child and family sociodemographic factors may influence their development.

Methods: Data for 365 2- to 4-year-olds were obtained from the “Pathways in ASD Study” — a prospective inception cohort study of preschoolers diagnosed with ASD. Children were assessed at time of diagnosis and 6 and 12 months later using the Vineland Adaptive Behavior Scales II (Socialization subscale) and the Preschool Language Scale 4. Latent growth curve models were developed to measure the associations between initial levels (intercepts) and rates of change (slopes) of SOC and LANG and child- and family-level covariates.

Results: Children showed significant growth in SOC and LANG over 12 months as a group, with significant variability between individual rates of change across both domains. The intercept of LANG predicted rate of change of SOC; however, the converse was not true. Rates of change were moderately correlated between domains over the 12 months after baseline assessment. Children’s participation in language intervention prior to diagnosis was associated with increased improvement in SOC (but not LANG)Younger age at time of diagnosis was linked to increased improvement in LANG. Child age and cognitive ability, but not sex, were positively associated with baseline SOC and LANG. Higher family income was positively associated with baseline SOC and higher level of caregiver education was linked to higher baseline LANG.

Conclusions: Language ability as measured shortly after time of diagnosis was more predictive of change in social competence in young children with ASD, than vice versa. The two domains were moderately coupled. Child IQ, age at diagnosis, engagement in services, and family characteristics such as income and primary caregiver education appeared to influence social and language trajectories during the preschool years in this cohort. Broadening the scope of ASD assessment to include supportive identification of family and other contextual strengths and challenges, as well as children’s skills and abilities should be considered and evaluated as part of an equitable and individualized model of care. Service models should address contextual factors known to affect the development of children with ASD, including additional support for families struggling with low socioeconomic status, in addition to core child ASD symptoms, language and other key developmental skills.

417.014 *(Poster)* Developmental Regression in ASD: A Pilot Study in Chongqing, China

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder, and the number of ASD combined with developmental regression—loss of previously acquired skills— reported by parents is increasing.

Objectives: This study described the basic information of ASD children with regression, sought to explore the influencing factors of regression, provide references for the diagnosis, and make a proposal for health care system improvement and social support for families with autism.

Methods: Of a total of 110 ASD children from Chongqing, China, comprehensively identified through clinician records, questionnaire investigation, and telephone consultation, 57 of them had concomitant regression. The data was analyzed by SPSS 19. The relationship between history of rescue at birth, history of postnatal disease and regression, which was considered as dependent variable, was taken by logical regression analysis respectively, age for first concerned of autistic symptoms by parents, ASD combined with regression by two–sample t–test. Wilcoxon rank sum test was conducted to assess the correlation between regression and the family's economic burden—proportion of expenditure on rehabilitation treatment for autism to total household income.

Results: In this study, the ratio of male to female was 4.78 :1 (91/19) for total of ASD, 4.18:1 (46/11) for ASD combined with regression. The average age for first concerned of autistic symptoms was 2. 00 ± 0.67 years old. 8 patients were unsure of the onset age for regression. The average age of the rest was 2. 21 ± 0.98 years old, mainly in the form of language (89.47%), followed by interest and social skills (49.12%), gross motor/fine motor (8.77%), and others (33.33%). The logical regression model b= -0.26, OR = 0.77 (0.24 ~ 2.47), P=0.66 (>0.05) was for history of rescue at birth and regression, b = -0.20, OR = 0.82 (0.34 ~ 2.00), P = 0.66 (>0.05) was for history of postnatal disease and regression. T = -1.18 and P = 0.24 (>0.05) were for the difference between onset age of autistic symptoms and regression by two–sample t–test. There was no statistical significance between ASD combined with regression and ASD combined without regression on onset age of autistic symptoms. The median on family financial burden proportion for ASD combined with regression was 0.80 (0.60 – 1.00), for ASD without regression was 0.70 (0.50 – 1.00). P = 0.94 (>0.05) was for the difference between regression and ASD without regression on family financial burden by Wilcoxon rank sum test.

Conclusions: In this study, there was no significant relationship between developmental regression and history of rescue at birth, postnatal disease and onset age of autistic symptoms. These factors couldn't be early predictors of regression in ASD children. The proportion of family financial expenditures wouldn’t be significantly influenced by regression, but the overall cost of rehabilitation for such subtype is quite high. Government should further improve the social health care system for ASD patients, and strengthen economic investment for families with ASD children.

417.015 *(Poster)* Developmental Trajectory and Prediction of Intellectual Disability in Children with Global Developmental Delay, with and without Autism

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Background: A diagnosis of Global Developmental Delay (GDD) is given to children younger than five years of age when there is clear evidence of developmental delay compared to expected function (according to chronological age), or dysfunction that can't be categorised yet to a specific diagnosis. Significant GDD as assessed before five years of age, is considered to be a preliminary marker of subsequent Intellectual Disability (ID).

Objectives: The purpose of the current study was to examine the stability and the correlation of developmental tests to subsequent IQ testing among GDD with ASD population, as compared to children with GDD and without ASD.

Methods: We compared the early initial DQ scores of children referred for an evaluation of developmental delay at the age of 1-3years to subsequent case by case achievements on IQ tests after the age of 3 years. The children that were subsequently diagnosed with ASD were compared to the children who did not receive such a diagnosis. The study included the data of 80 children (55 boys and 25 girls) that were diagnosed at the Weinberg Child Development Center at two time points between the years 2000-2009. First, the children received a diagnosis of GDD before the age of 42 months. Second, the same children returned for a re-evaluation after the age of 48 months using standardised IQ tests.

Results: Average MDI score among 80 children that were included in this study was M=56.10 (SD=8.23) and the score range was 49-74.

Follow-up analysis of the data revealed a cutoff point in MDI scores which has a significant effect on later IQ scores. Children with MDI score lower than 65 (high to moderate risk) have lower IQ (M=70-82, SD=15-19) than children with MDI score higher than 65 (M=100, SD=19).A statistically significant positive correlation was found between the MDI and IQ scores in the ASD group r_p=0.681, p<.00 (R^2=46%). Correlation between MDI and IQ scores was not significant in the GDD no ASD group.

Conclusions: A positive correlation was found between lesser degrees of developmental delay as measured by MDI to subsequent higher achievements on IQ in both groups, meaning that less delay predicts a higher IQ, as expected. It was found that scores of MDI below 65 highly predict intellectual disability in both groups.

The additional finding of a higher predictive value and stability among children with diagnoses of *both* GDD and ASD as opposed to children with GDD and *without* ASD, elutes to the heterogeneity and the significant motor involvement in GDD without ASD which precluded a more accurate assessment of GDD for those children.

417.016 *(Poster)* Differential Adaptive Value of Social Visual Engagement in Subgroups of Children with ASD at Different Levels of Social Impairment

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Background: Heterogeneity in autism spectrum disorder (ASD) presents obstacles in identifying causes of the disorder and designing targeted interventions to increase social functioning. Measures capturing the core underlying features of ASD, such as reduced interest in socially adaptive stimuli, may provide a means for parsing phenotypic-heterogeneity in ASD. According to a recent study, the adaptive value of where school-aged ASD children looked when viewing social scenes differed significantly based on their cognitive profiles (Rice, Moriuchi, Jones & Klin, 2011). Given the developmental nature of ASD, such findings call for further investigation into whether ASD subjects diverge in their social visual engagement strategies even in the earliest years of life, and whether such divergences reflect or predict distinct adaptive strategies and outcomes within the ASD population.

Objectives: This study aims to examine whether social visual engagement in the first 2 years of life differs, and has differential adaptive value for language development, between subgroups of ASD subjects characterized by different levels of social disability.

Methods: 59 ASD subjects (42 males) contributed eye-tracking measures of social visual engagement over the first 2 years of life, and received 24-month language assessments (Mullen expressive (EL) and receptive (RL) scales) and clinical best estimate diagnoses. Subjects were divided into subgroups based on their 24-month ADOS social affect (SA) scores. The high-ADOS group encompassed 33 ASD subjects with SA≥10 (24 males; M_{SA}=13.58, SD_{SA}=2.62); the low-ADOS group comprised 26 ASD subjects with SA<10 (18 males; M_{SA}=5.69, SD_{SA}=2.54). Between-group differences in percent fixation to regions of interest (ROIs) were assessed using repeated-measures ANOVA. Within-subgroup correlations were tested for associations between fixation to ROIs and 24-month Mullen RL and EL age equivalent scores.

Results: High-ADOS group subjects looked less at the eyes and more at the mouth, body, and objects than those in the low-ADOS group, and these differences reached statistical significance in the second year of life (M_{age}=18.56months, group*ROI F=3.62, p=0.0145). While social visual engagement was unrelated to 24-month language outcomes in the high-ADOS group, in low-ADOS subjects higher levels of eye-fixation in the first and second years of life predicted higher EL outcomes at 24 months (M_{age}=4.07, r=0.625, p=0.0042; M_{age}=24.73, r=0.504, p=0.0073, respectively); conversely, in low-ADOS subjects mouth-looking in the first and second years of life negatively predicted 24-month EL (M_{age}= 4.07months, r=-0.466, p=0.0441; M_{age}= 24.73months, r=-0.417, p=0.0306, respectively).

Conclusions: Less socially impaired infants with ASD look more at the eyes throughout early development, and show increased social adaptive value of eye-looking, compared to more socially impaired ASD infants. This suggests that fundamentally different social learning processes may be at play within subgroups of individuals with ASD, from the first years of life. Future work will use longitudinal modelling procedures to examine trajectories of social visual engagement as predictors of language and social outcomes within these subgroups of children with ASD.

417.017 *(Poster)* Discrepancy between Parent Report and Direct Assessment of Development in Toddlers with ASD: Does Child Gender Matter?

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Background: Underdiagnosis of females is thought to contribute to male bias in ASD prevalence (Ferri et al., 2018). Underdiagnosis may result from: (1) gender differences in the presentation of core and associated symptoms, and (2) gender differences in parental concerns and expectations (Halladay et al., 2015). Gold standard ASD diagnostic evaluations incorporate both parent-report and direct assessment of child behavior. Although there is good overall convergent validity at the group level between parent-report and direct observation measures (Le Couteur et al., 2008; Miller et al., 2017), gender effects have yet to be examined. Examining whether agreement between reporters varies as a function of child gender may shed light on differences in autism detection.

Objectives: To examine if agreement between parent report and direct assessment of language and fine motor abilities varied by gender in toddlers with ASD.

Methods: Data were collected as part of a larger study designed to lower the age of autism diagnosis and treatment. Analyses focused on a sample of toddlers diagnosed with autism (n = 100, mean age 24.32 months), matched on age, gender, and visual reception. Data on language and fine motor abilities were collected through parent report and direct assessment (i.e. VABS and MSEL age equivalent scores for receptive language, expressive language, and fine motor abilities). Two (data source: VABS/MSEL) by two (gender) mixed factorial ANOVAs were used to assess differences.

Results: There were significant main effects of data source on receptive language scores, F (1, 97) = 14.13, p < .001, η^2_p = .13, and fine motor scores, F (1, 98) = 6.40, p = .01, η^2_p = .06. Specifically, parent-report scores (i.e., VABS) were significantly lower than direct assessment scores (i.e., MSEL) in females for both receptive language (p < .001, d = .50) and fine motor abilities (p = .03, d = .32). No significant differences emerged for males. There were no significant main effects of gender on any developmental domain, but there was a significant data source by gender interaction for expressive language scores, F (1, 98) = 9.84, p = .002, η^2_p = .09. Specifically, parent-report expressive language scores were significantly higher than direct assessment scores in males (p = .04, d = .33). In contrast, parent-report scores were significantly lower than direct assessment scores in females (p = .02, d = .31).

Conclusions: Parents of female toddlers with ASD rated receptive language, expressive language, and fine motor abilities significantly lower than what was observed through direct assessment. Interestingly, parents of male toddlers rated expressive language significantly higher than what was observed through direct assessment. Significant main effects of gender were not observed on the VABS or MSEL. This pattern of findings may indicate that parental expectations for development differ by gender. Consequently, gendered expectations may influence parent interpretation and reporting of language and fine motor abilities. Given that gender-based differences may vary as a function of child age, it is important for future research to assess inter-rater agreement throughout the lifespan.

417.018 *(Poster)* Early Developmental Trajectories of Children with Autism from Multiplex and Simplex Families

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Background: Research has indicated that Multiplex (MPX; two or more affected individuals per family) and Simplex (SPX; only one affected individual per family) autism represent separate subgroups associated with distinct etiological mechanisms, and which may represent separate phenotypes. While some phenotypic differences in the cognitive and behavioural profiles between MPX and SPX children have been found, no study to date has compared the developmental trajectories over time between these groups. Given the heterogeneity evident in early developmental trajectories in autism, it is important to delineate the development of MPX and SPX subgroups over time.

Objectives: The first study aim was to compare the early developmental trajectories of young children with MPX and SPX autism over the period of one year. A second aim was to examine the relationship between baseline autism symptom severity and cognition at follow-up one year later in each group, to further inform any developmental differences in MPX and SPX children.

Methods: Assessment data at baseline and follow-up one year later on autism symptomatology (Autism Diagnostic Observation Schedule; Social Communication Questionnaire), cognition (Mullen Scales of Early Learning) and adaptive behaviour (Vineland Adaptive Behaviour Scales) from a sample of 147 (115 males) children diagnosed with Autism Spectrum Disorder attending a community-based early intervention centre was utilised to address the study aims. Children in both MPX (n = 47) and SPX (n = 100) groups were of similar ages at baseline (Mean = 34 months) and follow-up one year later (Mean = 45 months).

Results: 2 (Group: MPX; SPX) x 2 (Time: Baseline; Follow-up) repeated measures ANOVAs revealed significant effects of Time with both MPX and SPX groups showing similar increases in cognitive and adaptive functioning, and a reduction in symptom severity, over the period of one year. The only significant Group difference was that SPX children had more severe autism symptoms than MPX children at baseline. Both groups showed similar levels of cognition and adaptive behaviour at baseline and follow-up. In the MPX group (but not the SPX group) higher baseline autism severity scores predicted poorer outcomes in verbal and non-verbal cognition, after controlling for baseline cognition; no significant relationships were found in the SPX group.

Conclusions: Few phenotypic differences were revealed between young MPX and SPX children with autism with both groups showing similar developmental trajectories over time in cognition and adaptive behaviour. However, given the pattern of correlations between groups on baseline autism severity (with the SPX group showing more severe symptoms) and cognition at follow-up, it appears that development may be influenced by different factors in the MPX and SPX groups. It is therefore important that future research continue to examine differences in causal factors in the development of MPX and SPX.

417.019 *(Poster)* Early Executive Function Is Associated with Adaptive Functioning in Very Young Children with ASD

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Background: Impairments in executive function (EF) in individuals with ASD may emerge as early as 24 months, are present throughout the life span, and are associated with worse adaptive functioning (AF). EF has been associated with the AF subdomains of Socialization, Communication, and Daily Living Skills. Well-developed AF is essential to independent functioning and obtaining real world skills. However, to date, the relationship between EF and AF in children with ASD under 3 years old has not been reported.

Objectives: To investigate the relationship between EF at 12 months and AF at 24 months in children at high familial risk for ASD who do (HR-ASD) and do not (HR-NonASD) develop ASD, and a comparison group of children who are at low familial risk for ASD (LR).

Methods: This longitudinal sample consisted of participants (HR-ASD n=21, HR-NonASD=100, LR n=46) from all Infant Brain Imaging Study (IBIS) sites (UNC, CHOP, WUSTL, UW). All participants, a subsample from IBIS, had complete data at 12 and 24 months and a clinical-best-estimate diagnosis at 24 months. The A-not-B was used to assess EF at 12 months (total correct/total trials). The Vineland-II, used to assess AF at 24 months, yields 5 standard scores (Adaptive Behavior Composite [ABC]; Communication; Daily Living Skills [DLS]; Socialization; and Motor Skills). Overall cognitive development from the Mullen Scales of Early Learning Composite (ELC) at 12-months was used as a covariate in all analyses.

Results: Linear regression analysis revealed that group (HR-ASD>HR-NonASD, LR) moderated the relationship between 12-month EF and 24-month ABC (ΔR^2=.03, p=.03;ΔR^2= .04, p=.02 respectively; see Tables 1 and 2). Follow-up regression analysis of the ABC subdomains was conducted (see Tables 1 and 2) and showed that group moderated the relationship between 12-month EF and 24-month Communication (HR-ASD>HR-NonASD, LR;ΔR^2=.04, p=.01;ΔR^2= .05, p=.01 respectively) and 24-month Socialization (HR-ASD>HR-NonASD;ΔR^2=.03, p=.04; LR=ns). Group did not moderate the relationship between 12-month EF and 24-month Motor Skills and therefore was dropped from the model. Re-analysis without the interaction term revealed a significant relationship between 12-month EF and 24-month Motor Skills across group (F(3,147)=5.66, p=.001). There was no association between 12-month EF and 24-month DLS. Moderation effect of group on 12-month EF and 24-month ABC, Socialization, and Communication did not survive correction for multiple comparisons (α=.006).

Conclusions: This data provides some of the earliest evidence of associations between EF and AF. Trends in the current data are consistent with prior studies of older children with ASD. However, unlike prior studies, no significant association between EF and DLS was found, suggesting self-help skills in toddlers rely less heavily on EFs. On the other hand, the results of the current study suggest that earlier developing EF may be related to development and functional use of motor skills in a toddler's daily environment. These results provide important considerations for service providers who implement early intervention designed to increase adaptive skills in young children with ASD.

417.020 *(Poster)* Early Identification of ASD in Males and Females: Sex-Specific Behavioral Phenotypes in Toddlers Assessed with the STAT, RITLS, and PDMS-2

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Background: Recent research suggests that a two-tiered screening method utilizing the STAT shows strong positive predictive value and sensitivity as well as a reduction in the false positive rates of diagnosis. Previous research at our clinic examining sex-specific behavioral phenotypes in toddlers on the STAT revealed patterns of stronger play skills in girls with ASD, lending a lower overall total score on the STAT. This is consistent with existing literature on girls with ASD suggesting more age and gender-appropriate interests and play. A lower score on the STAT could potentially lead to girls missing the threshold on the STAT and being less likely to receive early intervention. As such, examining other areas of development, including cognitive functioning, language, and, and motor skills, may give further insight into a broader behavioral phenotype to better identify males and female toddlers at risk for ASD.

Objectives: This study aims to examine sex differences in toddlers assessed by clinicians using the Screening Tool for Toddlers and Young Children (STAT), Rosetti Infant-Toddler Language Scale (RITLS), and the Peabody Developmental Motor Scales, 2nd Edition (PMDS-2) to further refine potential diagnostic markers for the early identification of ASD in males and females.

Methods: This retrospective record review examines 281 children aged 19 to 36 months (median age 33) who were assessed through a multidisciplinary medical diagnostic evaluation utilizing the STAT, RITLS, and PMDS-2. A receiver operating characteristic curve analysis was used to identify overall diagnostic performance in the sample population. Non-parametric methods (Spearman correlation and Mann-Whitney U tests) were also used to compare and correlate STAT items by sex. A Youden's J was used to identify optimal cutoffs by sex. Future item analysis will be conducted to provide insight into trends across sexes on STAT items.

Results: In a preliminary analysis, boys (N=225, 80.1%) displayed a higher median score (3.00 vs 2.75 in girls, p=0.06) on the STAT, indicating greater severity of symptomatology associated with ASD. Furthermore, a lower cutoff score of 1.9 was indicated in females versus 2.1 in males to obtain the same level of sensitivity (89%), suggesting that females may be missed with the recommended STAT cutoff of 2.0, which would have lower sensitivity for diagnosing females (71%) than for males. When additional development results of cognitive, language, and motor testing were examined, preliminary analysis revealed that there are no sex differences among language, motor, or cognitive abilities for children diagnosed with ASD. Further analysis of performance on different developmental measures will be conducted to examine impact on STAT performance.

Conclusions: There are not identifiable differences between males and females in cognitive, language, or motor abilities during early diagnostic evaluations in toddlers. However, STAT scores suggested borderline statistical difference among males and females with females receiving a lower median score. This suggests that despite some similar behavioral phenotypes, identifying specific social communication differences on a second-tier screening tool is imperative to early, accurate diagnosis.

417.021 *(Poster)* Early Impairments in Social Attention Skills Detect and Predict Toddlers' Risk for Autism

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Background: Although there are lot of efforts to detect autism spectrum disorders (ASD) during toddlerhood, many ASD children remain undiagnosed until school age, because caregivers in daily life or paediatricians in time limited visits may miss their early signs of ASD. These phenomena are very pervasive in rural areas of China. Considering the importance of early intervention, it is of great importance to find quick and easy ways to detect early signs of ASD.

Objectives: This study examined whether some social attention skills tasks can detect children with autism risk and predict their later diagnosis, in order to provide a better understanding of social attention impairments in ASD.

Methods: Three groups of toddlers participated in the study: 30 toddlers with high autism risk, 23 toddlers with development delay, 22 typical developing toddlers. Participants were matched by their intellectual ability measured by cognitive subscale of Bayley Scales of Infant Development and social adaptive ability measured by Infant-adolescent Social Adaptive Scale (ISAS) ($p = 0.1$; $p = 0.09$ accordingly). When entering the current study, the three groups differed in autism risk measured by Autism behavior Checklist (ABC) (F（2,72）=150.1； p ＜0.001), with autism risk group had higher scores than other two groups. All participants took part in four social attention tasks: attention to self in mirror, attention to human faces, attention to others' distress, and attention to social sounds. Toddlers' ABC and ISAC scores were collected again three months later.

Results: Toddlers with autism risk had poorer performance than the other two groups in attention to self in mirror (F（2, 72） = 4.51; $p = 0.014$), attention to others' distress (F（2, 72）= 3.72; $p = 0.029$), and attention to human faces tasks (F（2, 72） = 4.13; $p = 0.02$). More importantly, toddlers performance in the attention to others' distress and to human faces tasks significantly correlated with their ABC scores three months later (r = －.352, p = .004; r = －.344, p = .005 accordingly), and their performance in attention to others' distress and to social sounds tasks correlated with their ISAS scores three months later (r = －.289, p = .019; r = －.271, p = .029 accordingly).

Conclusions: Early impairments in social attention skills, especially attention to others' distress, can distinguish toddlers with high risk for autism from others. More importantly, such impairments could reliably predict toddler's autistic traits and social adaption in later development. Though these tasks would not be sufficient to result in a diagnosis of ASD, they could raise parental and paediatricians' concerns and signal the need for further developmental assessments.

417.022 *(Poster)* Early Patterns of Social Visual Engagement Predict Later Language Outcome in Typical Development but Not in Autism Spectrum Disorder

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Background: Infants' patterns of social visual engagement to faces change over the first two years of life. While typically developing (TD) infants tend to fixate on a speakers' eyes, they shift their attention to the mouth at around 8-10 months, a developmental time point at which canonical babbling emerges (Lewkowicz et al., 2012), and again during the second year of life, when first words are spoken (Hillairet de Boisferon et al., 2018). These shifts in attention between the eyes and mouth have been shown to predict language outcomes in TD infants. For example, attention to the mouth and gaze-following at 12 months positively predicted vocabulary at 24 months (Tenenbaum et al., 2015). In contrast, infants later diagnosed with autism spectrum disorder (ASD) show atypical patterns of social visual engagement to faces, with early and prolonged declines in eye-looking over the first two years of life. Mouth-looking in infants with ASD increases during the same time, but the relationship between these patterns of early looking and later language abilities is not well understood.

Objectives: The present study examines the relationship between social visual engagement at the beginning of the first and second years of life, and language development at the end of the second year, in a longitudinally-followed cohort of ASD and TD infants.

Methods: Eye-tracking measures of social visual engagement were collected at the beginning of the first and second years of life, from infants at high and low familial risk for ASD. At 24 months, language development was measured using the Mullen expressive and receptive language scales, and clinical best estimates confirmed diagnoses of ASD (n=58) in the high-risk cohort and TD (n=119) in the low-risk cohort. Eye-tracking data were quantified as percentage of time spent visually fixated on regions of interest (ROIs). Between-group comparisons measured levels of fixation to ROIs in ASD and TD infants. Within-group Pearson correlations tested whether infants' early patterns of visual fixation predicted language scores at 24 months.

Results: In TD and ASD groups, the adaptive value of fixation patterns differs: TD infants' eye-looking at the beginning of the first year of life (M_{age}= 5.14mo) positively predicted receptive language (r=0.312, p=0.002), and mouth-looking during the second year of life (M_{age}=15.21mo) trended towards positive prediction of expressive language scores at 24 months; in contrast, in infants later diagnosed with ASD, patterns of visual fixation were unrelated to language scores. Instead, ASD infants' early (M_{age}= 5.12mo) eye-looking and later (M_{age}= 15.23mo) object-looking predicted ADOS total scores at 24 months (r=-0.346, p=0.029; r=0.384, p=0.009, respectively).

Conclusions: Increased visual attention to eyes at the beginning of the first year of life is adaptive in TD infants, positively predicting later receptive language. In infants with ASD, these patterns of visual fixation were unrelated to 24 months language outcomes. Instead, patterns of social visual engagement predicted levels of social disability at 24 months in infants with ASD. Future analyses will investigate longitudinal trajectories of social visual engagement as predictors of language outcome in both ASD and TD infants.

417.023 *(Poster)* Early Pregnancy Placental Markers in Maternal Serum and Autistic Traits in the Children

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Background: Males are more likely to be diagnosed with autism despite greater awareness of under-diagnosis or misdiagnosis of autism in females (Lai, Lombardo and Baron-Cohen, 2014). Sexual dimorphism in the prenatal endocrine environment may be a contributing factor. Several sex steroid hormones, including androgens and estrogens, are elevated in the fetal circulation of males with autism (Baron-Cohen et al., 2019). The placenta could be contributing in elevated steroidogenesis, as it synthesizes the majority of estrogens. Human choriogonadotropin (hCG) and pregnancy-associated plasma protein A (PAPP-A) are two placental proteins that are routinely measured in maternal serum in the 1st trimester, since their atypical levels may indicate developmental conditions affecting the brain, such as trisomy 21. Both very high and very low levels of HCG in maternal serum have been previously associated to autism likelihood (Windham, Lyall, Anderson, & Kharrazi, 2016).

Objectives: To investigate if the levels of hCG and PAPP-A in maternal serum:

1. correlate to steroid hormone levels
2. predict the number of autistic traits in the children
3. mediate their effects on neurodevelopment via changes in brain growth, as measured in ultrasound (U/S)

Methods: Following informed consent, clinical records were collected to ascertain values of 1st trimester human choriogonadotropin (hCG) and pregnancy-associated plasma protein A(PAPP-A) in the serum of n=196 pregnant women, taking part in the Cambridge Ultrasound Siblings and Parents (CUSP) study. Hormone median-of-means (MoM) values were calculated by standardizing for gestational age and maternal age according to international norms. Maternal serum samples were also collected as part of the National Prenatal Screening Programme (n=126). Concentrations of the following steroids and peptides were measured: Testosterone (T), Estradiol (E2), Dehydroepiandrosterone sulphate (DHEAS), Progesterone (P), Insulin-like Growth Factor 1 (IGF1), sex hormone-binding globulin (SHBG), via targeted immunoassays. Fetal brain development was assessed at two time-points by measuring head circumference and transcerebellar diameter via ultrasound (U/S) at 20-22 and at 26-30 weeks of gestation. Expectant mothers were also asked to complete the Quantitative Checklist for Autism in Toddlers (Q-CHAT) online when their infant was between 18- and 20-months old.

Results: PAPP-A MoM levels did not correlate to Q-CHAT scores. Preliminary analysis suggested that a binomial, U-shaped association between 1st trimester hCG MoM values and Q-CHAT scores of the children was statistically significant, with infant sex and the child's age at the time of assessment as covariates in the model (p=0.015). This effect was largely driven by females, as it was not significant in males after stratifying for sex. Increases in transcerebellar diameter in the 2nd trimester (20 to 22 weeks gestation) partly mediated the linear effect of hCG on Q-CHAT (ACME=0.31, p=0.04). hCG levels were also significantly associated with testosterone levels via linear Pearson's regression (p=0.038). There was insufficient power to detect potential associations of steroid hormones with Q-CHAT scores, as these measures were obtained in different subsets of the original cohort.

Conclusions: Atypical hCG levels may be an early indicator in the development of autistic traits and has relevance for the prenatal sex steroid and brain overgrowth theories of autism.

417.024 *(Poster)* Early Vocalization Trajectories Predict Which High-Risk Infants Develop ASD

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Background: Recent research has identified patterns of early vocalization development that differentiate infants at high familial risk for autism from infants at low risk (Paul, Fuerst, Ramsay, Chawarska, & Klin, 2011; Northrup & Iverson, 2015), but little is known about which high-risk infants will develop ASD. Significant heterogeneity in language development in high-risk infants has made it difficult to identify specific linguistic markers of enhanced autism risk. Recently, there has been a push to use naturalistic language sampling to characterize language development in ASD, rather than (or in addition to) standardized assessments and parent-report questionnaires (Barokova & Tager-Flusberg, 2018). However, prospective naturalistic vocalization sampling has yet to be used to identify markers of elevated autism risk in samples of infants already at high familial risk for ASD.

Objectives: This study utilizes a data-driven, latent class approach to (1) identify trajectories of language development from 6-24 months in a large sample of infants at high familial risk of ASD, and (2) assess the relative likelihood of being diagnosed with ASD in each pathway.

Methods: Infants at high familial risk of developing ASD (N=232) were assessed at 6 (AOSI; Bryson, Zwaigenbaum, McDermott, Rombough, & Brian, 2008), 12 (AOSI or CSBS; Wetherby & Prizant, 1993), and 24 (CSBS) months as a part of the multi-site Infant Brain Imaging Study, with diagnostic assessment at 24 months. Trained and reliable coders identified speech-like vocalizations (non-vegetative or affective) from videos. Vocalizations (count per 10 minutes) were entered into a general latent class mixed model fitted using maximum likelihood. The optimal number of classes was detected using goodness-of-fit statistics (BIC). Posterior classification probabilities and class membership by diagnosis are reported; class was used to predict diagnosis in a logistic regression.

Results: The optimal number of classes in this dataset is 2 (BIC=4599.64; Table). Class 1 (58.19%) showed steep growth in the production of speech-like vocalizations from 6-24 months (Figure). Class 2 (41.81%) demonstrated an attenuated slope, with large class differences by 24 months. Class significantly predicted diagnostic group (b=-1.27, z=-3.96, p<0.001); high-risk infants in class 2 (slow growth) were more likely to be diagnosed with ASD at 24 months than high-risk infants in class 1 (OR=3.57).

Conclusions: Wide variability in the phenotypic profiles of infants at high familial risk for ASD renders it challenging to identify early markers that confer likelihood of diagnosis. This study utilized data driven methods to identify two latent classes of speech-like vocalizing that were associated with differential likelihood of developing ASD. Infants with attenuated growth in speech-like vocalizations were 3.57 times more likely to be diagnosed with ASD than infants showing steeper growth. Infants in the steep growth class had a rate of diagnosis similar to rates seen in other populations of infant siblings (14.81%; Ozonoff et al., 2015) whereas the class with slower growth had a diagnosis rate of 38.14%. Class assignment did not identify 100% of infants later diagnosed with ASD, but could be utilized to identify infants who should be prioritized for diagnostic assessment and early intervention.

417.025 *(Poster)* Establishing the Early Intervention System at a Age of 12 to 24 Months in a Japanese Community Applying Esdm

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Background: The effectiveness of the Early Intervention for ASD has been stressed from research, but the EBPs for young children with ASD cost a lot, so the Japanese local authorities are hesitant to move forward. Saga city and Taku city that have the low population areas have build the 18 months check up system and started trying to establish the E.I.System for the resident. They chose the ESDM(Early Start Denver Model), and tried to put the budget to train the Public nurses as Early Detection materials, and train the professionals as certified ESDM therapist.

Objectives: Establishing the Early detection System on ASD before 2 yr old in a local community and apply the effective E.I. System locally.

Methods: Training the Public nurses for Early Detection, and the children who were screened as ASD were provided the ESDM once a week and for a year. Pre- post examining of the effectiveness of the children made the progress by ESDM were carried out, with New Kyoto Developmental test, Vineland2 and ADOS2. And the mothers were given the BDI-2.

Results: Once the training of the Public Nurses finished, the young children who are suspected as ASD at the age of 18 to 20 months are increased. Pre- Post examining showed the good progresses in all areas of all the tests and mothers' BDI2 were progressed.

Conclusions: It is a preliminary community study. Even the poor resources of the local communities, training for the nurses were effective to become the Early Detection, and providing the ESDM as an EI made the good progress in children's development.

417.026 *(Poster)* Examination of the Developmental Relationships between Social Motivation, Initiation of Joint Attention, and Language in Infants at Risk for Autism

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Background: Joint attention, the coordinated orienting of two individuals toward an object, has been linked to later language capabilities in children with typical development and with autism spectrum disorder (ASD). Early social motivation, the disposition to preferentially orient to social stimuli and to seek, like, and maintain social engagement, has also been hypothesized to promote language development. However, no prior research has examined whether social motivation and joint attention are necessary for the emergence of specific language abilities.

Objectives: We hypothesized that a minimal threshold of social motivation (SM) at 6 months (M) and the presence of initiation of joint attention (IJA) at 12M are each necessary but not sufficient for the later development of language at 24M. For our study, we examined specific aspects of language ability (verbal-utterance, symbolism, inference) by abstracting items from language subscales of standard developmental assessments. "Language" in our study was operationally defined as having a score>0 on items that indexed all 3 components (our "language pillars"). We then tested whether quantitative scores of earlier SM behavior at 6M and IJA at 12M correlated with 24M language abilities and language complexity scale scores (combined ceiling scores of the Receptive and Expressive subscales of both the Vineland II and MSEL).

Methods: Analyses involved 426 participants in the Infant Brain Imaging Study, a multisite, prospective study of infants at high and low familial risk for ASD. Measures included Expressive and Receptive subscales of both the Mullen Scales of Early Learning and the Communication Domain of the Vineland II (language); Question 7 of the Communication and Symbolic Behavior Subscales (IJA); and a composite Social Motivation Index (social motivation), derived from specific items in the Vineland II, Autism Observation Schedule for Infants, and Infant Behavioral Questionnaire-revised. Based on linguistically informed criteria, individual language items were assigned to novel language pillar subscales measuring verbal-utterance, symbolism, and inference. Items common across SM and language, and IJA and language were excluded. Additional items that indexed multiple language pillars were categorized under combination subscales (e.g., symbolism + verbal-utterance), with items fulfilling all 3 pillars deemed as measures of language. Correlations were computed between SM scores at 6M and language scores at 24M, and between IJA at 12M and language scores at 24M. These were followed by binomial probability tests to evaluate the necessity of threshold levels of 6M SM and 12M IJA for 24M language proficiency.

Results: 6M SM scores were significantly correlated with verbal-utterance, symbolism+verbal-utterance, inference+symbolism, and inference+symbolism+verbal-utterance scale scores at 24M ($p<0.005$). 12M IJA scores were significantly correlated with all language subscale scores at 24M ($p<0.005$). None of the binomial tests of probability achieved significance ($p>0.9$).

Conclusions: These findings provide novel evidence for links between early SM and later language. They also extend previously described associations between IJA and later language through the examination of associations between IJA and linguistically informed subscales measuring specific language capabilities. The failures of tests for necessity suggest that, while these domains interact, SM and IJA are not, by themselves, necessary developmental prerequisites for language.

417.027 *(Poster)* Executive Function at Two Years Is Associated with Executive Function at School Age in Children at High and Low Familial Risk for ASD

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Background: Impairments in executive function (EF) are present in individuals with ASD and their relatives. EF differences may emerge by 2 years of age in siblings of children with ASD. Working memory and inhibition of prepotent responses are among the first EFs to emerge and are present in typically developing infants by 12 months. EF increases in complexity and capacity with age and encompasses cognitive, emotional, and behavioral responses and actions. However, it remains unclear how early-emerging EFs relate to later EFs in younger siblings of children with ASD.

Objectives: To investigate the association between emerging EF at age 2 and EF at age 8-11 years in children at high familial risk (HR) and a comparison group of children with no family history of ASD (low risk; LR).

Methods: Participants are from the on-going, longitudinal, multisite (UNC, CHOP, WUSTL, UW) Infant Brain Imaging Study. To date, HR (n=31) and LR (n=18) participants with EF data at 2 years and school-age (8-11 years) have been evaluated. EF at age 2 was assessed using the A-not-B (total correct/total trials) and school-age EF with the BRIEF-2. The BRIEF-2 provides a Global Executive Composite score (GEC) and three index scores; (Behavior Regulation Index [BRI], Cognitive Regulation Index [CRI], and Emotion Regulation Index [ERI]). Higher scores on the BRIEF-2 indicate more impairment. IQ, assessed at school-age with the DAS-2, was a co-variate in the analyses.

Results: There was a significant main effect of EF at age 2 on school-age GEC ($F(3,38) = 3.62$, $p = 0.02$) and ERI ($F(3,38) = 2.95$, $p = 0.05$) controlling for IQ and group, but not on BRI and CRI. Interaction (group x EF at age 2) for GEC, ERI, and CRI was non-significant. However, group (HR vs. LR) moderated the relationship between EF at age 2 and BRI ($F(1, 37) = 2.71$, $p = 0.04$), controlling for IQ, such that better EF at age 2 was associated with lower scores on BRI in the HR group only (Figure 1). Follow-up analysis of the BRI subscales showed that group moderated the relationship between EF at age 2 and Self-Monitor ($F(1, 37)=2.98$, $p=0.03$), controlling for IQ. In the HR group, better EF at age 2 was associated with lower Self-Monitor scores, with the opposite pattern evident for the LR group (Figure 2). There were no significant main effects or interactions on the Inhibit subscale.

Conclusions: EF at age 2 was associated with overall EF and emotion regulation at school-age for both HR and LR children. EF at age 2 was also associated with behavior regulation at school-age (specifically self-monitoring), but only for HR children. EF is related to school readiness and academic success and has been linked to better outcomes later in life. These findings suggest that EF intervention may be warranted in HR children as young as 2 years of age when EF difficulties are present. Future studies are needed to evaluate whether EF intervention in very young children lead to better outcomes in school-age.

417.028 *(Poster)* Expressed Affect in Infants at High- and Low-Risk for ASD during an Emotion Eliciting Task

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Background: Children diagnosed with ASD have early histories of increased negative affect, decreased positive affect, and lower levels of behaviour regulation compared to children without ASD (e.g., Clifford et al., 2009; Garon et al., 2009; 2016). A better understanding of the development of these temperament traits is warranted given the implications for early detection and intervention. We aim to extend these findings based on parent-report questionnaires to behavioural observation. Here we focus on expressed affect in infants at high familial risk for ASD using a task designed to elicit positive and negative affect.

Objectives: To determine if affect expressed at 6, 12, and 18 months of age during the emotion eliciting task is related to ASD symptoms at 24 months.

Methods: Participants were 63 high-risk (HR) infants with an older sibling with ASD and 20 low-risk (LR) controls. Infants were assessed at regular intervals beginning at 6 or 12 months of age. The emotion task consisted of short sub-tasks in this order: neutral baseline video (BL), bubbles, BL2, toy play, toy removal, blank mask, cow mask, brush hair, wash face, BL3. The task was video-recorded and coded offline using Noldus Observer. Expressed affect was coded, blind to group, in 5 s intervals based on facial and vocal cues on a scale from -2 to 2 (negative to positive affect; 0 = neutral). At 24 months, infants were assessed with the Autism Diagnostic Observation Schedule, 2nd ed. -Toddler module (ADOS-T). For each age and group, we used *t*-tests to compare mean affect for each subtask to 0 (neutral), in order to determine if subtasks elicited the expected affective valence. For each age, we used Pearson correlations to determine if overall mean affect (all tasks combined) was related to 24-month ADOS-T scores.

Results: At each age, the valence in affect generally matched expectations for probed affect, especially at 12 and 18 months. In particular, mean affect for bubbles was consistently positive, with differences from neutral significant at 18 months for LR infants, and at 12 and 18 months for HR infants ($p < .002$). Face washing was consistently negative across all ages and groups (p's $< .005$ except for controls at 12 months). Pearson correlations indicate that overall mean affect at 6 months was negatively correlated with ADOS-T scores at 24 months ($p = .03$), with this relationship driven by the ADOS-T social affect score ($p = 007$).

Conclusions: The emotion task suitably elicited a range of infant affect displayed facially and vocally. Findings that 6-month-olds with lower mean affect on the emotion task have higher scores on the ADOS-T indicates that behavioural observation is sensitive to the relationship between early expressed affect and later ASD symptoms. A better understanding of this relationship could inform the development of very early intervention for infants at risk for ASD.

417.029 *(Poster)* Eye-Blink Entrainment in Infant-Caregiver Dyads

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Background: Typically-developing infants engage in contingent interactions with their caregivers, continuously modifying and being modified by the behavior of their social partners (Fogel 1993). For example, caregivers and infants coordinate their vocalizations, eye gaze, and facial expressions, providing a critical foundation for social learning. In addition to the coordination of these overt facial and vocal signals, previous studies of adults show that even subtle behavioral signals, such as posture, breathing, and eye-blinks, are synchronized between interacting partners. For example, eyeblinks are synchronized between communicative partners at attentional breakpoints, an entrainment phenomenon that may reflect a shared understanding of the unfolding narrative and facilitate successful communication (Nakano et al., 2010). Interestingly, eye-blink entrainment is not observed in adults with Autism Spectrum Disorder (ASD), highlighting deficits in interactional synchrony that may both reflect and contribute to the social communication deficits characteristic of ASD (Nakano et al., 2011). Investigating when eye-blink entrainment emerges in typical development and whether it is disrupted in infants later diagnosed with ASD will shed light on implicit aspects of interactional synchrony that provide an important foundation for successful communication and social learning.

Objectives: To determine if eye-blink entrainment is: (1) present in typically developing (TD) infants and (2) disrupted in infants with ASD.

Methods: Eye-tracking data were collected from: (1) 4- to 6-month-old TD infants (n=20) during a 70 second interaction with their caregiver; and (2) a pilot sample of 3- to 5-month-old infants with ASD (n=9) during a 30 second interaction with their caregiver (Figure 1). Blinks and lost data were hand coded at each frame (data sampled at 30 frames per second). Peristimulus time histograms (PSTHs) were used to quantify change in rate and timing of infant eye-blinks relative to moments when their caregiver blinked. Permutation testing was used to test the null hypothesis that the timing of infant eye-blinks was unrelated to the timing of caregiver eye-blinks. Over 1000 iterations, each infant's binary time series of blink data was circularly shifted by a random number and the 95th percentile across all permuted data served as a threshold for statistically significant blink entrainment ($p<.05$).

Results: Preliminary analyses reveal that both TD and ASD infants show eye-blink entrainment, with TD infant blink rate peaking 600 ms *before* the blinks of their caregivers (Figure 2A), and blink rate of infants with ASD peaking 150 ms *after* the blinks of their caregivers (Figure 2B).

Conclusions: Our results provide the first demonstration that eye-blink entrainment, a critical aspect of interactional synchrony, is already present in the first months of life. Preliminary findings from a small pilot sample of infants with ASD show that the timing of eye-blink entrainment may be delayed in ASD, a difference that may reflect disruptions in attunement to others' behavior. Immediate next steps include replicating findings in a larger sample size of age-matched infants, investigating the time-scale (within an interaction) over which infant-caregiver eye-blink entrainment emerges, and investigating the conditions under which infant-caregiver eye-blink entrainment is observed.

417.030 *(Poster)* Factors Related to Retention in a Prospective Longitudinal Study of Infants at Risk for Autism

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Background: Previous studies have examined cohort recruitment practices and retention in longitudinal study designs. In a premature infant clinical trial, birth weight and maternal age interacted with treatment in predicting dropout (Constantine et al., 1993)**.** A longitudinal study of general child development found participants with greater psychosocial risk were less likely to be retained to outcome (Woolfenden et al., 2016). Cohorts in longitudinal samples do not remain fixed over time and should be evaluated for representativeness based on recruitment strategies and participant retention. Biased patterns of retention can create threats to external validity. This has not yet been examined in longitudinal studies of infant siblings at risk for autism spectrum disorder (ASD).

Objectives: We explored factors that could influence participant retention in a longitudinal sample of infants at low and high risk for ASD by examining differences between participants who were and were not retained in a study protocol that spanned 2.5 years.

Methods: Non-retention was defined as having attended at least one study assessment but dropping out prior to the outcome assessment at 36 months old. The retained (N = 327) and not retained (N= 64) groups were compared on ten factors that may be related to retention (see Table 1), including recruitment group (low or high risk for ASD), demographics, travel distance, and pre-existing parental concerns captured at intake. We hypothesized that variables associated with family stress, feasibility of participation, and likelihood of an ASD diagnosis would predict retention patterns.

Results: Significant differences were found between the retained and not retained groups in family income and maternal education using the asymptotic linear-by-linear association test, with the retained group having significantly higher income ($z= -2.29$, $p =.02$) and significantly higher maternal education level ($z= -2.40$, $p = 0.017$). T-tests showed a significant difference for maternal age ($t=-3.18$, $p = 0.002$) where mothers in the retained group were significantly older. The not retained group had significantly longer travel distance than the retained group (Mann Whitney $U=10{,}000$, $p = 0.05$). There were no other significant group differences (Table 1).

Conclusions: In this infant sibling study sample, the retained group differed from the not retained group on three demographic variables. The retained group was more likely to have higher family income, higher maternal education, and higher maternal age. The retained group also lived closer to the research institute where the study took place. These findings can help researchers predict families most likely to drop out of a longitudinal study and develop procedures that can reduce dropout rates. Importantly, recruitment group and existing parental concerns, variables that could influence participant outcomes, ASD risks, and ASD recurrence rates and thus create serious threats to external validity, were not significantly different between groups. This suggests that the study findings from the retained group should be largely generalizable.

417.031 *(Poster)* Familial Genetic Liability for Autism and Brain Development in Infant Siblings

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Background: Inherited polygenic variation is thought to account for the vast majority of ASD cases, yet it is currently unknown how familial genetic liability for ASD contributes to individual differences in brain development. Recent work from our group (Girault et al., under review) has demonstrated that autistic traits in older siblings with ASD (probands) are associated with recurrence risk in their younger siblings, suggesting that proband ASD traits may serve as an important presymptomatic index of genetic liability for ASD in later born siblings. Here we investigate associations between proband autistic traits and sibling brain development in the first two years of life. We focus on three well-established brain phenotypes associated with ASD: total surface area (TSA), total cerebral volume (TCV), and extra-axial cerebrospinal fluid volume (EA-CSF).

Objectives: Define associations between proband ASD traits – as a potential presymptomatic index of genetic liability for ASD – and brain structural phenotypes at 6, 12, and 24 months in their younger siblings at high familial risk (HR) for ASD.

Methods: Participants included 346 pairs of probands and siblings from the Infant Brain Imaging Study. ASD probands (mean age 5.5 years, range 1.7 to 15.5 years) were phenotyped using the Social Communication Questionnaire (SCQ). Infant siblings underwent magnetic resonance imaging at 6, 12, and 24 months of age. T1 and T2-weighted images were used to generate measures of TSA, TCV, and EA-CSF. Siblings received a clinical best estimate diagnosis at 24 months using DSM-IV-TR criteria. Proband SCQ scores were evaluated as predictors of brain phenotypes at 6, 12, and 24 months in their younger siblings (n = 76 with ASD, n = 270 without ASD).

Results: Visual investigation and bi-variate Pearson's correlations revealed significant associations between proband SCQ scores and infant sibling TSA and TCV at 12 (TSA: r = 0.40, p = 0.011; TCV: r = 0.36, p =0.024) and 24 months (TSA: r = 0.41, p = 0.004; TCV: r = 0.35, p = 0.015) in infants who go on to develop ASD (HR-ASD); proband SCQ scores explained 16.8% and 12.3% of the variation in HR-ASD sibling TSA and TCV at 24-month diagnosis, respectively. No associations were found between proband SCQ and EA-CSF ($-0.02 \leq r \leq 0.20$, all $p \geq 0.203$). Longitudinal mixed models identified significant associations between trajectories of both TSA (beta = 0.44, p = 0.002) and TCV (beta = 0.40, p = 0.002) and proband SCQ scores in HR-ASD siblings.

Conclusions: This study reports quantitative associations between proband SCQ scores and brain development in infant siblings later diagnosed with ASD, building upon recent evidence to suggest that proband ASD trait level may serve as an important presymptomatic index of genetic liability for ASD in later born siblings. Further, these associations were specific to brain volume and surface area phenotypes, but not EA-CSF, suggesting distinct pathogenic mechanisms. Our findings suggest familial characteristics should be captured and included in prediction frameworks designed to parse heterogeneity in ASD and identify individualized early treatment targets.

417.032 *(Poster)* Improved Personality Flexibility Trait through Conducted Parent Early Start Denver Model (P-ESDM) Enhanced Parenting Effectiveness from Taiwan: A Pilot Study

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Background: Various researches report the parents of children with autism spectrum disorder (ASD) experience high levels of stress and a specific negative impact on their life quality. Parent implemented-early start Denver model (P-ESDM) program have been indicated effectiveness in Western and Asian culture (Rogers et al., 2012; Estes et al., 2014; Zhou et al., 2018）. As we know, the parent would be a good coach for the first life. The benefit of the parent coach could reduce stress and improve parenting. However, there is seldom the reasearch to figure out the personality trait associated with parenting courses.

Objectives: The first aim of this study is to provide an effective parent program and try to find the correlation between parent personality phenotype and parenting skills changed. The second purpose we also expect that parenting efficacy will increase after P-ESDM.

Methods: Three single-subject designs had conducted. We collected three different age levels (20m, 34m, and 41m) to learn the P-ESDM. All participants have assessed their cognitive/language abilities by Mullen scales of early learning. Autistic symptoms were measured by the Screening Tool for Autism in Toddlers & Young Children (STAT) and Childhood Autism Rating Scale–Second Edition (CARS-2) inventory. Individual ten treatment goals were set up for the next 12 weeks via the ESDM curriculum. P-ESDM was performed by a certified ESDM therapist who also completed the P-ESDM three-day workshop without certified for P-ESDM. Parent stress status from parent stress inventory (PSI), parenting sense of competence scale (PSCS), and board autism phenotype (BAP) were also measured.

Results: We found that parent fidelity increased after 12 weeks and maintain after three months and parenting sense of competence. The abilities based on curriculums improved across different developmental domains. And the parent phenotype was indicated to develop the decrease extent of aloof and rigid subscales, respectively.

Conclusions: In conclusion, we could find similar improved children's ability and parenting skills as previous studies. Moreover, the exciting things which indicated parent could be more flexible to conduct the joint activity routines with various themes of the play and daily life routines after training. These may also improve their personality trait phenotype. Parents implemented ESDM not only to decrease life/ parenting stress but also enhanced the parenting satisfaction associated with passion and flexible personality style.

417.033 *(Poster)* Investigating Early Attention to Non-Social and Social Stimuli and Underlying Mechanisms of Language in a Prospective ASD and ADHD Infant-Sibling Study.

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Background: Language impairments have been frequently observed in Autism Spectrum Disorder (ASD). Prospective studies have found a greater frequency of language delay and lower distributions of language scores for infant siblings at elevated-likelihood (EL) of ASD compared to those at typical-likelihood (TL). While ASD and attention deficit hyperactivity disorder (ADHD) frequently co-occur, there is limited evidence for language impairments in ADHD. Twin studies report impaired language skills in individuals with elevated ADHD traits; however, there is a dearth of developmental language research in ADHD. Early attention to underlying social communication cues from facial features (like the eyes or mouth) may inform the development of language abilities in ASD and/or ADHD.

Objectives: To investigate attention to underlying features of language, and its relation to language development in infant siblings at typical- and elevated-likelihood of ASD and/or ADHD.

Methods: This study included 93 five-month old infants (51 males) from the British Autism Study of Infant Siblings, Studying Autism and ADHD Risks (STAARS; staars.org). 25 TL controls, 42 EL-ASD, 14 EL-ADHD and 12 EL-ASD+ADHD infants completed an eye-tracking paradigm ('Frequency Task'). Ten-second videos of non-social stimuli (checkerboard pairs) and of social stimuli (face pairs) were presented to the infants. Three trials were presented for each condition, respectively. In both non-social and social conditions, each stimulus in the pair alternated at a different frequency; either 6Hz (i.e. the frequency of human syllabic speech), 1Hz or 10Hz.

Results: There was an effect of frequency on looking at checkerboards (F (1.78, 158.79) = 136.13, $p < .001$, $\eta_p^2 = .61$) and faces (F (1.95, 163.50) = 11.45, $p < .001$, $\eta_p^2 = .12$). This was significant for both checkerboards and faces when 10Hz was compared to 6Hz, and for checkerboards when 6Hz was compared to 1Hz (see Table 1 & Figure 1a). There was a marginal effect of EL-ASD on looking at checkerboards (F (1, 89) = 3.65, p = .059, $\eta_p^2 = .04$), while there was no effect of likelihood status on any other non-social or social analyses.

Infants looked more at the lower-face region of social stimuli that alternated at 10Hz compared to 6Hz ($p = .001$, $\eta_p^2 = .12$), and there was an interaction between EL-ADHD and frequency (F (1.87, 156.98) = 3.51, $p = .035$, $\eta_p^2 = .04$). Infants at TL-ADHD looked more than EL-ADHD at 6Hz compared to 1Hz, while EL-ADHD looked more than TL-ADHD at 10Hz compared to 6Hz lower-face regions (Figure 1b). Other two- and three-way interactions were not significant.

Conclusions: Young infants do not show an innate preference for stimuli within the frequency range of syllabic speech. Irrespective of likelihood status, infants preferred higher frequencies of non-social and social stimuli, generally showing a 10Hz>6Hz>1Hz looking pattern. These findings contribute to the literature on language development in TL and EL infants, suggesting that 5-months may be too young for infants to show perceptual tuning to underlying frequencies of language. Attention to other facial features such as the eyes may be more socially informative at this early stage of development.

417.034 *(Poster)* Investigating Gender Differences in the Early Markers of Autism Spectrum Conditions (ASC) in Infants and Toddlers

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Background: Many females on the autism spectrum are diagnosed later, missed, or mis-diagnosed, leading to lost opportunities for early intervention, supports, and services that can enhance quality of life. Research into the very early presentation of Autism Spectrum Conditions (ASC) in females is therefore critical.

Objectives: The primary objective of this study was to investigate gender differences in the early signs of ASC in infants and toddlers identified through primary care. A secondary aim was to examine gender ratio trends from 12- to 24-months of age.

Methods: A cross-sectional sample of 197 infants and toddlers aged 12- to 24-months (44 female, 153 male) at "high likelihood" for ASC were assigned to the following groups following gold standard assessment using the Autism Diagnostic Observation Schedule-Toddler (ADOS-Toddler) and Autism Diagnostic Interview-Revised (ADI-R): 1) Female-ASC; 2) Male-ASC; 3) Female Non-ASC; and 4) Male Non-ASC groups. Their early social-communication behaviours (e.g., eye contact, protodeclarative pointing, use of gestures, joint attention, showing, etc.) were then compared at 18 and 24 months of age, using the Social Attention and Communication Study-Revised (SACS-R; Barbaro & Dissanayake, 2010, 2013, 2018) tool. Comparisons were not conducted at 12-months due to small sample sizes in the female groups (both $n = 1$). The first author coded these behaviours via observation of videotapes of their diagnostic assessment using the ADOS-Toddler. A second rater, blind to diagnostic status, recoded 20% of the SACS-R behaviours, with overall percentage agreement of .96.

Results: No differences in the early markers of autism were found between females and males in both the ASC and Non-ASC groups at 18- and 24-months of age. However, the ratio of females to males with ASC decreased over time, with a ratio of 1:15 at 12-months, 1:3.8 at 18-months, and 1:3.2 at 24-months; the overall ASC gender ratio was 1:3.7.

Conclusions: The discrepant gender ratio between 12- and 24-months of age, with significantly fewer females at 12 months, suggests that females need to be closely monitored between 12 and 18 months when conducting screening and developmental surveillance for ASC. Furthermore, the lack of differences found between the groups on the early markers of autism indicates that future studies should continue to focus on the early autism phenotype in community-based samples, to assist with modification or development of female specific screening tools at these early ages.

417.035 *(Poster)* Is Effortful Control Related to Social Competence in Toddlers with Autism Spectrum Disorder?

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Background: Effortful control (EC), a key aspect of self-regulation, is critical to the development of social competence in children. In typically-developing preschoolers, EC was found to be positively related to social competence, with this association being stronger for children with higher negative affectivity (Eisenberg et al., 2014; Eisenberg et al., 2010). While a similar relationship was reported in both preschoolers with ASD (Jahromi, Bryce, & Swanson, 2013) and typically-developing toddlers (Spinrad et al., 2007; Mathieson & Banerjee, 2010), the association remains unclear for toddlers with ASD. As self-regulatory and social impairments are considered hallmarks of ASD, addressing this gap in research on affected toddlers can contribute insight into early intervention practices targeting social competence.

Objectives: To characterize the magnitude of the association between parent-reported effortful control and social competence in toddlers with and without ASD, and to investigate the role of negative affectivity in this association.

Methods: Parents of 136 toddlers (Mean age=21.71 months, SD=3.45) with ASD (n=82) and of chronological age-matched typically-developing (TD; n=54) toddlers completed the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart, 2006) and the Vineland Adaptive Behavior Scales (VABS-2; Sparrow et al., 2005). Autism symptom severity and nonverbal skills were concurrently characterized using the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2012) and the Mullen Scales of Early Learning (MSEL; Mullen, 2005), respectively.

Results: Toddlers with ASD scored lower on ECBQ-EC (d=-1.05, p<.001) and VABS-2 Socialization standard score (VABS-2 SOC; d=-2.08, p<.001) compared to TD toddlers. However, there was no difference in ECBQ Negative Affectivity (ECBQ-NA) scores (d=-0.05, p=0.775). A multivariable regression model computed for each group separately controlling for ECBQ-NA and Nonverbal DQ scores found no association between ECBQ-EC and VABS-2 SOC in either group (B_{ASD}=1.86, R^2=0.106, p=0.078; B_{TD}=2.29, R^2=0.223, p=0.441). A significant association was, however, found between ECBQ-NA and VABS-2 SOC in both groups (B_{ASD}=-2.23, R^2=0.106, p=0.029; B_{TD}=-6.92, R^2=0.229, p=0.016).

Conclusions: The present study found that parent-reported effortful control did not significantly predict social competence in toddlers with and without ASD. While negative affectivity has been reported to moderate the relationship between effortful control and social competence, our findings suggest that in the second year of life, negative affectivity may itself be a significant predictor of social competence. The increased relevance of negative affectivity may be a result of the younger age of our sample, as effortful control is thought to still be emerging at this stage. Our results thus suggest that the relationship between parent-reported effortful control, negative affectivity, and social competence may change across development. Future longitudinal studies should address the age-dependent factors shaping the emergence of social competence in the context of both ASD and typical development.

417.036 *(Poster)* Language Profiles in Toddlers with Autism Spectrum Disorders and Developmental Delay: A Function of Assessment Tools?

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Background: Language and communication deficits are hallmarks of the autism phenotype. Studies on typical language development show that toddlers develop language in a "receptive-better-than-expressive" pattern. However, language studies in toddlers with Autism Spectrum Disorder (ASD) often demonstrate an opposite "expressive-better-than-receptive" pattern (Nevill et al. 2019; Weismer, 2017). To measure language profiles, expressive-to-receptive discrepancy scores are calculated across measures. It has been noted that this expressive-better-than-receptive pattern holds for some standardized language and development measures, but not others, though studies often include children with wide age ranges, small samples, and varying diagnostic techniques. Evaluating the role of assessment tool in profiling language is imperative for early and accurate diagnosis of ASD and other developmental disorders and atypical symptoms (ATP). (Kwok, 2014, Nevill et al., 2019).

Objectives: 1) To examine if the Receptive – Expressive (R-E) discrepancy scores differ significantly from zero across diagnoses. R-E > 0 score denotes receptive-better-than-expressive pattern, and R-E < 0 denotes expressive-better-than-receptive pattern. We hypothesize that expressive-better-than-receptive profiles will hold true across measures for the ASD group, while typically developing (TYP) and ATP groups will express the opposite pattern.

Methods: 84 toddlers with ASD (M_{age}=22.3,SD=3.2), 48 ATP (M_{age}=21.4,SD=3.9), and 36 TYP (M_{age}=21.9,SD=3.7) were administered the Mullen Scales of Early Learning (MSEL) and Preschool Language Scales, 5th edition (PLS-5). Using standard and t-scores, E-R discrepancy scores were calculated across measures, yielding positive scores for receptive-better-than-expressive and negative for expressive-better-than-receptive. One-sample t-tests were run to evaluate if the E-R indices were different from zero.

Results: Please see Figure 1 for the R-E discrepancy scores for ASD, ATP, and TYP groups based on the MSEL and PLS-5 measures. On the MSEL, ATP (t(47)=2.29,p=.026) and TYP (t(35)=2.15,p=.038) groups showed significantly greater than 0 R-E scores, suggesting the receptive-better-than-expressive pattern. In the ASD group, the R-E score was negative, but it did not differ significantly from 0 (t(83)=-1.23,p=.22). However, on the PLS-5, in the ASD group, the R-E score was significantly lower than 0 suggesting the expressive-better-than-receptive pattern (t(83)=-2.58,p=.012). In the ATP and TYP groups the R-E score was not significantly different from 0 (t(47)=1.46,p=.14), t(d35)=-0.95,p=.35, respectively).

Conclusions: Consistent with prior work, language profiles differed based on language measures. Although there was an expected trend toward the expressive-better-than-receptive pattern for the ASD group on the MSEL measure, the PLS-5 had a more pronounced and statistically significant effect, as it more specifically targets language skills and relies on more recent and extensive national norms. As expected, the new norms in the PLS-5 resulted in minimizing the previously reported receptive-better-than-expressive effect in children with developmental delays and typical development. These findings hold clinical importance regarding selection of language measure for assessing toddlers with suspected social disability. When investigating language profiles, the PLS-5 holds greater promise to identify atypical language profiles in very young children with ASD. Using a more sensitive, language specific measure that better represents ASD populations is important in early screening, diagnosis, and the design of individualized intervention plans for affected children.

417.037 *(Poster)* Longitudinal Patterns of Objectively Measured Activity Level Among Infants Developing ASD and Diagnostic Concerns for ADHD

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Background: Elevated symptoms of attention-deficit/hyperactivity disorder (ADHD), including high levels of activity, are frequently observed in children with autism spectrum disorder (ASD) (Antshel et al., 2016), increasing risk for delayed or inaccurate diagnosis (Miodovnik et al., 2015). Despite this, little is known about developmental patterns of overactivity in infants who develop ASD versus diagnostic concerns for ADHD by 3-years of age. Understanding similarities and differences in the developmental time-course of overactivity is critical to improve early detection of both ASD and ADHD.

Objectives: Using accelerometry, an objective measurement of motion-based activity, we examined longitudinal patterns of activity in infants at high and low familial risk for ASD or ADHD.

Methods: Participants included 127 infants at high and low familial risk for ASD or ADHD. Continuous motion-based activity was recorded using tri-axial accelerometers worn on participants' ankles at 12-, 18-, 24-, and 36-months of age during structured developmental testing and the administration of the Autism Diagnostic Observation Schedule. At 36-months, participants were categorized into one of three outcome groups: ASD (n = 19; met *DSM-5* criteria), ADHD Concerns (n = 16; elevated ADHD symptoms based on examiner, parent, and teacher report), and a Comparison group without ASD or ADHD Concerns (n = 92) (Table 1). Two measures of motion-based activity were calculated from the accelerometer data recorded during each assessment ($M_{duration}$ = 120 min; $SD_{duration}$ = 30 min): the mean number of movements (mean activity) and the mean intensity of activity (mean intensity). Differences in longitudinal patterns of activity were assessed using generalized estimating equations (GEE).

Results: For both measures of activity level, there were main effects for outcome group [χ^2 (2) = 22.0, $p < .001$] and age [χ^2 (3) = 177.6, $p < .001$], as well as a significant interaction between group and age [χ^2 (6) = 21.6, $p = .001$] (Figure 1). Post-hoc analysis for the interaction between outcome group and age indicated that at 12-months of age the three outcome groups did not exhibit significant differences in mean activity or mean intensity of activity (all ps $\geq$ 0.64). Over time, both the ADHD Concerns and ASD outcome groups exhibited significantly higher activity levels relative to the Comparison group, with significant differences first observed at 18-months of age (ASD vs. Comparison [t (14.01) = 2.87, p = 0.01]; ADHD Concerns vs. Comparison [t (13.43) = 2.62, p = 0.02]), persisting through 24- and 36-months of age (all ps $\leq$ 0.05). No significant differences in activity level were observed between the ASD and ADHD Concerns groups at any age (all ps $\geq$ 0.07).

Conclusions: Infants developing ASD and ADHD concerns exhibited higher frequency and intensity of motor activity by 18-months of age compared to infants developing typically. While the findings suggest that symptoms of overactivity may be an overlapping marker of atypical development in infants/toddlers developing ASD and diagnostic concerns for ADHD, it is possible that there are different mechanisms mediating activity level in infants/toddlers developing ASD (e.g., social avoidance behaviors) and ADHD Concerns (e.g., general dysregulation).

417.038 *(Poster)* Maternal Trauma History As Risk Factor for Infant ASD Behaviors in the Chatterbaby Autism Risk Survey

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Background: Maternal trauma refers to a traumatic event that occurs during pregnancy which damages a woman's physical or mental health. The role of maternal trauma is particularly interesting in the placenta/fetal unit, where the hormonal interaction between the mother and developing fetus is regulated. Consequently, trauma occurring to the mother during pregnancy may significantly impact this regulation and the subsequent development of the child. The underlying mechanisms that lead to developmental delays, specifically autism spectrum disorder (ASD) remain unclear. Because maternal trauma may lead to higher exposure to cortisol levels and inflammation in the developing brain, the possible relationships between maternal trauma and presence of developmental delays in infants were explored. This analysis was largely motivated by previous findings that have shown that acute maternal stress during pregnancy increased the rate of neurodevelopment disorders in the offspring (e.g. schizophrenia).

Objectives: The purpose of the study was to examine the relationships between maternal trauma history and ASD-associated behaviors in infants.

Methods: Data were collected as part of a voluntary survey completed by any user of the infant cry translation app, ChatterBaby (n = 1798, infant age M = 1.23 years, mother's delivery age M = 30.41 years). The "ChatterBaby Autism Risk Survey" obtains participants' consent for their information to be used in research and queries demographic information, including maternal trauma history. These categories were based on traumatic experiences outlined by the National Traumatic Stress Network. Of the total participants, 14.6% of mothers reported experiencing a traumatic event during pregnancy. Mothers additionally responded to questions related to their child's development which were based on CDC developmental milestones. Of these questions, behaviors which indicated ASD concern were examined To examine the general relationship between maternal trauma and ASD-associated behaviors, trauma scores (sum of all traumas) and behavioral-risk-scores were calculated for each individual participant and then fitted to two linear regression models. Model 1 fitted behavioral-risk-score with mother's delivery age, mother's education, infant's age, infant's sex, and ASD family history. Model 2 added maternal trauma scores. An ANOVA test was then used to determine significance. To examine specific relationships between types of maternal trauma and ASD-associated behaviors, a Pearson correlation coefficient was used to correlate maternal trauma types with each behavior.

Results: Findings did show significant relationships between the presence of maternal trauma and infant ASD-associated behaviors in either model ($p < 0.05$). Male gender and increased maternal education were associated with increased behavioral risk. However, trauma-scores had an inverse relationship with behavioral risk; increased trauma was associated with a reduction in ASD-associated behaviors. Contrary to our hypothesis, results indicated significant negative correlations between trauma type and ASD-associated behaviors.

Conclusions: Trauma-scores did predict ASD-associated risk scores. However, the direction of this relationship was contrary to our hypothesis: increased trauma scores were found to be associated with reduced ASD-associated risk scores. These findings oppose previous research conducted on trauma and schizophrenia risk. Given various factors related to maternal trauma and development of ASD, additional research further examining these relationships is needed.

417.039 *(Poster)* Negative Emotional Reactivity, Effortful Control, and Self-Regulatory Strategies in Toddlers with ASD

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Background: The ability to inhibit and regulate emotional responses, actions, and cognition (Effortful Control, EC) is a leading predictor of overall well-being (Eisenberg et al.,2014). Individuals with Autism Spectrum Disorder (ASD) experience marked challenges in self-regulation and increased intensity of negative emotionality (Jahromi, Bryce, & Swanson,2013). Negative emotions and poor coping skills in combination likely contribute to the increased comorbidity of psychiatric disorders among those with ASD (Mazefsky,2014). Compared to their peers, toddlers with ASD exhibit increased negative emotionality (Macari et al.,2018) and deficits in EC (Macari et al.,2017). However, little is known about the relationship between self-regulatory capacity and negative emotional reactivity during frustrating situations in toddlers with ASD.

Objectives: (1) To examine whether toddlers with ASD exhibit elevated anger during frustrating tasks compared to atypically-developing (language delay, global delay: ATP) and typically-developing (TYP) toddlers; (2) To examine if toddlers with ASD exhibit impaired self-regulatory capacity as measured by parent report and direct observation; (3) To examine the association between self-regulatory capacity and intensity of anger in response to everyday challenges.

Methods: Participants included 220 toddlers (Mage=21.4mo, SD=3.60; 84 ASD, 71 ATP, 65 TYP). Toddlers underwent anger-inducing standardized probes adapted from the Laboratory Temperament Assessment Battery (LabTAB; Goldsmith & Rothbart,1999). Intensity of emotional expressivity (iEE) through facial, vocal, and bodily channels and the presence of social (looking to parent, physical comfort seeking) and nonsocial (gaze aversion, self-stimulatory, tactile exploration) self-regulatory strategies during LabTAB were coded offline by blinded coders. Parents reported EC using the Early Childhood Behavior Questionnaire (ECBQ; Putnam, Gartstein, & Rothbart,2006). Autism severity was quantified using the Autism Diagnostic Observation Schedule-2 Toddler module (ADOS-2, Lord et al.,2012).

Results: The analyses revealed that toddlers with ASD showed higher iEE of anger compared to TYP toddlers [p<.001, d=0.60] but no other differences were found between groups (all ps>.075). Toddlers with ASD used fewer social self-regulatory strategies during anger probes than their ATP [p=.038, d=.32] and TYP [p<.001, d=.68] peers. However, their employment of nonsocial self-regulatory strategies was comparable to the other groups (all p>.455). Parents of toddlers with ASD reported lower EC compared to ATP (p=.004, d=0.48) and TYP (p<.001, d=1.06) groups. Finally, iEE of anger was negatively correlated with nonsocial regulatory strategies in each group (ASD: r(84)=-.32, p=.004, ATP: r(71)=-.26, p=.029, TYP: r(65)=-.27, p=.030) but not with EC nor social regulatory strategies.

Conclusions: As expected, parents of ASD toddlers reported greater vulnerabilities in effortful control. When faced with frustrating tasks, toddlers with ASD showed significantly more negative emotionality and used fewer social regulatory strategies (e.g., looking toward parent) than their peers but were comparable in their use of nonsocial regulatory strategies (e.g., gaze aversion or disengagement from frustrating stimulus). Children who employed fewer nonsocial regulatory strategies exhibited greater intensity of negative emotions in all three groups. The study emphasizes the complex link between enhanced negative emotionality and self-regulation in autism, which requires further examination for the early identification of children with ASD at greatest risk for comorbid psychiatric disorders.

417.040 *(Poster)* Neural Responses to Audiovisual Speech in Infants at-Risk for Autism Spectrum Disorder: An ERP Pilot Study

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Background: Speech is inherently a multisensory process, wherein highly synchronized visual cues from the moving mouth complement the dynamic acoustic stream. Past research has shown typically developing (TD) infants “tune in” to multisensory speech, looking to the mouth of their communication partners by midway through the first year of life, presumably to access the audiovisual cues that facilitate speech processing and language learning.

Objectives: This study aims to determine a) whether visual cues increase the efficiency of speech processing as indexed via event-related potentials (ERPs) in infants at low risk for ASD (infant siblings of TD children; Sibs-TD), and (b) whether infants at high risk for autism spectrum disorder (i.e., infant siblings of children with ASD; Sibs-ASD) display a lesser boost in speech processing efficiency with access to multisensory versus unisensory cues compared to Sibs-TD?

Methods: Forty 6-18 month old infants (20 Sibs-ASD; 20 Sibs-TD matched on sex and chronological age) are being recruited. Participants view videos of a female speaker saying syllables in audiovisual (auditory speech + synchronous visual mouth movements) and auditory only (auditory speech + still image of the face) conditions. Data are collected using NetStation and 128-channel Geodesic sensor net (Net Amps 400 amplifier, Hydrocel GSN 128 EEG cap, EGI Systems Inc.). The raw EEG signal is sampled at 1000 Hz and referenced to the vertex (Cz). The amplitude of the N1 (i.e., defined a priori as occurring between 100 ms and 140 ms post-stimulus onset) and P2 (i.e., defined a priori as occurring between 160 ms and 340 ms) as measured at a centrally located electrode site (Cz) are extracted from the grand average waveform of each participant and manually reviewed.

Results: Preliminary results for data processed to date (7 Sibs-TD; 4 Sibs-ASD) suggest infants across groups display an *increased* P2 amplitude in response to audiovisual relative to auditory only speech at 8 and 10 months (the developmental window wherein typically developing infants begin to increase looking to the moving mouth of their communication partners) and display a *decreased* or suppressed P2 amplitude in response to audiovisual versus auditory only speech between 12-18 months of age (the developmental window wherein they have perceptually narrowed to their native language and tend to shift their gaze from the mouth towards the eyes of their communication partners). On average, Sibs-ASD display reduced differentiation of audiovisual versus auditory only speech as indexed by the P2 amplitude compared to Sibs-TD.

Conclusions: Findings from this work will provide new insights into the developmental trajectories of multisensory speech processing in infants at high and relatively lower risk for autism. Preliminary results suggest differential processing of audiovisual speech may emerge within the first year of life, marked by a brief period associated with increased processing demands followed by subsequent facilitation of processing when typically developing infants have access to multisensory versus unisensory speech cues. Infants at heightened familial risk for ASD appear to show reduced differentiation of multisensory versus unisensory speech that may prove clinically useful for predicting ASD and related symptomatology.

417.041 *(Poster)* Nonverbal Prediction across Toddlers with Autism, Language Delay, and Typical Development

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Background: Successful navigation of a complex and dynamic world involves extracting regularities from incoming sensory inputs, developing predictions regarding the timing and nature of upcoming events, planning and executing subsequent behaviors, and flexibly updating predictions based on error signals. Accurate prediction and prediction updating are important for learning: Verbal and nonverbal prediction skills are associated with language abilities in typically developing (TD) children. Difficulties with updating predictions (D'Cruz et al., 2013), perhaps due to a high and inflexible precision of prediction errors (Van de Cruys et al., 2014), are observed in ASD. This impairment may contribute to deficits in social and communicative functioning in individuals with ASD. However, we know little about prediction skills and their relationship with language and social communication during early development including in toddlers with or at-risk for ASD and language delay (LD).

Objectives: Examine nonverbal visual prediction in toddlers with or at-risk for social communication and language impairments versus TD toddlers, and examine if nonverbal visual prediction relates to language and social communication skills.

Methods: Preliminary data is collected from 25 participants 15-32 months of age (13 TD, 12 with or at-risk for social communication impairments and/or LD); data collection is ongoing (anticipated total n=60). Of the 12 participants in the clinical/at-risk group, 6 have ASD, 3 have LD, and 3 have an older sibling with ASD. Participants completed an eye-tracking task adapted from Reuter et al. (2018) in which a central audiovisual stimulus was followed by a peripheral audiovisual target to one side of the screen for the first eight trials (Block 1; 200 ms delay between stimuli), and then to the opposite side of the screen (novel location) for the subsequent eight trials (Block 2). We compared overall number of anticipatory eye movements (AEMs) to either peripheral location (i.e., prediction quantity) and proportion of correct AEMs in Block 2 (prediction updating) between groups.

Results: Data analyses are ongoing. Preliminary analyses suggest no differences between TD and clinical/at-risk groups in regard to number of trials with AEMs both across both blocks (regardless of correctness), as well as separately in Block 1 and Block 2 (p's > 0.5), suggesting similar profiles of attention to the task and disengagement frequency from the central stimulus. However, TD toddlers had a significantly greater proportion of correct AEMs to the novel location in Block 2 (M=0.77) compared to those in the clinical/at-risk toddlers (M=0.45), $t(23)=-2.91$, $p=0.008$.

Conclusions: Preliminary findings suggest that TD toddlers are more successful at updating their predictions than participants with or at-risk for social communication or language impairments. These results are consistent with prediction updating difficulties observed in older children/adults with ASD and may provide a framework to examine links between prediction and communication development in toddlers with ASD and related language/communication challenges. Further analyses on the full sample will examine relationships between nonverbal prediction, language and social engagement, as well as differences between subgroups of the clinical/at-risk group (e.g., ASD vs. non-ASD LD vs. at-risk but no clinical diagnosis).

417.042 *(Poster)* Parent Perception of Social Communication Behavior in the Autism Screening Process: A Review of the STAT-Q

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Background: Parents' perception of their child's behavior plays a critical role in the screening process for Autism Spectrum Disorder (ASD). Most research on sensitivity and specificity of parent - reported screening tools for infants and toddlers (e.g., M-CHAT,) focuses on the first tier of screening. Recent research suggests that a two-tiered screening method shows strong positive predictive value and sensitivity as well as reduces the false positive rate of diagnosis. The STAT is a second-tier screening tool with a parent questionnaire (STAT-Q) to help identify risk for ASD. Given the importance of early identification and intervention, an improved understanding of parents' perceptions of child behavior during the screening process, particularly within the second tier of screening, is necessary to understand the utility of the tool as well as support parents in the diagnostic process.

Objectives: This study aims to examine parents' perception of their child's behavior using the STAT-Q. This study will further identify its utility as a diagnostic tool including specificity and sensitivity of the tool, as well as identify differences in responding based on sex and language spoken in the home.

Methods: Children between 19 and 36 months (N=281), were assessed through a multidisciplinary clinic utilizing the STAT and STAT-Q. A receiver operating characteristic curve analysis was used to identify overall diagnostic performance in the sample population. Non-parametric methods (Spearman correlation and Mann-Whitney U tests) were also used to compare and correlate STAT-Q items across sex and caregivers' languages.

Results: The STAT-Q showed strong specificity across caregivers (82.4% mothers; 82.8% fathers). In addition, a Positive Predictive Value of 86.8% for mothers and 91.4% for fathers was obtained. However, this tool does not have strong sensitivity (58% mothers; 61.2% fathers). Specific differences were noted across sex and language used in the home among questions endorsed on the STAT-Q. Both mothers' and fathers' STAT-Q, predict an ASD diagnosis better among boys (mothers AUC=0.73, fathers AUC=0.81) than among girls (mothers AUC=0.55, fathers AUC=0.59). Fathers' responses on individual items related to following directions (rho=0.43) and pointing (rho=0.40) were more strongly correlated with an ASD diagnosis than the overall STAT-Q score (rho=0.37). Additionally, English speaking mothers of children diagnosed with ASD, obtained more severe scores than did Spanish speaking mothers on items related to shared social engagement ($p<0.05$). Whereas Spanish speaking mothers reported more severe ratings related to items including nonverbal communication and following directions ($p<0.01$).

Conclusions: While the STAT-Q does not have strong sensitivity, it does have a strong positive predictive value and shows strong specificity. Further, different perspectives across caregivers and cultural backgrounds may impact responses on the STAT-Q. Improved understanding of parents' perceptions of their child's behavior using the STAT-Q may improve a clinician's use of clinical judgment to support the diagnostic process for individuals with ASD and their families across cultures. The tool's optimal utility may be to better understand the parents' view of their child and autism related symptoms during the diagnostic decision-making process.

417.043 *(Poster)* Parent-Reported Social Communication Skills of Children with Autism, Language Delay, and Typical Development Early and Late in the Second Year of Life

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Background: Individuals with autism spectrum disorder (ASD) exhibit wide variability in their communication and cognitive profiles that can complicate efforts in early detection. Because delays in social communication can be observed in children at risk for ASD in the second year of life (Delehanty et al., 2018; Reinhardt et al., 2015), continued examination of this domain may help inform the development of improved screening tools. There is limited research examining parent report measures in characterizing the social communication of young children with ASD as well as differentiating this population from children with language delays (LD) and typical development (TD). Utilization of valid parent report measures of early social communication could help to lower the age of identification of children at risk for ASD.

Objectives: The purpose of this study was to explore differences on a parent report measure of social communication in a community-ascertained sample of children with ASD with and without global developmental delay (GDD), children with LD, and children with TD early and late in the second year of life.

Methods: Participants included 156 children recruited from archival database of the FIRST WORDS® Project (Delehanty et al., 2018; Dow et al., 2017; Wetherby et al., 2008). Children were given a best-estimate diagnosis of ASD (n = 45), ASD with GDD (n = 27), LD (n = 24), or TD (n = 60) at a M_{age} of 33.61 months (SD =7.69). Parents completed the CSBS Caregiver Questionnaire (Wetherby & Prizant, 2002) regarding their child between 12-16 months (Time Point 1; M=14.48, SD=1.43) and again between 18-22 months (Time Point 2; M=19.67, SD=1.41).

Results: Results of oneway ANOVAs indicated a significant main effect of group at each time point across all composites (all *p*s < .05). At time point 1, children with ASD evidenced significantly lower scores on the social composite compared to the TD group (M_{diff}=1.73), but differences across the other composites (speech and symbolic) were nonsignificant (*p*s >.05). At time point 2, children with ASD showed significantly lower scores across all composites and the total score compared to the TD group (M_{diffs}=1.58-2.89 and M_{diff}=10.67, respectively). The ASD group did not differ from the LD group on any of the composites or the total score at either time point (*p*s >.05). Children with ASD and GDD evidenced significantly lower scores on all composites and the total score than children with TD at both time points (M_{diffs}=2.07-4.99 and M_{diffs}=15.19-23.91, respectively).

Conclusions: Results provide preliminary support for the utility of the Caregiver Questionnaire in distinguishing children with ASD from children with TD under the age of 24 months. Increasingly, individuals diagnosed with ASD do not have co-occurring delays in language and cognitive domains. Early and late in the second year of life, it may be critical to supplement parent report of early social communication milestones with autism-specific questions to distinguish children with ASD from those with other developmental delays. The Caregiver Questionnaire is one of few parent report measures examining early social communication skills in the second year of life.

417.044 *(Poster)* Paternal Speech Directed to Young Children with Autism Spectrum Disorders with and without Intellectual Disability and Typical Development

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Background: The functional aspects of speech – that pertain its purposes – can be considered especially salient, as they seem to reflect more general parenting purposes of scaffolding child cognitive development within an affective framework (Bornstein at al. 1992). Research on the specific features of parent pragmatic speech directed to children with ASD is still limited and, in particular, paternal speech is almost completely unexplored (Flippin & Watson, 2015 ; Konstantareas, Mandel, Homatidis, 1988; Wolchik, 1983).

Objectives: Considering the urge of involving fathers of children with ASD in research and clinical practice, the main purpose of this study was to investigate paternal speech directed to children with ASD, with and without intellectual disability (ID), compared to that of fathers of language-age matched TD children. Moreover, we aimed to analyse how fathers' language was associated to children with ASD' severity of cognitive and linguistic impairments and of autistic symptoms.

Methods: To this aim, we coded multiple functional aspects of speech produced by fathers during 10-min of naturalistic dyadic play interactions with their pre-school children. Fathers language was firstly verbatim transcribed using the standardized format of the CHAT system (MacWhinney, 2000).Then, the transcripts were coded in terms of the primary function of each speech unit. Forty fathers and their children participated in this study: 20 were fathers of children with ASD (Chronological age: M =42.55, SD = 8.56, n = 20; Language age: M =24.83, SD = 14.11; 8 = females) and 20 were fathers of language age-matched TD children (Chronological age: M =23.45, SD = 3.82; n = 20; Language age: M = 23.45, SD = 3.82;12 = females).

Results: Results showed that fathers of children with ASD, essentially independently from child co-occurent ID, used a peculiar child-directed language that seems to reflect the effort to sustain a challenging social interaction, while providing enhanced scaffolding and reduced demands. In general, information-salient speech was used more often than all other speech main categories in both groups. A significant effect of group on affective-salient speech emerge, revealing that fathers of children with ASD used more affective-salient speech than fathers of TD children, $F(1, 36) = 9.35$, $p < .01$, $\eta 2 = .20$. Moreover, fathers of children with ASD called their child name more often than fathers in the TD group, $F(1, 36) = 4.74$, $p < .05$, $\eta 2 = .11$. Descriptions were used more often by fathers of children with ASD than fathers of TD children, $F(1, 36) = 7.71$, $p < .01$, $\eta 2 = .08$. Fathers of children with ASD referred more to child internal state, $F (1, 36) = 5.34$, $p<.05$, $\eta 2 = .13$, than did those of TD children. Moreover, fathers adapted aspects of their information-salient speech to the severity of specific child impairments.

Conclusions: Results of the present study expand the limited literature on fathering children with ASD. Our findings confirm the often-claimed urge to include fathers in early developmental intervention programs for children with ASD, by underlining fathers' spontaneous adaptation to their children needs.

417.045 *(Poster)* Responding to Joint Attention As a Mediator of the Relationship between Temperament and Symptom Severity in Infants at Risk of Autism Spectrum Disorder

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Background: Prospective research on the early development of autism spectrum disorder (ASD) has shown that infants at risk for ASD have an early temperament profile characterized by reduced positive affect, high negative affect, low regulation, and poor attentional and behavioral control (Garon et al., 2009, 2016). As temperament affects the development of social behavior and interpersonal relationships, the possible links between temperament, social-communication, and ASD are of interest. Indeed, early temperament may play a critical role in the development of later social-communicative skills (i.e., joint attention; Vaughan et al., 2003; Nichols et al., 2005). How these developmental processes interact longitudinally to predict emerging ASD symptomatology warrants examination.

Objectives: The purpose of this study was to examine whether joint attention mediates the relationship between early temperament and subsequent ASD symptom presentation in high-risk infant siblings.

Methods: *Participants:* 42 high-risk (HR) infants with an older sibling diagnosed with ASD. Infants were assessed at 12, 18, and 24 months of age. *Temperament*: At 12 months, caregivers completed the Infant Behavior Questionnaire (IBQ; Rothbart, 1981) to index caregiver perception of infant temperament. Three constructs were measured: Surgency/Positive Emotionality, Negative Affectivity, and Regulation. *Joint Attention:* At 18 months, infants were assessed on an adapted version of the Early Social Communication Scales (ESCS; Mundy et al., 2003), which examines an infant's ability to initiate and respond to social presses with an examiner during toy play. Initiating joint attention (IJA) and responding to joint attention (RJA) were coded. *ASD Symptom Severity:* At 24 months, the Autism Diagnostic Observation Schedule – 2nd ed. – Toddler Module (ADOS-T) was administered. Symptom severity was measured using total algorithm score. *Analytical Approach:* The mediator role of joint attention was assessed using the PROCESS macro for SPSS (Hayes, 2018). The ability of the IBQ to predict subsequent ADOS-T total score was examined using three separate models with IBQ constructs (Surgency, Negative Affectivity, and Regulation) as independent variables, and IJA and RJA as mediators.

Results: The total direct effect of IBQ Surgency was a significant predictor of ADOS-T score ($t(39) = -2.10$, $p = 0.04$). The mediation process showed that RJA, controlling for Surgency, was significant ($b = -2.65$, $t(39) = -2.10$, $p = 0.04$). Controlling for the mediator RJA, Surgency was a significant predictor of ADOS-T total score ($b = -0.12$, $t(39) = -4.38$, $p = 0.04$). There were no significant direct or indirect effects involving IBQ Negative Affectivity or IBQ Regulation on ASD symptom severity, nor did IJA mediate these relationships when included in the models.

Conclusions: RJA mediates the longitudinal relations between HR infants' temperamental Surgency and ASD symptom presentation. The results suggest that, in addition to aspects of temperament, RJA may be related and contribute to individual differences in the emergence of ASD. These findings highlight that interrelationships among temperament, joint attention, and symptom expression may be important to consider when investigating developmental outcomes and intervention mechanisms in children with ASD.

417.046 *(Poster)* Screen Time in 36-Month-Olds at Increased Risk for ASD and ADHD

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Background: The amount of time children spend viewing electronic media has increased dramatically in the last two decades. The latest screen time recommendations issued by the American Academy of Pediatrics suggest that children between 2 and 5 years of age limit the use of screen media to no more than 1 hour per day. Previous studies have found that preschoolers who engage in screen time more than 2 hours a day demonstrate significantly more emotion dysregulation (Stiglic & Viner, 2019), inattention, and hyperactivity (Tamana et al., 2019), as well as lower language (Byeon & Hong, 2015) and prosocial behavior, relative to those viewing less than two hours per day. Associations between screen time and such negative developmental outcomes may be especially relevant to children at risk for behavioral difficulties and/or developmental delays, such as those with a family history of Autism Spectrum Disorder (ASD) or Attention-Deficit/Hyperactivity Disorder (ADHD).

Objectives: We examined the relationship between video-based media viewing (screen time), behavioral outcomes, and language development in a sample of 36-month-olds including children at increased familial risk for ASD or ADHD.

Methods: Participants included 120 36-month-olds at high risk for either ASD (n = 62) or ADHD (n = 30) or at low risk for either disorder (n = 28) based on family history. Parents reported average daily hours of screen time viewed by the child. Examiners unaware of familial risk status conducted a standardized diagnostic evaluation including a language assessment. Participants were assigned to an outcome group of either ASD (n = 20), ADHD Concerns (n = 14; children exhibiting increased *DSM-5* symptoms of ADHD), or Comparison (n = 86; did not meet criteria for ASD or ADHD Concerns).

Results: Analysis of variance showed a significant effect of outcome group on screen time, $F(2, 117) = 7.50$, $p = .001$. Post hoc analyses indicated that the mean hours of screen time for the ASD group ($M = 2.03$, $SD = 0.94$, $p = 0.01$) and ADHD Concerns group ($M = 2.33$, $SD = 0.94$, $p = 0.001$) were significantly greater than the mean hours for the Comparison group ($M = 1.49$, $SD = 0.85$). There was no significant difference in screen time between the ASD and ADHD Concerns groups (see Figure 1). Regression analyses, controlling for outcome group, showed that screen time significantly predicted language development across groups, with both receptive (β = -0.32, standard error (SE) = 0.94, $p < .001$) and expressive language scores (β = -0.28, SE = 0.92, $p < .001$) decreasing with increased screen time (see Table 1 for parameter estimates).

Conclusions: The findings demonstrate an association between increased screen time, ASD, increased ADHD symptoms, and diminished language development at 36 months of age. Future longitudinal studies are needed to determine the direction of effects and causality. Children with or at risk for ASD or ADHD may be especially vulnerable to the negative effects of excess screen time on development and providing families with strategies to help reduce the use of screen time may be beneficial.

417.047 *(Poster)* Screening for Autism Symptomology in Infants Identified with Fragile X

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Background: Individuals with *FMR1* mutations are at risk for a spectrum of involvement including autism symptomology. However, with an average age of diagnosis of 38 months, there is very limited understanding of the earliest signs of autism, when they emerge, and how they progress from early infancy in infants with Fragile X[1]. As part of an innovative screening research pilot program in North Carolina, Early Check is offering parents the opportunity to screen their infant for *FMR1* full and pre mutations and participate in comprehensive follow-up procedures through three-years-of-age. Given the high prevalence of co-morbid autism spectrum disorder (ASD) in individuals with the full mutation as well as subthreshold symptoms in individuals with a premutation, assessment of autism symptomology is a necessary aspect of follow up in order to provide adequate surveillance. In order to assess the earliest signs of autism symptomology in infants identified through Early Check with the full or premutation of Fragile X, the Autism Observation Scale for Infants (AOSI) is administered, providing valuable insight to the social communicative development of these young children.

Objectives: To characterize and monitor autism symptomology in infants from 6 months of age identified with an *FMR1* mutation.

Methods: Parents of infants identified with an *FMR1* full or premutation are offered the opportunity to participate in follow-up developmental assessments at baseline (approx. 3-months), 6- and 12-months of age. At 6- and 12-months, participants are administered the Autism Observation Scale for Infants (AOSI)[2], a semi-structured 20-minute play observation designed to identify putative signs of autism in infants aged 6–18 months.

Results: To date, three infants with a premutation (all female) and three with a full mutation (one female and two males), have completed the 3- and 6-month follow-up assessments. A preliminary review of AOSI results suggest that 6-month old infants with an *FMR1* mutation display a range of behaviors thought to be indicative of autism; with infants with the full mutation exhibiting more of these behaviors than infants with a premutation. These behaviors include difficulty with disengagement of attention, orienting to name, imitation of actions, social babbling, and motor control and behavior.

Conclusions: Monitoring behaviors associated with autism from early infancy may contribute to the identification of "risk factors" for ASD in infants with Fragile X. Continued longitudinal assessments in infants identified pre-symptomatically with the full and premutation may help determine the stability of symptoms in young infants with Fragile X, and the efficacy of the AOSI as a predictive tool for ASD with these infants.

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417.048 *(Poster)* Sex Differences in Autistic Symptoms of Toddlers and Young Children

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Background: There are differences in the mean age of diagnosis and prevalence rates between males and females with autism spectrum disorder (ASD) (Petrou et al., 2018). However, previous studies examining sex differences in the phenotypic presentation of ASD have yielded conflicting results across wide age groups. While autistic symptoms may present differently across the developmental trajectory, there is still a lack of investigation exploring whether sex differences of core autistic characteristics appear early on to be detected in toddlers and young children and explore how such results may compare to their peers.

Objectives: The purpose of this study is to investigate sex differences in autistic symptoms of toddlers and young children with ASD, as compared with their typically developing (TD) and developmental delay (DD) peers.

Methods: A total of 473 Korean toddlers and young children, aged 10-42 months, comprised of 180 subjects with ASD (141 males, 39 females), 221 with typical development (TD, 130 males, 91 females) and 72 with developmental delay (DD, 43 males, 29 females) participated in the study (Table 1). A comprehensive evaluation using the Autism Diagnostic Observation Schedule (ADOS-2), Autism Diagnostic Interview-Revised (ADI-R), Social Responsiveness Scale (SRS), and Vineland Adaptive Behavior Scales (VABS) was administered. Domain scores of ADOS and ADI-R were used to examine autistic symptoms across diagnostic groups. Univariate analyses of covariance (ANCOVA), covarying for VABS scores were used to assess the main effects of sex on ADOS, ADI-R, and SRS scores. Further ANCOVA analysis was conducted by age groups (18-23, 24-35, and 36-48 months) to see whether age could have an effect.

Results: The social interaction (SI) domain in ADI-R revealed a statistically significant effect of sex ($F(1,177)=7.257$, $p=0.008$) in subjects with ASD where females showed higher scores (M=15.79, SD=5.488) than males (M=14.39, SD=4.736), while ADOS showed no significant differences in both sexes. SRS scores found an effect of sex only in the TD group ($F(1,218)=5.195$, $p=0.024$) with lower scores in females (M=45.37, SD=4.948) than males (M=47.67, SD=6.934). Both TD and DD group exhibited significantly higher scores in the restricted and repetitive behavior (RRB) domain of both ADOS (TD: $F(1,218)=4.598$, $p=0.033$; DD: $F(1,69)=4.592$, $p=0.036$) and ADI-R (TD: ($F(1,218)=5.717$, $p=0.018$; DD: $F(1,69)=7.780$, $p=0.007$) (Table 2). When broken down into age groups, only the DD group revealed a statistically significant effect of sex on ADI-R RRB scores across 18-23 months ($F(1,8=10.993)$, $p=0.011$) and 24-35 months ($F(1,31)=5.124$), $p=0.031$), with higher scores in males (18-23 months: M=3.40, SD=2.074; 24-35 months: M=2.25, SD=1.517) than females (18-23 months: M=1.00, SD=0.894; 24-35 months: M=1.21, SD=0.893).

Conclusions: The results suggest that female toddlers and young children with ASD experience increased dysfunction in the SI domain when compared to male toddlers and young children with ASD. RRB domain scores are consistently higher in male in the TD and DD groups, suggesting that there might be an effect of sex in behavioral characteristics in subjects without ASD. Further research is needed to examine whether specific items are responsible for such differences in sex.

417.049 *(Poster)* Social Communication Profile in High-Familial Risk Infants Who Go on to Have Autism

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Background: Social communication deficits often emerged around the first birthday in infants who go on to have autism (Ozonoff et al., 2010; Zwaigenbaum et al., 2005). Toddlers with autism who had better social communication skills at 21 months also had better verbal and nonverbal skills and less severe autism symptoms at 36 months (Wetherby, Watt, Morgan, & Shumway, 2007). Since early social communication skills are a harbinger for later development, investigating these skills during infancy may help shed light on early risk markers and treatment targets for infants who go on to have autism.

Objectives: The main objective of this study is to examine group differences in social communication skills measured with the Communication and Symbolic Behavior Scales (CSBS; Wetherby & Prizant, 2002) at 12 and 24 months of age across three groups: low familial risk typically developing infants (LR-Neg), high familial risk infants without autism (HR-Neg), and high familial risk infants with autism (HR-ASD).

Methods: Infant participants were assessed longitudinally, using the CSBS at 12 and 24 months. Inclusion criteria included the completion of at least one CSBS assessment and diagnostic outcome at 24-months (N=537). Eighty-seven high familial risk infants met clinical best-estimate criteria for autism using the DSM-IV-TR (HR-ASD), and 295 did not meet criteria for autism (HR-Neg). The 155-low familial risk (LR-Neg) infants in this study did not meet criteria for autism or language delay (MSEL ELC >85, Table 1). Dependent variables included raw scores for the CSBS total, social composite, speech composite, and symbolic composite. Raw scores were used due to floor effects in standard scores at the 12-month time point. The statistical model included the effects of group, time (chronological age), group*time. Sex of the infant was a covariate.

Results: Analyses using general linear models indicated significant main effects for group ($p<.01$), time ($p<.0001$), and group*time ($p<.0001$) for all CSBS scores (Table 1). HR-ASD infants had fewer gains in social communication from 12-24 months when compared to HR-Neg and LR-Neg infants (Figure 1). Cross-sectional analyses (Table 1) indicated that HR-ASD infants had lower CSBS total scores at 12 and 24 months when compared with the HR-Neg and LR-Neg groups. At 12 months the HR-Neg group had lower CSBS total scores when compared to the LR-Neg group. However, at 24 months, the HR-Neg and LR-Neg group did not significantly differ from one another. Results from follow up tests of subscale scores revealed a similar pattern of results (Table 1).

Conclusions: Our results indicate that HR-ASD infants demonstrate difficulties with social communication at 12 and 24 months that can be captured using standardized assessments. Interestingly, HR- Neg infants demonstrated a lag in social communication at 12 months when compared with LR-Neg infants. However, by 24 months these two groups did not significantly differ in social communication abilities with the exception of symbolic skills (Table 1). At 24-months HR-Neg infants scored lower on this subscale when compared to the LR-Neg infants. These findings have important implications for identifying and remediating early social communication difficulties in toddlers with ASD.

417.050 *(Poster)* Social Spectrum: Longitudinal Comparison of Social Skill Development Amongst Infants at High and Low Risk for Autism

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and interactions. Although social functioning is recognized as existing along a spectrum (Social Spectrum), little is known about the early development of social functioning across the full spectrum from typically developing children (TD) to children with ASD. Existing research has also indicated that females tend to demonstrate more social skills than males on clinician-based measures. Alternatively, parent rated measures tend to indicate more autistic traits. However, there is a paucity of research regarding potential gender differences in the social development trajectories for children, including how and when different skills for both males and females develop. Understanding when skills are developing and when developmental differences first emerge is crucial for informing early intervention services.

Objectives: This study evaluated the developmental progression of three types of social skills from 9 to 24 months of age. Additionally, this study examined if and how social development varies across the Social Spectrum and across gender.

Methods: High-risk (*N*= 108) and low-risk (*N*= 125) infants (Male= 150, Female= 83) were assessed at 9, 12, 18, and 24 months. Weighted raw scores for three skill categories (Emotion/Eye Gaze, Communication, and Gestures) that comprise the Social domain of the Communication and Symbolic Behavior Scales (CSBS; live observation of social and communicative interactions) were analyzed to assess for skill development over time. The sum of parent ratings (Not Yet/Rarely, Sometimes, or Often) on 22 items related to Social Interacting & Communicating at 9 months was used as a measure of Social Spectrum, with higher scores depicting greater impairment in social functioning. LME models were conducted separately for each skill with Visit, Gender, and Social Spectrum as predictors. Non-significant interactions and main effects were removed from the models when the AIC was lower.

Results: Results indicated a significant Visit by Social Spectrum interaction on Emotion and Eye Gaze (Figure 1) and Communication (Figure 3) development. Significant main effects for these variables were indicated in the prediction of Gesture development (Figure 2). There was also a significant effect of Gender for both Communication and Gestures (Figure 4).

Conclusions: Social skills related to emotion and eye gaze, communication, and gestures are developing from 9 to 24 months of age. Additionally, the development of these social skills varies depending on infants' social functioning at 9 months of age. Results related to gender differences are also consistent with extant literature regarding females typically demonstrating better social abilities. Early identification of trajectories and factors impacting development are imperative to better understand developmental pathways across the Social Spectrum as it relates to ASD. Such an understanding will help in the provision of individualized early invention services for children with varying degrees of social impairment. Upcoming research conducted by the authors is further examining potential differences in the developmental pathways of the individual skills (e.g., joint attention, types of gesture use) that comprise these broader social skill domains.

417.051 *(Poster)* Spontaneous Imitation and the Emerging Autism Phenotype in at-Risk Infants

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Background: Imitation is an early-emerging skill that facilitates infant social interaction, creating optimal conditions for learning. Imitation deficits are both pervasive and specific to ASD (Rogers et al., 2003). Existing literature on spontaneous imitation in ASD is focused on older children and has yielded inconsistent findings. While it remains unclear when the developmental trajectory of spontaneous imitation is derailed in ASD, the current study may shed light on the developmental sequelae of imitation deficits observed at later ages in ASD by characterizing imitation abilities and concurrent predictors thereof in a community-referred sample of infants with emerging ASD.

Objectives: Specific aims include (1) determining whether specific domains of spontaneous imitation are differentially impacted in infants with emerging ASD, and (2) examining the relationship between imitation ability and early social-communication skills.

Methods: Participants include N=65 infants between age 12-23 months (M=17.75, 78.5% male) who completed imitation tasks as part of a larger behavioral intervention RCT for infants showing behavioral features of ASD (NICHD P50-HD-055784, Project PI: Kasari). Spontaneous imitation was assessed using a semi-structured, nine-item battery yielding total, gross motor, and object imitation scores (Ingersoll, 2008; Rogers et al., 2003; Stone et al., 1997). Imitation tasks were embedded within a play interaction during which the assessor modeled each task without providing verbal prompts. Tasks were scored on a 0 to 4 scale to reflect accuracy of imitation responses. Hypothesized predictors of spontaneous imitation include autism symptoms, initiation and response to joint attention (IJA, RJA), expressive language, and play level as measured at study entry.

Results: At-risk infants performed significantly better on object tasks than on gross motor tasks ($t=5.511$, $p<.0001$; Figure 1). Results reveal that joint attention was a consistent predictor of spontaneous imitation performance (Figure 2). Linear regressions controlling for NVDQ demonstrate that IJA is a significant predictor of total imitation ($\beta=0.014$, $p=0.005$) and object imitation ($\beta=0.014$, $p=0.008$), and approached significance for gross motor imitation ($\beta=0.014$, $p=0.061$). RJA approached significance in the model predicting object imitation ($\beta=0.407$, $p=0.058$). No other social-communication skills of interest were found to predict imitation.

Conclusions: At-risk infants demonstrated poor performance on tasks of spontaneous imitation, and these weaknesses were particularly pronounced in gross motor tasks. Initiation of joint attention, but not developmental level or other social-communication skills, was predictive of imitation performance. Shedding light on this relationship early in development is critical given imitation and joint attention have a social function (e.g., sharing attention) and a learning function (e.g., imitating functional play) which facilitate the development of more complex skills (Ingersoll, 2008). The relationship between these skills and subsequent social development may be "gated" by joint engagement, an area of weakness for children with ASD and a common mechanism underlying imitation and joint attention (Kasari et al., 2008). The findings from the current study highlight weaknesses in foundational social-communication skills among infants at risk, and underscore the criticality of developing interventions that are specific to the emerging ASD phenotype and target the basic skills necessary for the development of more sophisticated forms of social-communication (e.g., language).

417.052 *(Poster)* Testability Developmental Paths in Young Autistic Children: A Longitudinal Study Using Conventional and Strength-Based Assessment.

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Background: Intellectual assessment in autistic children at the age of diagnosis bears many challenges which decrease testability in this population. A number of untestable autistic children are often excluded from studies and are presently underrepresented in the literature. It would be important to address this bias.

Objectives: We aim to document the variation of testability (i.e. the number of sessions required to complete a test) from the age of diagnosis (T0) until a year later (T1) and two years later (T2) in a group of young autistic and typically developing (TD) children. WPPSI-IV and Raven Coloured Progressive Matrices (RCPM) were used as conventional and strength-based assessment respectively.

Methods: A cohort of autistic and TD children aged 30-70 months were assessed using WPPSI-IV and RCPM at the age of diagnosis (T0), a year (T1) and two years (T2) later. Data from 60 children (20 autistics; 40 TD) who were testable on 2 out of 3 time points were used in the analyses (including dropouts or children having failed to complete the tests). Multilevel linear model (MLM) were used as they allow the use of all available data without the deletion of entire cases; they estimate the parameters using the available data. MLM are optimal for conservative analyses in clinical trials. Both groups were matched on age at baseline (*p*s > .05). Age in months at T0 was included as a covariable: [T0($M_{\text{Autistics}}$=50.3±11.0; M_{TD}=47.4±10.1), T1($M_{\text{Autistics}}$=66.1±8.7; M_{TD}=59.9±11.3), T2($M_{\text{Austistics}}$=80.1±9.4; M_{TD}=73.7±10.9)].

Results: Almost all TD children assessed with the WPPSI or the RCPM were able to complete the tests across time points (WPPSI: T0=87%, T1=100%, T2=97%; RCPM: T0=88%, T1=100%, T2=100%). In the autistic group, the proportion of children able to complete the WPPSI or the RCPM increased with time (WPPSI: T0=46%, T1=71%; T2=88%; RCPM: T0=44%, T1=78%, T2=93%). MLM analyses using testability on WPPSI as the dependent variable indicated a main effect of Group, $F(1, 62.96) = 32.20$, $p < .001$: the TD group (M=1.41±0.09) needed less sessions in average to complete the WPPSI compared to the autistic group (M=2.27±.012). There was also a main effect of Time [$F(2, 54.41) = 3.60$, $p = .034$]: both groups needed less sessions in average to complete the WPPSI at T2 (M=1.64±.0.14) compared to T0 (M=2.15±.15). MLM analyses using testability on RCPM as the dependent variable revealed a Group x Time interaction, $F(2, 52.56) = 4.02$,p= .024. Posthoc analyses revealed that autistic children needed less sessions in average from T0 (M=1.77±0.17) to T1 (M=1.11±0.65), $p = .002$ to complete the RCPM, and stabilized from T1 to T2(M=1.59±0.12), $p = .051$. TD children needed a similar number of sessions to complete the RCPM across time (T0: M=1.28±0.11; T1: M=1.06±0.05; T2: M=1.05±0.12), all *p*s > .05.

Conclusions: Our results confirmed that testability significantly increases with time in autistic children. Next steps will include (1)testing whether visual abilities or the presence of certain behaviors at T0 could predict the gain in testability, (2)investigating whether testability at T0 predicts cognitive level at T1 or T2 and (3) comparing the testability between different cognitive tests.

417.053 *(Poster)* The Accuracy of a Digitally-Administered M-CHAT in a Diverse Community Sample: Preliminary Findings

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Background: The Modified Checklist for Autism in Toddlers (M-CHAT) is the most widely used autism screener (Johnson et al, 2007). Its recent revision, the M-CHAT-R/F, incorporates a follow-up interview (FUI) that improves accuracy (Dumont-Mathieu, 2017). However, the FUI is not consistently administered (Guthrie et al., 2019; Khowaja et al., 2015). A digitally-administered M-CHAT-R/F automatically includes the FUI, decreasing rates of false positive screening (Campbell et al., 2017; Harrington et al., 2013). Parents with less-than-average education report increased risk on the M-CHAT (Chiang et al., 2018; Fujiwara, 2014) and are less likely to be up-to-date with pediatrician visits (Bishop-Fitzpatrick, et al., 2017; Mandell et al., 2009). This study aims to examine the impact of maternal education level on M-CHAT-R/F screening when it is digitally administered to an ethnically-diverse sample.

Objectives: (1) To examine positive screening rates before and after FUI via digitally-administered M-CHAT-R/Fs and the effect of maternal education on these rates in a community sample. **(2)** To examine preliminary accuracy of the M-CHAT-R/F in relation to diagnostic outcomes ascertained by electronic medical record (EMR) review. **(3)** To examine sociodemographic factors affecting the likelihood of having up-to-date pediatric visits.

Methods: 231 parents completed the M-CHAT-R/F on a tablet during their toddlers' 18-, 24-, and 30-month well-child pediatric visits. Toddlers (63% male; Mage=23mo, SD=4.843) were minorities: 48% Black, 23% Mixed-Race, 3% Asian, and 46% Hispanic. Maternal education consisted of: 14% less than high school, 46% high school, 28% some college, 4% college, and 10% graduate school. M-CHAT-R/Fs categorized as medium-risk (3-7 failed items) were automatically administered the corresponding FUI. Diagnostic outcomes for 192 (83%) of the children were available via EMR review (Mage=35mo; ASD: 4%; developmental delays: 16%; typical development: 64%).

Results: (1) Of the 231 participants, 84% initially screened negative (scores 0-2), while 16% initially screened positive (scores ≥3). After FUI, 9% screened positive and 91% screened negative. Maternal education was not related to initial ($\chi2(4,231)=2.01$,p=.721) or final risk classification ($\chi2(4,231)=3.38$,p=.497). **(2)** For the 192 children with known diagnostic outcomes, the positive predictive value for ASD was 44% and the negative predictive value was 99%. Overall accuracy was 95% (sensitivity=0.958; specificity=0.875). **(3)** The 39 children without updated visits in the EMR did not differ from children with updated EMR outcomes by risk classification or racial/ethnic groupings (p-values>.336), but did differ by maternal education ($\chi2(4,231)=12.95$,p=.012). The "some college" and "graduate school" groups were more likely to have unknown outcomes.

Conclusions:

Contrary to previous findings, there were no significant differences in initial or final M-CHAT risk by maternal education. Our positive screening rates were higher than those in population studies (Robins, 2014; Stenberg, 2014), but are comparable to those reported for minorities (Khowaja, 2015; Rea, 2019). Maternal education affected the likelihood of having a current visit and thus a diagnostic outcome in the EMR. Future research should clarify this relationship. Although results regarding accuracy are limited by the small sample size and short length of follow-up to outcome, this study provides preliminary support for the use of digitally-administered M-CHAT-R/F in diverse populations.

417.054 *(Poster)* The Association between Esdm Fidelity and Child's Response

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Background: The Early Start Denver Model (ESDM) is a comprehensive evidence-based intervention for toddlers (12-48 months) with Autism Spectrum Disorder (ASD). ESDM draws its principles from developmental and behavioral science with a focus on cognitive, social-emotional, and language development (Rogers & Dawson, 2010). Adherence to manualized procedures in ESDM is measured using the ESDM fidelity checklist, which includes 13 items. Despite initial evidence for efficacy of the ESDM (Dawson et al., 2010; Rogers et al., 2019), response to intervention is variable, and knowledge is limited on the role of treatment fidelity on intervention response.

Objectives: We examined the association between fidelity of ESDM implementation and child's learning in response to ESDM, focusing on both overall fidelity and item-level contributions.

Methods: Participants were receiving ESDM in an ongoing clinical trial. Twenty videotaped sessions of 10 toddlers (18-36 months) with ASD who received ESDM from 10 therapists at different stages of their ESDM training were randomly selected. Sessions were coded to derive (a) fidelity of implementation across the 13 items of the ESDM fidelity checklist and overall fidelity score, and (b) child's performance in response to the use of the ESDM techniques. Each of the 13 ESDM fidelity items were operationalized on a Likert scale between 1-4 (1 = absence of fidelity and 4 = best example of fidelity) based on guidelines by Rogers & Dawson (2010). Scores were specific to each individual fidelity item. Child learning was operationalized as instances of the child emitting the targeted behavior in response to therapist's instruction. Inter-rater reliability between three independent coders was above 80% across all variables of interest. Associations between child learning and fidelity across each item as well as overall fidelity were first examined using Pearson Product Moment Correlation Coefficients. Linear regression analyses were then conducted including fidelity variables that had significant correlations with child learning.

Results: Average fidelity scores across the 13 items ranged from 2.2 to 3.9. Children's learning was positively correlated with overall fidelity score; (r = .69, p < .001). Additionally, 8 of the 13 fidelity items were significantly correlated with the child's response (r's ranges = .45-.73; all p's < .05). A linear regression showed that overall fidelity contributed to approximately 25% of the variance in child's learning above and beyond variance explained by child's age and IQ (*R Square change*=.25, *F Change p*<.01). A second linear regression showed that no single fidelity item contributed to child's learning above and beyond the contribution of the other fidelity items, with the exception of "management of child attention", which explained approximately 20% of the variance in child's learning above and beyond variance explained by child's age and IQ and all the other fidelity items significantly associated with child's learning (*R Square change*=.19, *F Change p*<.05).

Conclusions: Variations in treatment fidelity contribute to variations in children's learning in response to ESDM. The therapist's ability to manage the child's attention plays a particularly important role on a child's intervention response.

417.055 *(Poster)* The Development of Gestures in Children with Autism Spectrum Disorder and Its Relationship with Other Abilities

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder, with impairments in social interaction and communication, and restrictive and repetitive behaviors as its main symptoms. Gesture is a form of nonverbal communication and acts as the preamble of language. Studies have found that typically developing children (TD) begin to consciously use gestures to communicate with their caregivers at 7-9 months. Furthermore, gestures have an important impact on information processing, language acquisition, cognition, and memory. Atypical manifestations and/or defects in gestures have been found in early development of ASD, and are an early sign of impairments in social interaction and communication.

Objectives: 1. To explore the differences in gestures between TD and ASD from the aspects of quantity, quality, communication purpose and specificity. 2. To find the relationship gesture has with language, social ability, intelligence, symbolic behaviors and adaptive behaviors.

Methods: Participants were split into two groups: 24 TD (12-36 months, 7 females; 17 males) and 37 ASD (24-48 months, 7 females, 30 males). Gestures were coded from a 10-20 minutes video recording a standardized semi-structured gesture assessment adapted from Autism Diagnosis Observation Scale (ADOS). All children were assessed by the Chinese Communicative Development Inventory (CDI), ADOS, Bayley Scales of Infant development (BSID) or Wechsler Intelligence Scale for Children (WISC), Infant-Toddler Checklist (ITC), Adaptive Behavior Assessment System (ABAS).

Results: (1) Compared with TD, ASD displayed gestures fewer in quantity, worse in quality, and more specific, as well as more naive gesture communication purpose (GCP). (2) For minimally verbal children (i.e. speak single or no words), ASD has fewer gestures than TD, and ASD GCP is more naive, meanwhile the quality of ASD gesture is worse. The difference is reduced in children with phrase speech. No statistical difference was found in the number of gestures between ASD and TD, but ASD GCP remains more naive and gesture quality is still worse. (3) In ASD, children with phrase speech are better at integrating gesture and language than those who are minimally verbal, and their GCP is more mature. TD children with phrase speech are more accomplished in integrating gestures in voice or language than minimally verbal TD children, but their GCP is not significantly different. (4) In both ASD and TD groups, gestures are correlated to language, social ability, intelligence, symbolic behaviors and adaptive behaviors. ASD gestures have more relevance to language, intelligence, social ability and symbolic behavior, while TD has more relevance to adaptive behavior.

Conclusions: In early development, the differences in gestures between ASD and TD are significant which might help differentiate ASD and TD in early life. We found that these differences may be affected by speaking ability. And unlike TD, ASD speaking ability might not only affect the ability to integrate language with gestures, but also affect GCP. Lastly, future research can explore whether gestures can be an effective indicator for early assessment of ASD functional levels, as gestures are significantly correlated to other abilities.

417.056 *(Poster)* The Development of Play in Very Young Children with Elevated Likelihood for Autism Spectrum Disorder

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Background: There is accumulating evidence for atypical play development of young children with elevated likelihood (EL) for autism spectrum disorder (ASD) who develop ASD in comparison to EL-children who do not (Campbell et al., 2018). However, longitudinal studies on this matter are scarce and focus only on younger siblings of children with ASD. Nevertheless, preterm children are another important EL-group (e.g., Agrawal, Rao, Bulsara, & Patole, 2018).

Objectives: This study examined play skills at 10- (T1) and 14 months (T2) in both younger siblings of children with ASD and premature children (<30 gestational weeks) and its relationship with ASD characteristics at T2 and 24 months (T3).

Methods: As part of a longitudinal study, play skills of EL-children (n=30) were assessed at T1 and T2 using diverse measures. First, the relative duration of functional play was coded in videos of a semi-structured play observation. Secondly, the subscale Object Use of the Communication and Symbolic Behavior Scales-Developmental Profile Caregiver Questionnaire (CSBS-DP CQ, Wetherby & Prizant, 2002) assessed parent-reported play skills. ASD symptoms were observed with the ADOS-Toddler (ADOS-T, Lord et al., 2012) at T2 and T3.

Results: A repeated measures ANOVA determined that parent-reported play skills of 30 infants included up to date, increased significantly between T1 and T2 ($F(1,21) = 22.458$, $p < .0001$). Moreover, functional play was only observed in two children at T1, in contrast to 22 children at T2. Preliminary analyses showed no significant differences in play skills between the two EL-groups. As reported by parents at T1 ($\rho(23)= -0.56$, $p = .004$) and T2 ($\rho(24)= -0.39$, $p= .047$), and as observed at T2 ($\rho(26)= -0.44$, $p = .021$), play skills were negatively related to restricted and repetitive behaviour (RRB) scores on the ADOS-T at T2. The relative duration of functional play at T2 was marginally significantly lower in EL-children with an elevated concern for ASD according to the ADOS-T scores (n=7) in comparison to EL-children who scored within the range of little to no concern ($U=40$, $p= .073$). Finally, there was no significant agreement between presence of parent-reported functional play and presence of observed functional play at T1 ($\kappa = .018$, $p = .869$) and T2 ($\kappa = - 0.016$, $p = .932$). Since the study is still ongoing, results of a much larger sample and associations between play skills at T1 and T2, and ADOS-T scores at T3 will be presented at the meeting.

Conclusions: This prospective study provides information on the association between early play skills and ASD-characteristics in two EL-groups, which has been examined in only a few studies. Overall, no significant differences in play skills were found between the two EL-groups. Furthermore, these preliminary results indicate increasing play skills between T1 and T2, consistent with studies of play in typically-developing children. In addition, our findings show that play skills are associated with RRB and not with social-affect symptoms. Lastly, it is important to emphasize the use of both parent-report and observational measures to map the early development of play as complementary methods.

417.057 *(Poster)* The Impact of Socioeconomic Status on Early Vocal Development in Infants at Risk of ASD

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Background: Socioeconomic status (SES) is known to impact many aspects of child development, including language acquisition, but the mechanisms by which different SES factors may interact with ASD risk to affect severity of outcome are not well understood. It is unclear whether two main factors, access to resources (household income) and parental environment (education and occupation), show profiles that differ for ASD, and whether any such differences are significant in relating core features of autism to language.

Objectives: The goal of this study was to test whether indices of socioeconomic status measuring parental income and education at birth predict early trajectories of vocal development over 0-24 months and later language outcome at two years, in autism and typical development.

Methods: As part of an NIH Autism Center of Excellence, we tracked vocal development in 45 high-risk siblings and 35 low-risk controls. Using a recording device (LENA) worn by each child, we made audio recordings of each child's language environment from 0-24 months. Using speech recognition technology, we counted the number of vocalizations per hour for child and adult, as well as the rate of contingent interactions. Using Functional Data Analysis, we calculated developmental trajectories for each child. We modeled each trajectory as an exponential curve with scale and exponent parameters to separately characterize overall dosage and change over time. Receptive and expressive language scores from the Mullen Scales of Early Learning were collected from children who completed clinical assessments at 24 months. Based on parent questionnaires, we calculated the Hollingshead Four-Factor Index from caregiver education and occupation, together with household income quantized into $25K intervals.

Results: Comparing the joint distribution of the two SES indices, we found significant differences between risk groups; both showed the expected correlation between income and education, but the high-risk group scored lower on both. We found significant correlations between both income and education factors and expressive and receptive language scores overall, but no significant difference between risk groups, indicating that SES impacts language outcome regardless of autism risk. We found significant correlations between education and income factors and the scaling parameter of the adult vocalization rate trajectories, but not with any other parameters, suggesting that SES affects the overall amount of parental input, but does not affect either child volubility or vocal contingency, or change over time. In contrast, our previous research showed that rate of change over time in vocal contingency, rather than adult and child volubility, is the main predictor of diagnosis and language outcome in high-risk infants. This suggests that the mechanism by which SES influences language outcome is common across risk groups and unrelated to autism.

Conclusions: Consistent with previous studies, we found that SES is correlated with parental input and language outcome. Although there are differences in SES between high-risk and low-risk infants, this research suggests that early differences in parental input, generally associated with socioeconomic status, do not resemble early deficits in infant-caregiver social interaction specifically associated with autism, indicating that these are separate compounding factors impacting language outcome.

417.058 *(Poster)* The Importance of Maternal Responsiveness: The Association between Social Communication and Disruptive Behaviors in Toddlers with Autism Spectrum Disorder

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Background: One in three toddlers with ASD display clinically significant disruptive behaviors (Hartley, Sikora, & McCoy; 2008). Although there is empirical support for the association between: (a) disruptive behaviors and social communication (Park, Yelland, Taffe, & Gray, 2012), and (b) child social communication skills and maternal responsiveness in children with ASD (Gros-Louis, West, King, 2014), the extent to which maternal responsiveness mediates the association between disruptive behaviors and social communication skills remains unknown (Baptista et al., 2019; McDoniel & Buss, 2018). Maternal responsiveness may mediate this association because children who demonstrate fewer disruptive behaviors may allow for more responsive parent-child interactions.

Objectives: The current study aims to examine the (1) association between children's disruptive behaviors and social communication skills and (2) extent to which maternal responsiveness mediates the association between children's behaviors and social communication skills in toddlers with ASD.

Methods: The current study included 89 mother-child dyads of toddlers with ASD (Range: 19.02-48.95 months, M = 33.22, SD = 6.22). Standardized 10-minute mother-child interactions were transcribed and micro-behavior coded using Mangold InterACT software (Mangold, 2015). Maternal responsiveness was defined as the percentage of utterances that were temporally and topically contingent on the child's previous communicative act. Children's social communication was measured using the Total Weighted Raw Score from the Communication and Symbolic Behavior Scales Developmental Profile Infant-Toddler Checklist (CSBS DP; Wetherby & Prizant, 2002). Children's behaviors were measured using the Infant-Toddler Social Emotional Assessment, a parent-report that examines four domains of behavior: Externalizing problems, Internalizing problems, Dysregulation, and Competence (ITSEA - Parent form; Carter & Briggs-Gowan, 2006).

We conducted a series of linear regressions to determine the relationship between disruptive behaviors and social communication, controlling for child age and nonverbal cognition (MSEL; Mullen, 1997). We planned to test for mediation of disruptive behaviors on social communication through maternal responsiveness, using a Sobel test (Baron & Kenny, 1986).

Results: Multiple linear regressions revealed the ITSEA Competence Domain positively predicted CSBS score ($B = 23.40$, $t = 2.46$, $p < 0.05$). More competent behaviors were predictive of higher social communication scores. The remaining ITSEA behavior domains were not significant predictors of CSBS score (see Table 1). Given child competence was also predictive of maternal responsiveness ($B = 0.26$, $t = 4.17$, $p < 0.001$), we were able to test for mediation (see Table 2). Results revealed the effect of competent behaviors on children's social communication abilities was partially mediated through maternal responsiveness (indirect effect = 17.63 (5.76), $p < 0.01$).

Conclusions: The presence of children's positive behaviors, rather than the absence of disruptive behaviors, may allow mothers to be more responsive, and as such provide optimal linguistic input to facilitate children's social communication development. These findings support the use of intervention strategies targeting the increase of competent behaviors and the decrease of disruptive behaviors in toddlers with ASD. Future research should consider (1) the relationship between children's disruptive behaviors and more nuanced language measures and (2) which specific types of competent behaviors are most related to social communication and maternal responsiveness.

417.059 *(Poster)* The Parental Report Early Motor Questionnaire Can Detect Early Motor Abnormalities in a High-Risk Population for ASD

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Background: There is evidence that motor abilities predict the later development of social communication skills. Motor impairments are among the earliest signs of autism spectrum disorder (ASD). The Italian Network for early detection of ASD (NIDA), the largest Italian cohort of infants at high risk for ASD (HR: siblings of children with a diagnosis of ASD, small for gestational age, and premature newborns), is actually applying a multi-observational protocol from birth to 36 months in the entire Italian territory. The protocol includes the evaluation of spontaneous movements at 10 days, 6, 12, 18, and 24 weeks of age and the comprehensive clinical assessment of several areas of development at 6, 12, 18, 24 months. To date, NIDA has enrolled 247 HR siblings and 114 low-risk infants.

Objectives: To evaluate whether early motor performances predict developmental outcomes in a cohort of siblings of children with a diagnosis of ASD.

Methods: We prospectively evaluated the fine and gross motor development of a subgroup of HR infants enrolled in the NIDA Network. The HR infants were subdivided into three groups based on their clinical outcome at 24-36 months: 6 HR diagnosed with ASD (HR-ASD); 8 HR diagnosed with NDDs (HR-NDDs) and 16 HR with typical development (HR-TD). Each child completed a range of motor, cognitive, and diagnostic assessments through parental reports and direct observational measures. The motor assessment included the Griffiths fine and gross motor subscales and the Early Motor Questionnaire (EMQ), a parent-report measure of motor development organized into three sections: gross motor, fine motor, and perception-action integration skills. Statistical analyses were carried out on data from 12 and 18 months. The Pearson correlation coefficients were computed to define the concurrent validity of the two tests at 12 and 18 months. Differences between clinical groups were analyzed using repeated-measures ANOVA (12 and 18 months) in the subset of HR infants with available data.

Results: EMQ and Griffith's motor subscales resulted correlated: EMQ gross motor and Griffiths locomotor subscale at 12 months (r= 0.465, p= 0.005) and at 18 months (r= 0.373, p= 0.042); EMQ fine motor and Griffiths eye-hand coordination subscale at 18 months (r= 0.422, p= 0.020); EMQ perception-action and eye-hand coordination subscale at 18 months (r=0,482 p=0.006). At 18 months, HR-ASD and HR-NDDs children showed lower EMQ scores in perception-action integration skills than HR-TD (p< 0.026; p< 0.028). HR-NDDs and HR-TD significantly differed in the EMQ gross motor skills (p< 0.029). No between group differences emerged at 12 months.

Conclusions: Early motor development may provide crucial clues to anticipate social delays in HR infants. Indeed, HR infants later diagnosed with ASD or NDDs showed reduced perception-action integration skills at 18 months of life, long before the diagnosis. Our findings suggest the EMQ questionnaire can provide an affordable, easy-to-apply, and informative assessment for evaluating early motor divergences and predict abnormal outcomes in HR infants. The ongoing NIDA enrolment will overcome the current small sample size.

417.060 *(Poster)* The Relationship between Early Autism Symptoms and Maternal Pitch Contours within Infant-Directed Speech

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Background: Mother-infant interactions during the first year mediate development and comprise the infant's sensory environment. The communication between the mother and infant is a central component of early interactions, and the infant-directed speech (IDS) the mother uses is crucial to many aspects of development. The prosodic elements of IDS, in particular pitch contours, can encourage infant language learning and social communication. There is little research, however, investigating maternal pitch contours in relation to infants showing deficits in socio-communicative, sensory regulation and language development, such as those displaying early symptoms of Autism Spectrum Disorder (ASD).

Objectives: The aim of this study was to explore the relation between pitch contours used by mothers when interacting with their 12-month-old infants displaying early symptoms of ASD.

Methods: 105 mother-infant dyads (44f, 59m) participated in a 15-minute recorded interaction. Infants were assessed for early ASD symptoms using the parent-report First Year Inventory (FYI; Reznick, Baranek, Reavis & Crais, 2007) and the observer-rated Autism Detection in Early Childhood assessment (ADEC; Young, 2007). Pitch contours used by mothers in the interaction (n=36,128) were analysed and classified into contour type (rising, bell, sinusoidal, u-shape, slow-fall, rapid-fall/rise, flat, or complex). 10 infants scored as 'at-risk' for receiving a diagnosis of ASD on the FYI and on the ADEC, respectively. Spearman's rank correlation coefficient was used to determine relations between the contours and the infant's FYI and ADEC scores.

Results: Maternal pitch contours used during the interaction were related to both the FYI and the ADEC. Mothers made fewer utterances (r= -.30, p=.005), and used fewer sinusoidal contours (r= -.31, p= .003) when their infants displayed more early autism behaviours as indicated by FYI total risk scores. Mothers of infants displaying more early ASD behaviours were observed to use more flat (r= .22, p= .03) and slow-fall contours (r= .22, p= .03), however. These associations were most strongly associated with sensory regulation symptoms on the FYI. Mothers used less sinusoidal (r= .32, p=.002), and more flat (r=.23, p=.03) and slow-fall contours (r= .21, p= .05) with infants displaying higher scores (more dysregulated) in sensory regulation. In terms of the ADEC, mothers used less bell (r= .40, p= .05) and flat contours (r= .48, p= .02) as infants score increased (indicating more ASD behaviours present).

Conclusions: These data provide initial support for the notion that mothers of infants displaying early ASD behaviours, use different patterns of IDS. Patterns of IDS appear to be particularly related to sensory regulation features in the infants. Early interactions are likely to be bi-directional in nature, with both the infant and mother active participants. Future research is needed to determine the nature of IDS within the early sensory environment, and whether the mother is modifying her behaviour in response to infant feedback, which could help inform early intervention involving interactions with infants showing early ASD behaviours.

417.061 *(Poster)* The Relationship between Gaze to the Mouth and the First Word Milestone in Typical Development and in Autism Spectrum Disorder

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Background: Successful social functioning relies upon the ability to identify and learn from salient aspects of one's environment. In typical development (TD), infants show increased attention to the eyes early in life; this facilitates social learning in TD children and those with Autism Spectrum Disorder (ASD) (Klin et al., 2003). As infants acquire new skills, different aspects of the environment become salient, and attention is reallocated accordingly. Within the second year of life TD infants demonstrate a shift in preferential looking from eyes to the mouth. This shift occurs at ages that coincide with word learning and is associated with later vocabulary (Tenenbaum et al., 2015). However, past findings are variable regarding the adaptive value of mouth-looking for children with ASD, depending on the age and developmental level of a given sample. In both TD and ASD, it is also unclear whether and to what extent mouth-looking is specifically related to the first word milestone.

Objectives: The present study explores the adaptive value of mouth-looking during the period of early word learning in TD and ASD groups. We hypothesize that mouth-looking will be directly associated with language ability only at key points of word learning; specifically, we predict a significant relationship between mouth-looking and language at the onset of word learning, for both TD and ASD groups.

Methods: Chronologically age-matched ASD (n=48; M_{age}(SD)=14.85 (4.348) months) and TD (n=109; M_{age}(SD)=13.01(3.001) months) children were assessed using the MSEL expressive and receptive language scales and eye-tracking measures of visual engagement (quantified as percentage of time spent fixated on different facial regions of interest (ROIs)). Children were classified into four groups based on their early word learning status (MSEL item 11scale: no words (n=39), one word (n=31), two-to-seven words (n=57), and eight-or-more words (n=25). Within each category of word learning, we tested for between-group differences in visual fixation to eye and mouth regions, and within-group associations between visual fixation and concurrent expressive and receptive language.

Results: Once children with ASD reached eight-or-more words, they displayed significantly less mouth-looking than TD children in the same stage (p=0.049); there were no other differences in amount of eye- or mouth-looking between groups. TD children without words exhibited a positive association between mouth-looking and concurrent receptive language (r=0.654, p<0.001), and an inverse relationship between eye-looking and expressive language (r=-0.564, p=0.002). Those closest in time to the first word milestone (one word) exhibited a positive association between mouth-looking and concurrent expressive language (r=0.448, p=0.036). Eye- and mouth-looking were unrelated to language in ASD children at all stages of word learning.

Conclusions: These findings suggest that for TD children, the adaptive value of mouth-looking changes around the first word milestone: specifically, mouth-looking positively predicts receptive language ability before word onset, then positively predicts expressive language ability during the immediate period following word learning. These patterns were not observed in children with ASD. Future analyses will explore associations between visual fixation and language in a cohort followed longitudinally across the first word transition, and potential heterogeneity in this relationship within ASD.

417.062 *(Poster)* The Relationship between Joint Engagement, Joint Attention, and Cognition in Infant-Toddlers at Risk for Autism Spectrum Disorder

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Background: Deficits in joint attention (JA) are well documented in individuals with autism spectrum disorder (ASD; Mundy et al., 1990), and interventions targeting joint engagement (JE) have a positive and sustained effect on JA (Kasari et al., 2010). Furthermore, JA is a precursor to important developmental milestones, such as language (Mundy et al. 1990), and is known to be influenced by cognitive ability (Mundy et al. 2007). However, little is known about how cognition influences the relationship between JA and JE in infants-toddlers at-risk for ASD.

Objectives: To analyze the association between joint engagement and joint attention in infants at-risk for ASD and whether it is influenced by non-verbal cognitive ability (NVIQ).

Methods: This analysis includes baseline data from 80 infants with ASD (MAge= 17.66 months, 54% non-white, 80% Male) enrolled in a clinical trial of JASPER for children at risk for ASD. Children met for mild-moderate concern on the ADOS Toddler Module (Luyster et al., 2009). Children's NVIQ was assessed using the receptive language and visual receptive domains on the Mullen Scales of Early Learning. The Early Social Communication Scales (ESCS) measured children's percentage of responding to joint attention (RJA) and frequency of initiating joint attention (IJA). JE was coded from a 10-minute parent child, free play interaction using a scheme adapted from Adamson and colleagues (2009). First, a negative-binomial regression was fit with IJA gestures as the dependent variable and age, time spent jointly engaged, NVIQ and the interaction between NVIQ and JE as mean centered, independent variables. Next, multiple linear regression was used with RJA as the dependent variable and age, time spent in joint engagement, NVIQ and their interaction as the independent variables.

Results: In the IJA model, for every 1 standard deviation (SD) increase in JE the frequency of IJA is expected to increase by 10% and for every 1 SD increase in NVIQ the frequency of IJA is expected to increase by 109%. However, the interaction term indicated that the effect of NVIQ decreases by approximately 60% for each SD increase in JE. In the RJA model there were main effects of JE and NVIQ on RJA and the interaction term for the RJA model was significant, t(55)= -2.61, p <.01 indicating that increases in joint engagement had a more positive association with RJA in those with low NVIQ.

Conclusions: Decisions about what goals to prioritize in very young children with autism remains a critical area of interest for clinicians and early intervention researchers. Consistent with other samples, in our sample, lower cognitive ability was strongly related to fewer initiations of joint attention (Mundy et al., 2007). However, we found that infants' ability to maintain periods of joint engagement with their parents appears to protect against this effect. Those children with more joint engagement had more initiations of, and responses, to joint attention, regardless of their cognitive ability. Overall, these data reiterate the importance of joint engagement as a foundation to teach joint attention skills, particularly in those infants with more global developmental delays.

417.063 *(Poster)* The Relationship between Motor Skills, Gestures and Language Development in Children with an Elevated Likelihood of ASD

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Background: Early motor skills are known to correlate with language development in typically developing (TD) and ASD populations. In TD groups however, this relationship has been found to be mediated by representational gesture frequency. Although gestures have also been shown to be a predictor of language development in children with (elevated likelihood (EL) of) ASD, the relationship between motor skills, gestures and language development remains understudied in these groups. More insight into this relationship is necessary given the prevalence of impairments in these domains in children (with EL of) ASD.

Objectives: To provide more insight into the potentially mediating role of gestures on the relationship between motor skills and language development in a population at risk for impairments in these domains.

Methods: As part of a longitudinal study we investigated gestures, motor and language skills in 40 children. 26 children were siblings of children with ASD, thus with an EL for ASD (EL group). The control group (TL) consisted of 14 children. At fourteen months, early and late gestures were examined with the Dutch version of the MacArthur-Bates Communicative Development Inventory. Fine and gross motor skills were observed with the Mullen Scales of Early Learning (MSEL). The MSEL was also used to obtain scores for receptive and expressive language at 36 months. Intercorrelations were assessed using Spearman's rho and group differences were assessed with Wilcoxon signed-rank tests while correcting for multiple comparisons. Mediation analyses were executed using regression analysis and bootstrapping with 1000 iterations. Early and late gestures were investigated as possible mediators on the relationship between gross and fine motor skills on the one hand and receptive and expressive language on the other.

Results: We observed medium to high significant correlations (ranging from .34 to .69.) between variables, except between early gestures and gross motor skills. Group differences were only observed for expressive language and late gestures, with the TL group scoring better on all variables (all p's <.008). The EL group showed substantial within-group variance in all variables. Regression analyses evaluating the influence of gross motor skills on receptive language showed no significant effect for either group separate. When assessing this influence on the continuous sample however, the analysis yielded a significant effect. For the EL group only we found a significant effect of gross motor skills on expressive language and this effect was fully mediated by late gestures (p = .01). However, when adjusting for multiple comparisons, the effect did not survive.

Conclusions: Our results show a trend suggesting that late gestures do indeed mediate the relationship between gross motor skills and expressive language in a population at risk for impairments in these domains. This suggests that it could be important for clinical practice to pay closer attention to the gesture use of children with an increased likelihood of ASD given their potential influence on language outcome. More research however is needed to confirm this finding, given the limited sample size of the current study.

417.064 *(Poster)* The Weak Link- Hypotonia in Infancy and the Autism Spectrum

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Background: Since the diagnosis of ASD is clinical, the age by which diagnosis is given- is influenced by the presented symptoms and concerns. Recently it was recommended that the evaluation should be performed at a younger age, and that a diagnosis made during the second year of life is stable. The earlier the intervention, the more effective it is in improving functioning. Accurate identification of easy to recognize, measurable and reliable "red flags" is paramount to the improved outcome.

Objectives: We suggest that low muscle tone- hypotonia, is a sign that meets the above criteria of consistency and reliability, and may serve as an early "red flag" to prompt neurodevelopmental evaluation and autism diagnosis.

Methods: Comparing age distributions and testing for significance of rates of ASD in the presence of muscle-tone indicators, as reported in the Keshet database. A machine learning algorithm was used to construct a predictive model in order to further enhance the significance of the observation to ASD diagnosis.

Data set:

Keshet center database of children diagnosed at the child developmental center from 2010 to 2018. A machine learning algorithm was used to construct a predictive model. Data was cut off at 2 years of age, in order to facilitate a condition where the sum of diagnoses given to an individual is un-known after 2 years, making an attempt to predict based only on diagnoses given up to that point.

Results: A dataset of 5280 children (75% less than 12years old), 1659 with ASD, 207 of them diagnosed before age of two years. Examining the full dataset reveals that while the mean age of ASD diagnosis in the absence of hypotonia is around 5 years for males and 4 for females, it will decrease significantly in the presence of hypotonia, by an average of 2 years for males and 1.5 years for females.

Distributions of age at first ASD diagnosis and significance:

Since the actual diagnosis of hypotonia is transient by nature and decreases with age, we further cut the overall data set to children diagnosed before age seven. The age for first diagnosis remained consistently lower for both males and females by one year and in ½ year respectively in the presence of hypotonia. Similarly, a predictive model showed 90% confidence to a significant difference in males for the probability of ASD in the presence of hypotonia and torticollis, if diagnosed before the age of 2 years.

Conclusions: Early signs and symptoms such as lack of eye contact can be recognized during the first year of life, and motor gaps such as head lag, hypotonia and motor asymmetries should prompt a more extensive evaluation.

We proved that low muscle tone is a recognizable marker of ASD. It is also a marker of severity, since it adds delay in motor milestones to the language and communication delays so children with ASD and hypotonia are more likely to present with global developmental delay, and subsequent Intellectual Disability, which accounts to more severe ASD.

417.065 *(Poster)* Understanding the Development of Large-Scale, Automatically Identified White Matter Tracts in Typically Developing Infants

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Background: Establishing growth curves of white matter tract development in typical infancy is critically needed for identifying deviations therefrom in infants later diagnosed with autism spectrum disorder (ASD)[1]. Diffusion tractography is the only available method for mapping infant white matter development non-invasively and longitudinally[2]. However, traditional methods of delineating infant white matter tracts suffer from several limitations: (1) it is time consuming to delineate tracts in a large cohort; (2) it requires extensive expertise in neuroanatomy; (3) large inter- and intra-experimenter variability exists; (4) only about a dozen major fiber tracts can be feasibly studied using manual delineations and (5) tractography performed in the template space can be limited by the complexity of models supported by the template data. Due to these limitations, we implemented a framework to automatically delineate a large number of fiber tracts in infants without the need for manual interventions. This approach will accelerate our understanding of early white matter development in infants with and without ASD.

Objectives: The objective is to implement an automatic framework to derive large number of fiber tracts in infants without neuroanatomy expertise and manual interferences.

Methods: *Participants:* 33 typical developing infants (age = 113(54) days; 10 females) were enrolled. *Longitudinal Data Sampling:* DTI data were collected from each infant at three pseudorandom time points between birth and 6 months, yielding a total of 63 scans. *Data Acquisition*: Data were collected on a 3T Siemens Trio system with 32-channel head coil. Multiband MRI sequences that simultaneously acquire several slices of data[3] were used. DTI parameters are: TR/TE of 6200/74ms, a multiband factor of 2 combined with a GRAPPA factor of 2, FOV of 184×184, spatial resolution of 2mm isotropic, b=0/700 s/mm^2, 61 diffusion directions. *Data Processing*: Data were preprocessed for susceptibility and eddy-current distortions using FSL. A two-tensor with Unscented Karman Filter method was used to delineate whole-brain tractography in each infant's diffusion space[4]. After whole-brain tractography was derived, these tracts from infants were mapped onto a fiber atlas. 800 fiber clusters were automatically derived and then grouped into 58 deep fiber tracts and 198 superficial fiber tracts[5]. Microscopic properties of these tracts were indexed by tensor-derived scalar measure, fractional anisotropy(FA).

Results: Unlike the registration of anatomical T1 and T2 images in which white matter and gray matter in infants younger than 6 months tend to have reversed imaging contrasts compared to older infants, whole-brain tractography in infants remain similar in terms of morphology as that in adults, resulting in less challenges in aligning whole-brain tracts. 58 deep white matter tracts were identified to form anatomically meaningful tracts in each infant's original space. Subsidiary association fibers with protracted development such as SLF III can be probed and studied for their developmental changes (Fig.1).

Conclusions: Aimed to overcome many issues that plagued white matter connectivity studies in infants using conventional methods, the current novel and automatic framework can perform tractography analysis on large infant cohorts, studying both deep and superficial white matter tracts and without the need for manual interventions.

417.066 *(Poster)* What Are the Odds?: Predicting the Likelihood of Negative Episodes in Toddlers with ASD Using Parent and Child Behaviors

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Background: Individuals with ASD exhibit deficits in emotion regulation (ER) (Konstantareas and Stewart, 2006). These impairments can result in poorer response to intervention and treatment (Jahromi et al, 2012). Thus, preventing challenging behaviors and negative episodes may help to improve children's intervention outcomes. It is known that parents play an important part in co-regulating their toddlers with ASD (Gulsrud et al., 2011), but there have been no attempts to describe how parent and child co-regulation strategies interact to increase or decrease the likelihood of negative or disruptive behavior in real time.

Objectives: This study aims to identify specific parent and child behaviors that make a negative episode more or less likely to occur within parent child interactions.

Methods: 71 toddlers with ASD (24 – 36 months) completed a 3-minute distress task at entry into the study based upon the Lab-TAB distress task used with typically developing preschoolers (Goldsmith, Reilly, Lemery, Longley, & Prescott, 1999). Toddlers were given a locked toy box and a ring of keys and encouraged by parents to open the box. Videos of the task were coded in 10-second intervals for child negativity, child ER strategies and parent co-regulation strategies. Each child had a total of 17 intervals leading to 1207 total intervals across children. Each interval was considered a unique measurement period. Mixed effects logistic regression was used to account for the nested structure of the data (intervals within child) with child ER strategy, parent co-regulation strategy and parent responsiveness entered as categorical predictors of the presence of negativity in the following interval (i.e. interval 2 strategies predicting interval 3 negativity) while controlling for cognitive ability (MSEL). All results are reported in terms of odds-ratios.

Results: The full table of results including estimates and confidence intervals is provided below. Overall, the confidence intervals for the estimates were large. Children's use of tension release (i.e: high energy behavior with no instrumental purpose such as hand-flapping or kicking legs) was 3 times more likely to occur preceding a negative episode. In contrast, parental use of emotion regulation strategies and children's use of distraction reduced the likelihood of a negative child episode by 34% and 39%, respectively, although the confidence interval for these two estimates crossed 1. Lastly, parental non-responsiveness was almost twice as likely to precede an episode of child negativity compared to parental responsiveness (5.5 and 2.75 increased likelihood respectively).

Conclusions: Several notable findings emerged from these analyses. Firstly, the use of tension release appeared to be an antecedent of dysregulation, rather than an emotion regulation strategy. Additionally, children's use of distraction and parents' co-regulation strategies decreased the likelihood of dysregulation, although the large confidence interval speaks to the variability in the sample. Lastly, parents categorized as non-responsive were 2 times more likely to have a child have a negative episode in the following interval than parents who were categorized as responsive. These findings indicate the need for a targeted, parent-mediated intervention for parents and their young children with ASD.

417.067 *(Poster)* "Differentiation Time Window" and Different Pattern of Gesture Use in Infant Siblings of ASD

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Background: Researches have found significant group differences of gestures between infant siblings of autism spectrum disorder (ASD) and infants with no family history of ASD, with high-risk infants (HRA) producing fewer gestures compared to their low-risk peers (LRA). Based on these differences, fewer gestures at 12-14 months of age may be an early sign of ASD.Considering a few previous studies suggest that the quality of early gesture in HRA is also different from LRA and remains unclear, the analysis of more fine-grained communicative gestures, may lend deeper insight into the earliest emerging communicative differences.

Objectives:

1. To explore the "differentiation time window" of early gestures between HRA and LRA from both quantity and quality perspectives.
2. To explore the different pattern of gesture use at the differentiation time.

Methods: This study includes three cross-sectional analysis of gesture use at 9 months old (N_{HRA}=17, 10 males; N_{LRA}=12, 5 males), 12 months old (N_{HRA}=20, 16 males; N_{LRA}=12, 7 males), 15 months old (N_{HRA}=16, 13 males; N_{LRA}=9,3 males). There were no significant group differences of age. Gestures were examined using an observational measure adapted from the Communication and Symbolic Behavior Scales Behavior Sample (CSBS-BS; Wetherby & Prizant,2002) and a new coding manual was developed. All Infants were assessed by The *Griffiths* Mental Development Scales-*Chinese* (GDS-C) across six separate subscales: Locomotor, Personal-social, Language, Eye-hand co-ordination, Performance.

Results: We found that there were no significant group differences in GDS-C results at 9、12、15 months old and in gestures at 9 and 12 months old. The group differences of gestures are detectable at 15 months old ($p<0.05$, Table 1). Among these different gestures, overall gesture frequency, BR gesture, integration gesture and compliant gesture have strong positive correlations with personal-social Score and language Score($r>0.6$, $p<0.05$) in HRA. While language Score only has strong positive correlations with gestures integrating verbalization in HRA($r>0.6$, $p<0.05$).

Conclusions: Our findings show that the potential differentiation time window of early gesture ranges from 12 to 15 months old, at which time the differences of motor, Social, language skills between HRA and LRA may yet not appear. Our findings show different pattern of gesture use in HRA at 15 months old: low frequency (overall frequency and frequency of behavioral regulation) and poor communication quality (less initiative, less integration with Vocalization or verbalization, less compliant), and is related to personal social and language skills. Compared to LRA, this gesture pattern of HRA may be more relevant to language. By implication, risk group differences have been informative in suggesting that gesture may be a risk factor for ASD, early gesture use should be closely monitored and assessed in high-risk infants to identify those who will be diagnosed as ASD ASD at a later age.

Early Phase Drug Discovery

POSTER SESSION — **EARLY PHASE DRUG DISCOVERY**
418 - Early phase drug discovery Posters

418.001 *(Poster)* Dopamine D1 Receptor Antagonism Influences Social Behaviour and Locomotion in Juvenile Zebrafish

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder severely affecting the life of 1% of the population and substantially increases the risk of other psychiatric conditions. Social deficits are a hallmark for autism, and although there are promising findings suggesting that the neuropeptide oxytocin and a handful of other drugs may reduce this core symptom there are no established pharmacological treatment options available. The overall goal of our research is to identify pharmacological tools for reversing social deficits in animal models with validity for autism. Zebrafish offers a great in-vivo model to run high-throughput phenotypic screens for potential drug therapies. To date, most high-throughput studies in zebrafish measures locomotion or anxiety-like behavior in very young larvae. High-throughput drug screens for social interaction are needed to provide better possibilities for finding drugs that can improve social abnormalities seen in autism and related disorders. While social interaction in zebrafish is a good model to study etiology and treatment of such disorders, raising fish to adulthood has significant time and cost associated with it. Zebrafish larvae show robust social interaction at 3-weeks of age and we are using a paradigm that allows efficient and higher-throughput testing of social interaction in larval fish. Moreover, we have recently shown that deficient oxytocin signalling decrease social preference in zebrafish. This study aims to investigate to what extent dopamine receptor D1 modulates social preference behavior in young zebrafish. Dopamine is known to play a prominent role in social reward and has been suggested to be relevant for the social deficits seen in ASD patients. Previous studies have shown that a dopamine D1 receptor antagonist (SCH-23390) can reduce social preference in adult zebrafish.

Objectives: In this study, we investigate if SCH-23390 may alter social behaviour in three-week-old juvenile zebrafish.

Methods: The behavioural experiments were performed in arenas flanked by social (fish stimuli) and non-social compartments (empty). Test fish were treated with 0, 1 or 10 mg/L of SCH-23390 for either 30 or 60 minutes. Time and location in the arenas were scored and a social preference index was calculated. A separate control test for studying movement, vision and motivation was performed by addition of artemia. We used t-tests or repeated-measures multi-variate ANOVAs as appropriate to determine statistical significant ($p < 0.05$) differences between the comparison groups.

Results: Fish treated with 10 mg/L preferred the social stimulus side less than control fish and those treated with 1 mg/L of SCH-23390 after both 30 and 60 minutes exposure. Moreover, a decrease in the distance travelled was observed in both drug-treated groups compared to the control group. However, there was no correlation between distance moved and social preference index. The control test showed an increase in movement after addition of artemia in all treatment groups, which indicates that the fish can detect and react to food stimuli also when dopamine D1 receptor signalling is inhibited.
Conclusions: Our results suggest that dopamine D1 receptors may regulate, independently of one another, social preference and locomotion in developing zebrafish.

Education

PANEL SESSION — **EDUCATION**
211 - Parents and Teachers: Collateral Benefits for Children with ASD

Panel Chair: Lisa A. Ruble, *University of Kentucky, Lexington, KY*

Discussant: Brian Boyd, *Juniper Gardens Children's Project, University of Kansas, Kansas City, KS*

At the conclusion of early intervention, children with autism spectrum disorder (ASD) transition to school with all of its requisite challenges, such as getting along with peers and teachers. Although about 40% of children with ASD are included in general education classrooms, their teachers may not have received the training to accommodate them and their parents. Parent-teacher communication quality has implications for both coordination of educational goals for school and at home, as well as for the development of optimal student-teacher relationships. Four papers address aspects of parent and teacher interaction that have positive, collateral effects on children. The first paper reports on a parent-to-parent program (Parents Taking Action) to help urban, low income Black parents understand ASD and to better prepare them and their children for school (Dababnah et al.). The second paper involves parents and teachers (K-5) working more effectively with each other as part of the Partners in School model (Azad et al.). The third paper examines whether parent-teacher relationships have any bearing on student-teacher relationships (Losh et al.). The final paper presents the first phase of the development of an IES-funded intervention to improve student-teaching relationships (Smooth Sailing; Bolourian et al.).

211.001 *(Panel)* A Feasibility Study of a Peer-to-Peer Parenting Program for Urban Black Families Raising Children with Autism
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Background: While racial and socioeconomic disparities in autism diagnoses and treatment in the U.S. have been well-documented, there is a dearth of intervention research focusing on low-income families of Black children with autism.
Objectives: We will report the results of a feasibility trial of an adapted version of a peer-led, 14-week manualized program, *Parents Taking Action* (PTA), among urban caregivers raising Black children with autism in low-income neighborhoods. PTA aims to increase autism knowledge, improve advocacy skills, build social support, reduce parenting stress, and manage challenging child behavior.
Methods: We used a mixed-methods approach to adapt, implement and evaluate PTA. We formed an advisory board composed of local parents, providers, and other stakeholders to recommend program adaptations. We trained four Parent Leaders (caregivers of Black children 9 years and older with autism) to deliver the in-home program to caregivers of Black children ages 8 and younger with or at-risk for autism. Social workers provide case management for material needs. Participants complete measures on service use, parenting stress, depression, autism knowledge, family functioning, and child behavior before, mid (session 7), and after the 14-week program. Parent Leaders submit fidelity checklists weekly. Additionally, researchers observe the Parent Leaders twice during the 14-week program for fidelity.
Results: We will present preliminary results on program feasibility and participant baseline results. Parent Leaders have delivered the program sessions to seven mothers with a high level of fidelity. All participants have significant concrete needs, such as homelessness and food insecurity. The average time between sessions is three weeks, with the primary reasons for session cancellations related to meeting these material needs.
The average participant age is 32.6 years (SD=5.1). Approximately 29% of the participants are single; the remaining are married (29%) or living with a partner (43%). 80% of participants have annual incomes lower than $40,000. The average child age is 5.7 years (SD=1.4). The average child age when parents had first developmental concerns was 14.6 months (SD=8.2) and the average age of autism diagnosis was 3.9 years (SD=1.4). About 66% of participants indicated they were stressed and 57.1% of participants reported they were depressed at pre-intervention assessment. At baseline, 43% of participants indicated they understood their child's strengths, needs and abilities and about 30% of participants indicated they had access to local autism resources and supports. Approximately 14% of parents reported they had support systems, knew their rights, and advocated for their child at pre-intervention assessment.
Conclusions: We describe our efforts to culturally and contextually adapt an intervention aimed at families living in low-income urban neighborhoods, with significant input from a community-based advisory board. Parent Leaders can deliver the program as intended in the PTA manual. At baseline, participants on average reported experiencing high levels of stress and depression, and limited access to local autism services and supports. Delivering the program on a weekly basis is challenging due to participants' other needs. Our findings can inform current and future efforts to better serve communities experiencing the multiple effects of poverty.

211.002 *(Panel)* Partners in School: An Implementation Strategy to Optimize Parent-Teacher Communication for Children with Autism Spectrum Disorder

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Background: Effective communication is essential to ensure that parents and teachers are addressing pervasive concerns and implementing the same interventions across settings (i.e., problem-solving), as well as for sustaining high quality relationships. However, little is known about what communication skills parents and teachers need to successfully work together.

Objectives: To examine key areas for optimizing parent-teacher communication in the *Partners in School* model. In this implementation strategy, parents and teachers: (1) identify a mutual concern, (2) define mutually agreed upon evidence-based interventions to address the concern, and (3) implement those steps at home and school. We examined the communication skills that parents and teachers reported needed training in, and the extent to which those communication skills were related to problem-solving and relationship quality.

Methods: Participants were 21 teachers and 36 parents of children with ASD. Parents were mothers (72.2%) and averaged 35.6 (SD = 7.5) years of age. They identified as white (44.4%), black/African American (41.7%), American Indian/Native Alaskan (5.6%) and Asian (8.3%). Almost a third (36.1%) reported an annual income of less than 45K (36.1%). Teachers were all female, with an average age of 33.5 years (SD = 10.3). Approximately 86.1% of the teachers were white, 16.7% were black/African American, and 2.8% were Asian. Teachers reported teaching for 6.8 years (SD=7.4); 70% reported no training in working with parents. The students were in pre-kindergarten through 5th grade, and were on average 5.4 years (SD = 2.5). Parents and teachers completed the Participation in Problem-Solving Scale. Relationship quality was assessed with two subscales (joining and communication to the other) on the Parent-Teacher Relationships Scale.

Results: On average, teachers reported needing communication training in information exchange (1.81; SD=.51), time management (2.00; SD=.68), and identification of problems (2.15; SD=.47). Linear regression models suggested that teachers with better time management also reported more problem-solving with parents (B= 2.92, p= .007). Age and time management were related to relationship quality. More specifically, older teachers reported more joining (i.e., partnership) with parents (B= 2.23, p= .034) and more positive communication with them (B= 2.33, p= .027). The extent to which teachers managed their time was also related to joining with parents (B= 2.26; p= .032) and communicating more effectively with them (B= 2.59, p= .015). On average, parents reported needing communication training in intervention adherence (2.20; SD=.54), time management (2.36; SD=.49), and shared decision-making (2.45; SD=.46). For parents, older age was also associated with more joining with teachers (B= 2.77, p= .010). The better parents managed their time, the more effective their communication was with teachers (B= 2.41, p= .023).

Conclusions: These results highlight the communication skills that parents and teachers need to more effectively work together, and sustain positive relationships with each other. Our findings also indicate that age and time management skills are essential to consider in parent-teacher communication. This information was used to develop parent-teacher communication training as part of the *Partners in School* model.

211.003 *(Panel)* The Impact of Parent-Teacher Relationships on Student-Teacher Relationship Development for Young Students with ASD

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Background: Student-teacher relationship (STR) quality in early elementary is a key predictor of later academic, social, behavioral, and emotional functioning (Zeedyk et al., 2016). In addition to facing unique challenges during the transition into early school due to social communication barriers and commonly co-occurring behavioral challenges, students with autism spectrum disorder (ASD) have poorer-quality STRs (i.e., higher conflict and lower closeness; Blacher et al., 2014). Specific risk factors for poorer-quality STRs include externalizing behaviors, autism symptom severity, and parent intrusiveness, whereas protective factors include IQ and language skills (Caplan et al., 2016). Parent-teacher relationships (PTRs), which have been found to predict student engagement and socio-behavioral functioning among typically developing (TD) students, may be another key predictor of STRs (Kim et al., 2013). Externalizing behavior problems are a risk factor for poorer-quality PTRs (Garbacz et al., 2016), thus, students with ASD may be at compounded risk for poorer academic, social, and behavioral outcomes via lesser-quality PTRs and STRs. Although child risk and protective factors are emerging, the conjunction of PTRs and child factors in STR development for young students with ASD remains unexplored.

Objectives: The present study examined whether PTR quality predicted change in STR quality over the course of one school year for young students with ASD, above and beyond child background predictors of STRs.

Methods: Participants were 135 students with ASD (4-7 years) who were enrolled in a longitudinal study examining early school transition for students with ASD (see Table 1). At the beginning of the school year (Time 1), their teachers completed the Parent-Teacher Relationship Scale (PTRS) and Student-Teacher Relationship Scale (STRS), their parents completed the CBCL and SRS, and students completed the WPPSI and CASL. At the end of the same school year (Time 2), teachers again completed the PTRS and STRS (see Table 1).

Results: Bivariate Pearson correlations between PTRS Time 1 scores, child characteristics (WPPSI, CASL, CBCL externalizing, SRS), and STRS Time 2 scores revealed significant correlations between STRS Time 2 and the following: (a) PTRS Time 1, (b) WPPSI, (c) CASL, and (d) STRS Time 1 (see Table 2). In order to assess whether PTRS scores significantly predicted change in STRS over the school year above and beyond WPPSI and CASL, multiple regression analysis was conducted using STRS Time 2 as the outcome and STRS Time 1 as a covariate. The model explained 34% of the variance in STRS Time 2, but only PTRS significantly predicted outcomes alongside the covaried STRS Time 1 (see Table 2).

Conclusions: Findings indicate that PTR quality at the beginning of the school year predicted change in STR quality over the remainder of the school year for students with ASD, above and beyond child predictors of STR quality. Because STRs are critically important for student outcomes across several domains, and young students with ASD are at risk for poorer-quality STRs, future research should explore specific key characteristics of positive and negative PTRs and aim to develop teacher interventions to promote proactive, positive PTRs in this at-risk student population.

211.004 *(Panel)* Smooth Sailing: Iterative Development of a Teacher-Directed Intervention

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Background: Funded by IES, the *Smooth Sailing* study involves general education teachers, grades K-2, in the iterative process of developing a teacher-directed professional development (PD) intervention to improve teacher readiness to work with students with autism spectrum disorder (ASD), including their ASD-specific knowledge, their self-efficacy to teach students with ASD, and the quality of their relationships with students with ASD. The intervention contains three components (i.e., educational modules, coached parent-teacher interviews, and semi-structured student-teacher interactions). The current study presents data from initial focus groups conducted with partnering general education teachers to obtain their perceptions and input on their experiences with children with ASD in their classrooms, including a description of the initial iterative development process of the PD program.

Objectives: Primary aims of the focus group were to understand general education teachers' perspectives of (1) autism, (2) pedagogical practices for including students with autism in the classroom, and (3) strategies for building positive relationships with these students. Ultimately, these perspectives were utilized in the iterative development of the intervention, particularly in the development of the student-teacher relationship-building component of the program, the *Time2Connect* sessions.

Methods: Cross-site focus groups were conducted with participating teachers (*n*=8, California; n=10, Massachusetts). Teachers were from schools that served culturally and socioeconomically diverse populations. Three prompts were pre-determined to address the objectives of the focus group. Participants engaged in a series of guided activities (i.e., free-listing, ranking, and pile-sorting). In response to prompts, teachers were asked to write down words/phrases on individual cards. Next, they reviewed their cards and the cards of other participants to individually rank responses. Saliency scores were calculated (Grinker et al., 2015; Miguel & Cohen, 2018), with higher scores indicating greater consensus across participants. Finally, participants were asked to sort cards under a single category and label them based on determined categories. Pile-sorting helped determine which responses were similarly perceived.

Results: When asked what words/phrases came to mind when thinking about their student with ASD, recurring themes included Social Communication Difficulties; Restrictive, Repetitive Behaviors and Sensory Issues; Emotion-Regulation Difficulties; and Strengths (e.g., charming, uniquely talented). The theme with the highest saliency score was Social Communication Difficulties; lowest saliency score was associated with Strengths and Positive Attributes. The same procedures for developing saliency scores will be used for analyzing inclusion practices and relationship-building strategies.

Conclusions: Findings indicate that teachers recognized difficulties associated with ASD, but did not consistently identify positive attributes of ASD. Findings also reflect a high level of awareness around ASD among participating teachers, given that two out of the four emerging themes in their perceptions of ASD align with the core DSM-V diagnostic criteria. Next steps include conducting a single case research design (SCRD) study to collect observation data and determine the effects of the intervention in the classroom. A description of the iterative development process as well as preliminary findings from this SCRD will be presented. We expect the *Smooth Sailing* program to lead to improved student-teacher relationship quality between young students with ASD and their general education teachers.

ORAL SESSION — **EDUCATION**
312 - Autism in the Schools: Contexts and Supports

312.001 *(Oral)* Making on and Off the Spectrum: An Inclusive, Strength-Based Program to Support STEM Interests and Related Skills in Middle-School Students

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Background: Students on the spectrum have strengths well-suited to STEM careers, such as the ability to engage in systemizing thinking and excellent attention to detail (Baron-Cohen et al., 2009). However, their challenges in social interaction and a lack of opportunities to engage in engineering practices may hinder their achievement of full potential. To support their STEM career preparation in inclusive education, this project collaborated with STEM education program developers and autism educators to develop an inclusive engineering design program, the "Maker Club". The program features a strength-based approach that utilizes students' interests in hands-on engineering practice.

Objectives: To investigate the feasibility of the Maker club program in public middle-schools and its effectiveness on engineering practice and peer engagement.

Methods: The program was implemented in three public middle-school in a large urban area by eight teachers in those schools. A total of 150 students (60 with autism and 90 without) participated in the program over 2017-2019. Data collection included:

- Field observations of every program session in 2017 (n=55)
- Mid-year focus group with all teachers (n=2) and post-implementation focus groups with the teachers at each school (n=15)
- Program implementation logs from teachers (n=41)
- Parent interviews in two schools during student presentations
- Video-based social behavior observation over 14 45-min program sections in one school. Trained observers coded each social initiation, its purpose (social/functional), and type (seeking/ sharing/ attending/ offering/ joking), and each social response and its quality (topic-extending/ topic-relevance/ tangent).

Results: Participating teachers successfully implemented the Maker Program without assistance after the first-year piloting. Field observation and teacher report showed high-level student engagement, with all students with autism completed the entire curriculum and created individual design projects. Teachers reported that students with autism required less additional support then in typical classes, such as visual demonstration of complex steps and assistance with manual dexterity. Further, we observed that students spontaneously integrated individual interests in engineering practice and showed great self-determination in creating individual designs. Parents reported that students were highly motivated by the program and showed increased knowledge and interest in engineering.

Positive peer engagement was also observed. Teachers reported observing increased peer interaction in students with autism during the program than in regular classes, including conversing about their projects and helping each other. Structured behavior observation showed no significant differences in rates of social initiation (p=0.11) and response (p=0.11) between students with and without autism (Fig.1). Patterns of social behaviors between students with and without autism were similar, except for initiation purposes (Fig.2, p=0.02). Ratios of initiation types and response qualities were similar between groups (initiation type: p=0.30; response quality: p=0.59). Both groups initiated interaction primarily by sharing and seeking (Fig.3) and responded to peers with more topic-relevant and extending responses (Fig.4).

Conclusions: The Maker Club was a feasible extracurricular engineering practice program that can be sustainably implemented in autism inclusion public middle-schools. Demonstrating promising outcomes on engineering practice and peer engagement, the program is supported by the National Science Foundation for expansion to broader schools and grade-levels.

312.002 *(Oral)* School-Based Professionals' Knowledge and Selection of Evidence-Based Practices for Students with Autism

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Background: In response to the national focus on evidence-based practices, the National Professional Development Center on ASD (NPDC) conducted a large-scale, systematic review to identify effective interventions for students with autism (Wong et al., 2015). As a result, the NPDC identified 27 evidence-based practices for students with autism which they have translated into user-friendly online modules to teach practitioners how to implement the practices. As of May 29, 2019, AFIRM had 78,031 registered users from 179 countries and this number has continued to increase since the modules were launched in 2015 (Sam et al., 2019). Although AFIRM has a wide user base, the majority of users are school-based professionals. Given the large amount of data that are generated from school-based users, researchers and administrators have the opportunity to learn about the selection of, and knowledge about, evidence-based practices for students with autism. This has implications for researchers interested in how to effectively design a socially valid professional development model for school-based professionals.

Objectives: The purpose of this study was twofold: to analyze (1) school-based AFIRM user data to determine if there are differences in the selection of evidence-based practices by occupation, and (2) pre-test scores for each evidence-based practice to determine if there are differences in the pre-test knowledge of school-based professionals by occupation.

Methods: Data for this study came from a total of 22,775 unique AFIRM users who identify as a school-based professional and completed a total of 67,546 pre-tests across the 27 modules. Overall usage data were analyzed with descriptive statistics, and a one-way ANOVA was conducted to examine the differences in pre-test knowledge of evidence-based practices for school-based professionals by occupation. Post-hoc comparisons were examined using the Games-Howell test due to unequal sample sizes across occupations, using a Bonferonni correction for multiple comparisons ($p < .003$). Effect sizes were calculated as partial eta squares (η^2). Correlations were examined using Spearman's rho correlations among average pre-test knowledge of evidence-based practice and the average use of the evidence-based practices per month.

Results: Overall, there were significant differences in average pre-test knowledge across evidence-based practices by occupation, $F (5, 22{,}769) = 167{,}55$, $p < .001$, $\eta^2 = .04$. Post-hoc comparisons indicated that the average pre-test knowledge of evidence-based practices for related service providers was significantly higher than all other occupations. Additionally, when considering the mean number of modules for which school-based professionals completed pre-tests, paraprofessionals selected to learn about the most evidence-based practices.

Conclusions: This study provides an important first step in increasing our understanding about the pre-test knowledge and selection of evidence-based practices for students with autism. By analyzing user data for the AFIRM modules, valuable insight is gained into which practices school-based professionals have more or less knowledge about and which practices are being selected more or less frequently. Although specific occupations had a higher pre-test knowledge of some practices than others, the average pre-test knowledge was generally low across all occupations and indicates school-based professionals continue to need training in evidence-based practices for students with autism.

312.003 *(Oral)* The Effects of Embedding Circumscribed Interest in Activities on the Engagement and out-of-Seat Behaviors of Children with Autism Spectrum Disorder

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Background: Engagement in academic and social activities within early childhood settings is critical for young children to achieve academically as well as for them to develop appropriately socially and emotionally (Hojnoski & Missall, 2010; Williford, Whittaker, Vitiello, & Downer, 2013). Young children with autism spectrum disorder (ASD) often exhibit challenging behaviors (e.g., out-of-seat behavior) that makes it difficult for them to engage in academic and social activities (McWilliam & Bailey, 1995). As a means to decrease the negative developmental outcomes associated with lack of engagement and challenging behaviors, efforts to address these behaviors in children with ASD and improve these children's engagement in academic and social activities within early childhood settings are necessary. The Division of Early Childhood (DEC) of the Council for Exceptional Children recommends practitioners to identify and use children's preferences to promote engagement in active learning, which in turn, can decrease challenging behaviors (DEC, 2016). For children with ASD, this can be achieved by incorporating circumscribed interest within classroom activities.

Objectives: The purpose of this study was to examine the effects of embedding circumscribed interests in large group activities on engagement and out-of-seat behaviors for young children with ASD in early childhood settings.

Methods: Three children (ages 3-5 years) with ASD exhibiting low levels of engagement and high frequency of out-of-seat behavior during large group activities in inclusive early childhood classrooms participated in this study. Prior to the implementation of the intervention, the participants' general education teachers, along with a special education teacher and the participants' caregivers, identified the circumscribed interest for each participant. The general and special education teachers collaboratively developed circumscribed interest embedded activity plans, which were implemented by the general education teachers in each participant's classroom. A multiple baseline experimental design across participants was used to examine the functional relation between circumscribed interest embedded activity and the engagement and out-of-seat behaviors. Each experimental session was videotaped for data collection purposes and the behaviors were measured using a partial interval recording system.

Results: Data across participants are displayed in the attached graphs. For all three participants, a functional relation was established between the intervention and increases in the levels of engagement in the target activities. Moreover, a functional relation was established between the intervention and decreases in the challenging behaviors exhibited by all three participants. The effects of the intervention generalized across stimuli and maintained after the intervention was discontinued. Interobserver agreement (IOA) data were collected on 25% of the randomly selected experimental sessions across all participants, for both target behaviors. Procedural fidelity data were collected on 35% randomly selected intervention sessions across participants. The mean IOA for engagement behavior was 99%, out-of-seat behavior was 100%, and the mean fidelity was 92%.

Conclusions: The results of this study illustrate the effectiveness of incorporating circumscribed interest into large group activities in early childhood general education classrooms on engagement and out-of-seat behaviors for young children with ASD. Data will be presented and discussed in terms of their implications for research and practice.

312.004 *(Oral)* Inclusion of Children with Autism Spectrum Disorder: Toward an Alignment between Teachers' Practices and Evidence-Based Models

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Background: In many countries worldwide Education Systems have attempted to implement Evidence Based Practices (EBPs) for children with Autism Spectrum Disorder (ASD) in inclusive settings. However, no single educational intervention is effective for all, and the diverse nature of abilities in the autism diagnoses requires general educators in inclusive classrooms to learn a range of skills and knowledge to be able to respond to the variety of needs of pupils with ASD. While the research community is increasing attention toward educators training on ASD and EBPs, teachers in inclusive schools face the challenges to maintain the focus both on individual needs of children with ASD and the rest of their peers.

Objectives: Our implementation research project in Sacramento, California was established to develop a training program on the Group-based Early Start Denver Model (G-ESDM) by Vivanti et al. (2017) while ensuring the educational inclusion of learners with autism in a community-based preschool. In the first exploration phase of this study, which utilizes the Active Implementation Frameworks by Fixsen, et, al. (2005), we explored possible alignment between teachers' practices and G-ESDM core components. In collaboration with teachers, the objective of this study was to assess the fit and examine the innovation of the G-ESDM in the school culture, organization, and structure.

Methods: Participants were early childhood educator in a community-based preschool: lead teachers (TE=8), instructional assistant (IA=13), and the director (DI=1). This study was conducted at baseline, before the G-ESDM in-service training commenced, and it utilizes quantitative and qualitative methods to identify specific enablers and barriers to the model. We assessed the fit and the innovation by comparing three core components of the G-ESDM with those of the school: curriculum program; daily schedule; and teachers' roles. Second we assessed teachers' skills at the baseline with ESDM and G-ESDM fidelity tools (Dawson, Rogers, 2010; Vivanti et al., 2017) in order to create a training program and to identify G-ESDM ingredients that teachers naturally implement in their practices. Third we analyzed teachers' tools for measuring child progress toward desired outcomes(Desired Results Developmental Profile) with the ESDM Curriculum Checklist.Teachers' perspectives on the G-ESDM, potential use of the G-ESDM as a classroom strategy, and barriers were identified through a questionnaire and guided discussions.

Results: Overall, teachers found G-ESDM valuable, but they identified some challenges. We found inhibiting factors, in the organization and culture of the school such as teachers retention to the training; teachers' reluctance to adapt specific part of the program, teachers' perception on their abilities to play with children with ASD.

Conclusions: Our study describes a process of obtaining quanti-qualitative information and feedbacks from frontline stakeholders who face the challenges of individualized programs for pupils with ASD and ensure the educational attainment of the class. Our implementation study provides a generalizable model for researchers to build community-based collaborations and promote an optimally use of the G-ESDM in mainstream classrooms. Future efforts should concentrate on developing training programs, which are feasible for teachers, whilst aligning, translating and applying EBP's to their educational practices.

POSTER SESSION — **EDUCATION**
419 - Education Posters

419.001 *(Poster)* ASD in the Classroom: Teacher Strategies Supporting High-Quality Student-Teacher Relationships.

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Background: Children with autism spectrum disorder (ASD) are at risk for poor student-teacher relationship quality (STRQ). This trend is concerning because high-quality relationships with teachers promotes academic and social engagement (Eisenhower et al., 2015). Researchers have identified child factors that predict STRQ for children with ASD but have rarely examined the impact of teacher characteristics and behaviors. Teachers' use of structure and emotional support predict STRQ for children with ASD (Manti et al., 2013), as do teachers' level of experience and education (Caplan et al., 2016). Researchers have called for investigation of a wider range of teacher factors and examination of differences between general education and special education settings (Eisenhower et al., 2015).

Objectives: The current study sought to determine whether specific teaching strategies and aspects of teachers' professional preparedness promote or hamper STRQ and academic engagement. We also examined whether factors associated with these outcomes differ between general education and special education settings.

Methods: The sample included 122 young children (18% female; M_{age} = 5.5 years) who had confirmed ASD diagnoses and their teachers. Children were entering pre-K, kindergarten, or first grade at enrollment; 57% were in general education classrooms (43% special education). Data were collected in spring of two consecutive school years. Teachers reported on their professional preparedness (years taught, highest degree, professional training in ASD, self-perceived preparedness to teach children with ASD), use of specific teaching strategies (praise, proactive strategies, parental engagement, limit-setting, and punitive strategies), students' academic engagement (emotional and behavioral), and STRQ (closeness and conflict). Children also rated STRQ. Multiple linear regressions were used to predict teacher- and student-rated STRQ as well as students' behavioral and emotional engagement in school, controlling for students' STRQ and academic engagement at the end of the previous school year. Missing data were handled using FIML.

Results: In both general and special education settings, parental engagement predicted higher teacher-rated relational closeness. In special education (but not general education) settings, praise was positively associated with student-rated STRQ, and punitive strategies were negatively associated with student-rated STRQ. In general education (but not special education) settings, punitive strategies were negatively associated with students' behavioral engagement. Teachers' years of experience and self-perceived ASD preparedness were positively associated with student- and teacher-rated STRQ in special educational settings. Contrastingly, in general education settings, self-perceived preparedness was negatively associated with teacher-rated relational closeness, and years of experience was negatively associated with behavioral engagement.

Conclusions: This study found that the factors that promote or undermine STRQ and academic engagement differ significantly across general and special education settings, although parental engagement emerged as universally important for STRQ. Although punitive strategies appear to increase risk for negative outcomes in both settings, they appear to impact different outcomes. Contrary to study hypotheses, perceived ASD preparedness and years of experience were associated with better STRQ and engagement in special education classrooms but were negatively associated with these outcomes in general education classrooms. Teachers, particularly in general education, may benefit from support around the use of appropriate strategies with students with ASD.

419.002 *(Poster)* Achievement Emotions and Math Performance: The Role of Math Anxiety across Learning Contexts for Students with Autism

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Background: Among typically developing (TD) populations, a link between the role of achievement emotions (i.e., emotions connected to achievement activities and outcomes) and math performance exists (Pekrun, 2006). Since individuals with autism spectrum disorder (autism) experience challenges regulating their emotions (Samson et al., 2015), achievement emotions are likely to impact their performance in math as well. Studies examining mathematical performance in children with autism have focused primarily on cognitive and linguistic abilities as predictive factors (Miller et al., 2017), while the role of achievement emotions has received less attention. Additionally, there is a high comorbidity of autism and clinically-elevated anxiety (Lopata & Thomeer, 2014). Among TD children, research has associated math-related anxiety with poor math outcomes (Lichtenfeld et al., 2012). Researchers have demonstrated a similar relationship between test anxiety and math performance among students with autism (Oswald et al., 2016), however, the nature of this relationship across academic contexts remains unknown. Understanding how students with autism experience anxiety in math across learning contexts can help teachers better meet the emotional needs of these students.

Objectives: In the present study, the researchers explore how achievement-related anxiety across academic contexts predicts mathematical performance among students with autism through the following question: How does math-related anxiety in the contexts of class time, homework completion, and test writing predict math performance among students with autism above and beyond predictors of cognitive ability and expressive language ability?

Methods: Recruitment is ongoing, with a projected *N* expected to exceed 45 by April, 2020. Presently, 32 students diagnosed with autism aged 6 to 15 (*M*=10.24 yrs) completed the Basic Concepts composite of the *KeyMath-3 Diagnostic Assessment* to assess math performance. Participants also completed the Formulated Sentences subtest of the *Clinical Evaluation of Language Fundamentals, Fifth Edition* to assess expressive language ability, and age-appropriate versions of *Raven's Progressive Matrices* to assess non-verbal cognitive ability. Lastly, participants completed the *Achievement Emotions Questionnaire, Elementary School* (AEQ-ES), which measures achievement emotions in math, including anxiety, across academic contexts (i.e., class time, completing homework, and test writing).

Results: Using current data, we conducted a regression analysis with the anxiety scale of the AEQ-ES. Hierarchical regression models demonstrated that cognitive ability and expressive language explained 66.9% (p<.001) of the variance in math performance, while overall math anxiety explained an additional 10.3% (p=.024). In the second model, where cognitive ability and expressive language were controlled, math anxiety experienced during class was the only unique contributor (=-.243, p=.048), while homework-based math anxiety approached significance as a second unique contributor (=-.254, p=.058). Math test anxiety made no unique contribution.

Conclusions: Preliminary results suggest math performance of students with autism is grounded in cognitive and linguistic skills—however, anxiety towards math is another factor that may affect performance. Specifically, anxiety experienced during math learning activities (i.e., class time and homework) may impact math understanding and, consequently, the math performance of students with autism. The results suggest that educators need to support students with autism by implementing strategies designed to reduce anxiety inside and outside of the classroom.

419.003 *(Poster)* An Exploratory Study into Parental Perceptions of the Diagnostic Process of Girls with ASD in Australia

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Background: Girls with autism spectrum disorder (ASD) are less likely to receive a timely diagnosis and experience a longer diagnostic process compared to boys with ASD (Dukevot et al., 2016). Girls are often misdiagnosed or diagnosed later than boys due to gender differences in presentation (Dworzynski, Ronald, Bolton & Happé, 2012). Girls tend to present with a less severe expression of ASD characteristics and develop coping strategies to mask their difficulties in social environments (Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015). Recent research suggests that professionals do not have enough gender-specific knowledge on girls with ASD that is needed to reliably diagnose girls at an early age (Gibbs et al., 2019). This has resulted in girls and their families experiencing heightened stress due to a lack of information, professional support and access to timely therapeutic interventions (Crane, Chester, Goddard, Henry, & Hill, 2016).

Objectives: To explore parental experiences of the diagnostic process and support needs following a diagnosis for girls with ASD in Australia.

Methods: This current study consisted of 188 Australian parents who have a daughter with ASD aged between 4 to 17 years. Parents completed a detailed online questionnaire that included the Strengths and Difficulties Questionnaire – parent report (SDQ) to assess girls' complexity of needs and the Kessler Psychological Distress Scale (K10) to assess perceived parental stress. Thematic analysis was conducted to interpret parents' experiences of the diagnostic process based on responses in relation to initial concerns, information/support provided by professionals, and current information/support needs following a diagnosis for girls with ASD.

Results: The findings of this current study reveal that initial concerns were raised at approximately five years of age (M = 4.52, SD = 3.02). The diagnostic process spanned two years and two months (M = 2.13, SD = 2.25) from when initial concerns were raised until the point of diagnosis at nearly seven years of age (M = 6.65, SD = 3.40). Parents reported experiencing a difficult and stressful diagnostic process. Professionals showed a lack of knowledge on girls internalised ASD symptoms and consequently, parental concerns were disregarded or disbelieved. Due to a diagnosis of ASD being provided past the early intervention cut-off age in Australia, parents reported experiencing financial difficulty due to the high cost of therapies and having limited access to funding. Australian parents currently seek face-to-face parent support groups to ease the perceived isolation experienced from parenting girls with ASD and mentorship/social support groups for girls with ASD.

Conclusions: This current study identified a diagnostic timeline for girls with ASD in Australia and factors impacting upon parents' lived experience of the diagnostic process. Numerous professional practice recommendations were provided to assist in the identification of symptoms for girls with ASD. There is a need for clearer information to be provided to parents in terms of the impact of ASD on development and methods to access support. This study shows that more support is required to assist girls with ASD and their families in preparation for future difficulties.

419.004 *(Poster)* An Overview of University Accommodations and Supports for Autistic Students: A Cross-Institutional Survey Study

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Background: In the past decade, the number of autistic students entering and expecting to enter higher education (HE) has increased significantly (Bakker et al., 2019). There have been reports of poor postsecondary outcomes for autistic adults, especially compared to those with other disabilities, concerning HE attendance and employment (Shattuck et al., 2012; Roux et al., 2013) and a growing literature examines challenges faced by autistic HE students, highlighting co-occurring mental health conditions and interrelated difficulties with social interaction, self-advocacy, and executive functioning (e.g., Anderson et al., 2017; Elias & White, 2017; Jackson et al., 2018). Studies have recently reported notable strengths of autistic university students in areas of college writing (under review) and academic examination grades (Bakker et al., 2019) compared to non-autistic peers. Some universities have implemented mentorship programs or other services but very few have been systematically evaluated and many charge a fee in addition to tuition (Barnhill, 2016).

Objectives: This study aims to characterize services provided to and utilized by autistic university students and their helpfulness/satisfaction with services in a cross-institutional study.

Methods: Participants (n=71, $Mage$=24.4, 43.7% male, 67.6% White, 70.4% undergraduates; representing 8 countries and 48 universities) completed an online survey assessing accommodations and supports available to and utilized by students and their relative helpfulness/satisfaction. Participants were also asked how services at their university could be improved. Open-ended responses were coded by two independent coders.

Results: Participants used extra time (64.8%) and alternate testing environments (53.5%) accommodations most often. Participants reported the accommodations they received to be helpful 74.8% of the time. When reporting on more general supports, participants used one-on-one meetings with professors (64.8%), social supports from friends (63.4%), general accessibility services (57.7%), and social support from family (52.1%) most often. Overall, 63% of participants who reported using general accessibility services at university found them to be helpful, the lowest of any support discussed (Table 1).

When asked how supports at their university could be improved (Table 2), most participants reported the need for more group-based supports (51.8%) such as autism-specific social groups (14.1%). Participants also cited the need for increased autism awareness or training for faculty/staff (18.8%) and fellow students (10.6%). On a five-point agreement scale, participants were most satisfied with one-on-one mentorship (M=4.1 out of 5) and group meetings which involved autistic people (M=4.1) and least satisfied with available employment-related supports (M=3.1) and mental health supports (M=3.3).

Conclusions: This research provides an overview of services used by autistic university students and their relative helpfulness in a sample of university students across institutions. Overall, the results point to participant satisfaction with accommodations and supports but the desire for autism-specific group supports and spaces is noteworthy. A larger, more diverse sample is needed to conclusively confirm these findings. However, university staff should consider these findings when providing and designing services for autistic students to better serve their needs.

419.005 *(Poster)* Anxiety and Wellbeing in Autistic Children during School Transition: Individual Differences and Group Comparisons.

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Background: Previous research has suggested that autistic people experience higher levels of anxiety and may have worse well-being compared to typically developing individuals or other developmental disorder groups (e.g. Down syndrome) (Cribb, Kenny & Pellicano, 2019). However, most studies have examined anxiety and well-being cross-sectionally, using participants across a wide age-range, and thus it is unclear how the different individual experiences may impact on anxiety and well-being in autistic children.

Objectives: This current study included autistic children who were at the end of primary school in England and who were about the transition to secondary school. Inclusion of this specific age group allowed examination of individual differences and whether these individual differences were similar and predicted by the same factors as children with other developmental disorders, namely Williams syndrome and Down syndrome.

Methods: During their final year at primary school, parents and children completed a range of questionnaires that measure anxiety and wellbeing, including *Spence Children's Anxiety Scale SCAS-P (Spence, 1999)*, Strength and Difficulties Questionnaire (Goodman, 1997), Sensory Profile Questionnaire (Dunn, 2014), Social Responsiveness Scale **(***SRS-2 ; Constantino & Gruber, 2012)***,** *Health-Related Quality of Life Questionnaire (Kidscreen-10 Index, HRQOL)*, and Kids Coping Scale (Maybery et al., 2009). Data was obtained for 23 autistic children (mean age 11;04 years old), 23 children with Down syndrome (mean age 11;06 years old), and 18 children with Williams syndrome (age 11;03 years old).

In first instance group differences were explored using ANOVA's for overall scores and Chi-Square was used to see if there were any differences between the groups for the number of children that reached cut-off criteria for clinical diagnosis. Secondly, correlations and regression analyses were run to explore relationships between anxiety and wellbeing.

Results: Across all three groups a significant number of children experienced higher anxiety before making a school transition. However, in each groups there was large variability in the overall anxiety children experience. There were no differences between the three groups for overall levels of anxiety. However, looking at the different types of anxiety, autistic children experienced more anxiety that relates to repetition or OCD. However, there was also considerable overlap in the different types of anxiety across the different groups. In addition, in all three groups anxiety correlated with SDQ scores and SRS scores. Regression analyses showed further group differences.

Conclusions: This study's findings highlight some important parallels between the groups in the nature of the anxiety (i.e. physical injury and pain) but also group differences. A better understanding of these group and individual differences in anxiety and wellbeing allows the development of better group and individual specific interventions to help tailor support and prevent long-term suffering.

419.006 *(Poster)* Artea – Artistic Practices with Children in the Autism Spectrum

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Background: Brazil doesn't have robust epidemiological data on prevalence of ASD. Our education has worked from the perspective of inclusive education since 1994, but the law that regulates this model was only enacted in 2016. In 2007, official data from the city's municipal education office in Belo Horizonte, Minas Gerais, pointed only 38 children with autism in early childhood education (0 to 60 months). In 2008, this number rises to 68; and in 2016, 140 students. However, in 2018, we identified (through document analysis) 12 children diagnosed with ASD in only one of the 131 schools in the network.

Children at this age spend between 20-38h weekly at school. Knowing the importance of children's time quality, the importance of early intervention, and knowing the lack of knowledge of those teachers on ASD, we built a pilot project called ArTEA (art-ASD, in portuguese), using art-education as main tool.

Objectives: To present ArTEA as a tool to expand the range of possibilities for offering ASD care in the context of early childhood education in Brazilian context;

Identify if artistic practices can be useful for early intervention and sensitization of Early Childhood teachers;

Reflect on the potential of using methodologies to work with art education in the field of inclusion, as well as the importance of interdisciplinary work in addition to health and education courses, including Visual Arts, Dance, Music and Theater.

Methods: Pilot Project with a group of Municipal Unit of Early Childhood Education-UMEI: 20 children aged 4/5 years, 2 with ASD, 2 teachers and 2 auxiliaries of inclusion (paraprofessionals, with no professional licensure and almosto no training in ASD);

20 4-hour meetings of artistic workshops, focusing on group corporal movement experimentation, aiming at inclusive activities, that instill the corporality of all in the activity. We used some principles of the Early Star Denver Model (ESDM) as a coadjuvant, namely: following child leadership, reciprocity (being play partners), and positive affect. We also use sensory-body and rhythmic proposals, using different materials (percussive musical instruments, tissues, hula hoops, balloons, etc.);

10 training meetings with teachers, coordination and paraprofessionals;

Application of post interview and questionnaire (with Likert scale) pre and post project for teachers.

Results: We note inclusive power of artistic work when performed in conjunction with typical children, especially in aspects of relational improvement among pairs and play repertoire expansion of childrens in the spectrum. We observe the importance of planning activities based on elements children in the spectrum bring - preferences, focus of attention, etc.

Teachers feel more secure and interested after participating in the workshops, although the school hasn't been able yet to schedule the theoretical training sessions.

Conclusions: The project is situated in a frontier territory between art, education and clinic. Artistic practices, even though they are neither therapeutic nor educational in their origin, place us face multiple possibilities of encounter. It is important that new practices and research be done, filling the gap of methodological and experiential knowledge about the arts with children with ASD and early childhood education.

419.007 *(Poster)* Assessing Social Validity of Parent-Implemented Function-Based Intervention: Mixed-Methods Study

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Background: The term *social validity* was developed from anecdotal reports of concerns about the social meaningfulness of interventions in ABA-based research (Wolf, 1978). In the ABA field, conducting research that is "socially important" is the primary purpose (JABA, 2016). Two articles, the first by Wolf (1978) and the second by Kazdin (1977), responded to these concerns and defined the concepts of how to measure "social importance," which is now considered under the rubric of social validity. Since 2005, measuring social validity became one of the quality indicators in single-case research (Horner et al.). However, according to the reviews of the literature, in single-case research, there are several limitations of measuring social validity: (a) social validity assessments have not been well conducted within single-case design research, (b) the reviewed studies contain insufficient information about how researchers conducted social validity assessments and what they measured, and (c) the reported results are insufficient to infer that studies are socially valid. One way to overcome the limitations of social validity assessment is to apply a mixed-methods; multiple data sources will capture a different dimension of the social validity in a certain intervention.

Objectives: We conduct a mixed methods study to assess the social validity of the intervention we previously delivered to three parents who have children with disabilities and challenging behaviors.

Methods: The purpose of the previous intervention was to evaluate the effectiveness of a parent training and coaching program, delivered via telehealth, for implementing functional communication training (FCT) with their children. We used single-case design to demonstrate the intervention effectiveness by observing parents' and children' behaviors change. The intervention demonstrated a functional relation between parent training and coaching program and parents' fidelity of behavioral strategy. Also, the intervention showed decreases in children's challenging behaviors. In the current study, to assess whether the intervention was socially valid to the participated family members, first, we conduct pre- and post-intervention interviews with parent implementers and other family members. As a secondary data sources, we survey blind professional raters to evaluate the acceptability and effectiveness of the previous parent-implemented FCT. By mixing all those data, we evaluate whether the intervention was socially valid to the participants and related stakeholders.

Results: The preliminary finding from the interviews indicate that the outcome of the function-based intervention exceeded their expectations and agreed it was effective to decrease their children's challenging behaviors. Parent interventionists all agreed the social validity goal was met, and they also gave some suggestions for improving study procedures of a future replication. The blind raters' survey data collection is completed, and analysis is currently in progress.

Conclusions: Preliminary findings showed some degree of evidence of socially valid parent-implemented FCT. By mixing multiple data sources, various aspects of social validity will be evaluated. Study limitations and future implications will be discussed.

419.008 *(Poster)* Autism Preschool Education Services: Does Parent Preference Matter?

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Background: In the United States, schools must include parents in developing their child's individual education plan (IEP; IDEA, 2006). Inclusive preschool classrooms, autism specific classrooms, and home-based interventions are some of the most common special education services preschool-aged children with an autism spectrum disorder (ASD) use. Little is known about the degree to which parent preferences drive placement – nor whether child or family characteristics increase the likelihood that parent preferences match a child's placement.

Objectives:

1. We examined the association between parent preference for child special education placement and placement of child in special education services.
2. We examined whether child or family characteristics predicted an increased match between parent preference and their child's special education placement.

Methods: The sample included 48 preschool aged children with autism receiving community-based services. Participants completed developmental and diagnostic assessments (i.e., Mullen Scales of Early Learning, Autism Diagnostic Observation Schedule – 2) and parents completed demographic and developmental forms (i.e., child race, child gender, mother's education, Adaptive Behavior Assessment System [ABAS]). Parents also completed a survey regarding their preferences regarding preschool placement. We also reviewed children's IEPs. We completed descriptive statistics (Objective 1) and employed forward selection logistic regression (Objective 2) to examine the association between child and family characteristics and agreement between parent preference and placement.

Results: Parent reported preferences were as follows: 41.7% autism-only, 22.9% mixed disability, 33.3% inclusion, and 2.1% home. Approximately 48% of parents had children in the placement that was their stated preference. Maternal education, child race, child gender, and ADOS severity score did not predict match between parent preference and child placement. However, lower adaptive behavior scores as measured by the ABAS (p= .03, CI: .82-.99) predicted an increased likelihood that parent preference matched IEP placement.

Conclusions: Approximately half of the children in our sample received special education services in the setting their parent preferred. Demographic variables often associated with oppression (i.e., race, maternal education) were not significant predictors of match between parent preference and child special education placement. Worse adaptive behavior skills were significantly associated with match between parent preference and child special education placement, even after controlling for other covariates. This finding may indicate that parents and the IEP team are more likely to agree on the most appropriate child placement if the child has clear functional difficulties that are best supported in less inclusive environments where a child may receive more individualized support.

419.009 *(Poster)* Autism Severity Changes in Young Children with Autism Are Similar across Distinct Educational Settings

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Background: In Israel and other western countries children with autism are eligible for placement in either special education (i.e., small classes with relatively large well-trained staff) or regular education (i.e., regular class with a minimally-trained educational assistant). In 2018, approximately one third of children with autism in Israel, ages 3-21, were placed in regular education settings and two thirds were in special education settings. There are several advantages and drawbacks to each educational setting. For example, placement in special education is twice as expensive as inclusion in a regular education setting. Remarkably few studies have compared the developmental outcome of children across the two educational settings, which differ dramatically in their structure, content, and cost.

Objectives: The aim of the current study was to compare longitudinal changes in ADOS scores of 2-5-year-old children who were placed in special education versus those placed in regular education.

Methods: We examined longitudinal data from 122 children, who were recruited at the National Autism Research Center of Israel (www.autismisrael.org). All children were 11-65-months old (mean age = 33.25 months) at the time of their autism diagnosis. ADOS scores, cognitive scores, and socio-demographic data was collected twice: once during the initial diagnosis and again 12 to 24 months later during a follow-up assessment. Longitudinal differences in each measure were calculated for each of the children. Measures were compared across groups using t-tests and relationships across measures were examined using Pearson's correlations.

Results: ADOS comparison scores decreased (i.e., improved) slightly over the 1-2-year period between assessments (Mean = -0.7, Std = 2.1). Differences in ADOS comparison scores were similar across educational settings and did not differ ($t(120) = -1.1$, $p = 0.29$). There was a significant correlation between the age of diagnosis and improvement in ADOS scores ($r(122) = 0.279$,$p = 0.002$). Children in the two educational settings did not differ significantly in terms of age of diagnosis ($t(120) = 0.852$,$p = 0.396$) nor in their initial ADOS scores ($t(120) = -0.81$, $p = 0.41$). Children placed in special education did exhibit significantly lower socio-economic level ($t(120) = 2.6$, $p = 0.01$), poorer initial cognitive abilities ($t(86) = 2.79$, $p = 0.006$) and their mother's level of education was lower ($t(97) = 3.21$, $p = 0.002$).

Conclusions: These finding support previous findings regarding the importance of early diagnosis and treatment for longitudinal improvement in ADOS scores. Placement in either special education or regular education settings, however did not have an overall impact on longitudinal changes in ADOS scores. These initial findings suggest that young children with autism develop similarly in terms of social abilities in both setting. Additional comparisons of changes in cognitive abilities, adaptive behaviors, language abilities, and other measures of development are highly warranted for assessing the efficacy of each setting for specific autism cases.

419.010 *(Poster)* Autism and the Right to Education in the European Union

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Background: Research into the effects of inclusion of children with autism in education has surged in recent years and specially after the surge at the international level of the policy that autistic children with special education needs (SEN) should be included in education instead of separated into special schools and that best practices should be applied when addressing these children. However, as of yet, there has not been any large-scale report on how these initiatives have been translated into national policy.

Objectives: To investigate all 28 European Union (EU) Member States' SEN and autism policy; aiming to create a comparative policy analysis that will culminate into one report of the differences that are observed in autism educational policy across the EU. The work carried out in this project aimed to first map international, EU and national autism policies in the field of education across these 28 countries.

Methods: We used an analysis of policy path interdependency that drew on past and current international, EU, and national policies in the field of SEN and autism from 1948 up to date. Path dependence approaches allow the identification of policymaking patterns and establish influences and interrelations among policies in linear layers of temporality. It also enabled policy process-tracing, which (1) aims to explain what factors are present in critical policy junctures, (2) aims to create a reference framework and depict how decision processes come to conclusions, and (3) aims to describe how behaviour that takes place in different stakeholders as a response to external factors affects different institutional. We used a timeline to show connection and overlap between policies to enable further analysis. This enabled the interpretation of policy creation as historical sequences and patterns and allowed for the identification of path dependence.

Results: The values of the Universal Declaration of Human Rights and the Convention on the Rights of Persons with Disabilities have been closely translated into the respective education systems of the countries under study, offering special education needs services and support in mainstream education with the aim of including as many children into mainstream education as possible, regardless of the vast differences in education systems.Additionally, fragments of a segregated system are still in place across the EU in order to account for the development of children with SEN that are unable to attend mainstream education due to their condition. Proper teacher training was found to play a significant role in addressing SEN adequately in classrooms, while family involvement was generally limited to social support of the child.

Conclusions: All countries under study have incorporated the values of the international documents in their respective education systems, while emphasising the need to include as many children in the mainstream system as possible.Remnants of a segregated system ensure the inclusion of all children with autism in the education systems of the EU.

419.011 *(Poster)* Bullying Victimization Experiences of High Schoolers with ASD

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Background:

A growing body of research suggests that youth with autism spectrum disorder (ASD) are more likely than their typically developing peers to experience bullying victimization. Although specific rates are difficult to ascertain due to varying definitions and measurement procedures, a meta-analysis of 17 studies estimates that 44% of youth with ASD have been victims of bullying (Maïano, Normand, Salvas, Moullec, & Aimé, 2016) with a range of 7% to 80% of youth with ASD being bullied. Compared to the U.S. Department of Education's indication that 20.8% of the general population of middle and high schoolers report being bullied at school (Lessne & Yanez, 2016), this rate within the ASD student population is alarming. However, the known heterogeneity of symptomology and experiences of individuals with ASD presents a challenge for understanding potential risk and protective factors against victimization within schools. The existing research variably addresses individual and contextual heterogeneity related to school factors, associated diagnoses, and adaptive skills.

Objectives:

1. Determine the rate of teacher-reported victimization for high school students with ASD
2. Examine whether victimization rates vary based on individual characteristics (i.e. race, cognitive ability, ASD symptom severity, adaptive behavior, comorbid mental health diagnoses) or school experiences (i.e. time spent in general education classroom, educational program quality).

Methods:

This secondary data analysis included 136 students (age 13-22) in 30 high schools in North Carolina, California, and Wisconsin participating in a larger ongoing study of high school programs. The dependent variable of interest was teacher report of victimization experiences (physical verbal, social, or cyber). Potential predictor variables were based upon special education classification of autism and time spent in general education, parent-reported demographics and other diagnoses, and standardized measurements of symptom severity (Social Responsiveness Scale), adaptive behavior (Vineland-II), nonverbal IQ (Leiter-3), and program quality (Autism Program Quality Rating System). Analysis included descriptive statistics of victimization frequency and group comparisons between victimized and non-victimized students using t-tests and chi-squared tests.

Results:

The secondary data analysis revealed 14% of the student sample had experienced some type of victimization within the last four weeks. For students experiencing victimization, 2.2% experienced physical bullying, 9.6% experienced verbal bullying, 10.3% experienced social bullying and 0.7% experienced cyber bullying. In total, 47.4% of student experienced more than one type of bullying. Victimized and non-victimized groups did not differ significantly on any individual characteristics or school experiences.

Conclusions:

This study indicated a lower prevalence of victimization experiences among students with ASD than has been reported by others. This may reflect improvements in anti-bullying initiatives and inclusion of students with ASD, but could also signify underreporting by teachers. Additionally, previous research has suggested links between victimization and higher-functioning ASD, mental health comorbidities, and general education settings, none of which appeared in this analysis. Such lack of associative findings may relate to the complexity and heterogeneity of the autism spectrum, suggesting that individual variables cannot adequately capture differences in risk. Future studies should consider differences in teacher, parent, and self-report of victimization and use larger samples for more complex analysis.

419.012 *(Poster)* Characterization of Schooling of a Sample of Preschoolers Diagnosed with ASD in Uruguay in Low and Middle Class Patients

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Background: In recent years, reflections and debate regarding the right to quality education for everyone, moving from a view based on access to schools from one based in the quality of the learning achievements has deepened. In Uruguay, legislation meant to guarantee access to quality education to persons with disabilities exists. However, various difficulties in access to schooling is frequently noted in clinical practice. Moreover, teachers lack necessary supports to ensure successful educational inclusions. Education in Uruguay is mandatory as from 4 years of age, however it is an extended practice in our culture that children are schooled early in development, commonly around two years of age. The increase in early diagnosis of Autism Spectrum Disorders (ASD), together with the aforementioned paradigm changes towards inclusive education, bases the importance of deepening research in this area.

Objectives: Determine the frequency of preschoolers with ASD who attend and don´t attend school, number of hours of those schooled

Determine the amount of hours preschoolers of hour sample attend school.

Look for association between different variables, such as social class, severity of ASD, Access to language and presence of challenging behaviors and access to school.

Methods: a cross-sectional, descriptive and exploratory study, of two different settings public hospital and private office a child psychiatrist who specializes in ASD. Subjects: 34 preschoolers aged between 2 and 5 years of age who were referred to the outpatient clinic specialized in ASD at Centro Hospitalario Pereira Rossell in the period august 2018 august 2019 and receive an ASD diagnosis base on clinical evaluation and ADOS administration. A sample of preschoolers of the same age range referred during the same period to a psychiatrists private office is currently being analyzed.

Instruments: Data were taken from clinical records, if necessary telephone interviews were conducted. Information considered was the one obtained during the first visit. Data wew anlyzed using Excel . Ethical aspects were considered.

Results: More than half (68%) of preschoolers with ASD in the low socio economic sample are under-schooled, the reasons are diverse, predominantly lack of resources in the school and comorbidity with challenging behaviors as reported by parents. The average number of school hours in that sample is 2.2 hours per day. Given the low number of children who were with the personal assistant resource (n=7), the incidence in the adaptation process could not be assessed. Results in the middle class sample are being processed. We expect to see if there are differences in the aspects considered in the middle class sample.

Conclusions: In low class sample access to school in children with moderate and severe ASD is highly compromised. Reasons for this are varied, focusing in lack of resources as well as challenging behaviors not part of ASD core symptoms. Children with mild ASD have better access to school, but still tend to have reduced schedules and poor support. . We expect to conclude if there are differences in access to school in the private and public setting and possible reasons.

419.013 *(Poster)* Child and Family Predictors of the Emergent-Literacy Skills of Children with Autism

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Background: There is an emerging body of research on emergent literacy and its role in the acquisition of conventional literacy skills for children with autism. Children with autism tend to have a discrepant profile of strengths in code-related skills (i.e., alphabet knowledge) but meaning-related skills that seem to lag behind their peers. However, there is significant variance in emergent-literacy skills for children with autism. The heterogeneity in emergent literacy has been found to be related to autism severity, oral language, and nonverbal cognition. It is unclear whether other child variables (gender, age, race, preschool attendance) or family SES variables (education, income) are related to the variability in children with autism's emergent-literacy skills.

Objectives: Therefore, we examined three research questions: (1) are there differences in the emergent-literacy skills of children with autism in comparison to children with language impairment (LI) and children who are typically developing (TD)?, (2) What are the child and family predictors of gain in emergent-literacy skills for children with autism?, and (3) what are the child and family predictors of gain in emergent-literacy skills for children with autism in comparison to children with LI and children who are TD?

Methods: Data for the current proposal represent children with autism (n = 33), children with language impairment (n = 93), and children who are typically developing (n = 503) from the larger sample. Measures of emergent-literacy skills included four subtests from the Phonological Awareness Literacy Screener (PALS; Invernizzi et al., 2004): uppercase letters, lowercase letters, book and print awareness, and name writing.

Results: Results indicated that children with autism had similar scores on alphabet knowledge tasks (uppercase and lowercase letters) in both the fall and spring of preschool as children with LI and children who were TD. However, there were significant differences for the book and print awareness and name writing tasks, such that children with autism were lagging behind both children with LI and children who are TD in both the fall and spring. None of the child or family variables were significant predictors of children with autism's residualized gains in any of the emergent-literacy skills. However, for both book and print awareness and name writing results indicated that children with autism were scoring about 3 points lower than their peers on the book and print awareness task and 2 points lower than their TD peers on the name writing task when controlling for child and family variables.

Conclusions: First, when examining the descriptives, the findings from this sample align with much of the previous research on children with autism's emergent-literacy skills – strength in alphabet knowledge and a weakness in print knowledge. In addition, children with autism also seemed to lag behind their peers in name writing. Second, child and family variables do not seem to be related to children with autism's gains in emergent-literacy skills; however, when controlling for child and family variables autism status was a significant predictor of book and print awareness and name writing.

419.014 *(Poster)* Comparison between Strategies in Expository Text between Children with ASD and Typical Development

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Background: Reading comprehension (RC) is the ability to extract meaning from a written text. Understanding RC in ASD is vital since, according to recent studies, 65–73% of school-age children with ASD have RC difficulties.

Objectives: Only one study to date compared reading strategies within ASD, and only a few examined strategies that facilitate expository text RC. The purpose of this study was to compare two reading strategies (main idea [MI] or graphic organizer [GO]) to see which would enhance expository-text RC abilities within ASD. The study is novel in three significant aspects: a) examination of group improvement (ASD/TD) of RC abilities following the use of RC strategies;b) comparison between two expository text RC strategies and c) comparison of open-ended /close-ended comprehension questions.

Methods: Participants: 56 third-grade children from central Israel: 28 ASD (2 girls, 26 boys); 28 TD (11 girls, 17 boys). There were fewer female participants in ASD, following the uneven gender ratio in ASD. All participants had VIQ of 75 or above (PPVT-III; Dunn & Dunn, 1997). Participants were matched for VIQ and SES.

RC was assessed via two expository texts, which were matched on the complexity level. Four questions examined explicit knowledge (two open-ended and two close-ended questions), and four questions examined implicit knowledge (two open-ended and two close-ended questions). Half of the participants were taught the MI strategy, and half were taught the GO strategy.

Results: Without strategy: significant group difference for implicit knowledge $F(1,52)=4.98$, p=.03, $\eta^2=.09$.

Improvement with strategy: No significant group effect. The effect without the strategy score retained a negative trend, with a regression to the median. Children who had a lower RC score without strategy improved more than the children who had a higher RC score, beyond group (ASD / TD)

Comparison between the two strategies (MI / GO) for improvement measures.

A significant effect only for GO beyond group (ASD/TD(was found for:

improvement of understanding implicit knowledge $F(1,51)=6.48$, p=.01, $\eta^2=.11$; answering close-ended questions $F(1,51)=7.02$, p=.01, $\eta^2=.12$; and for the general reading comprehension score $F(1,51)=4.45$, p=.04, $\eta^2=.08$.

Comparison between the two strategies (MI / GO) within groups.

ASD group: only with GO significant improvement in close-ended questions (b=-1.58, p=.007); in general RC score (b=-1.49, p=.03); and close to significant improvement in implicit information (b=-.97, p=.06)

TD group: non-significant improvement.

Conclusions: The findings before the strategy use highlight the complexity of understanding expository texts within ASD. The study's findings expand empirical evidence concerning RC strategies specific for expository texts and can be implemented into daily practice in educational settings for children with ASD. GO strategies significantly improved RC abilities for ASD, giving strong support to the recommendation to teach RC skills through GO strategies. This finding has substantial practical educational bearing since RC interventions need to be designed according to students with ASD unique needs. A further contribution is the comparison of question format, which influences RC abilities. The improvement found may be due to the activation of more efficient search behaviors activated following the use of the strategy.

419.015 *(Poster)* Effectiveness of an Online Program Using Manga to Change Japanese High School Students' Attitudes Toward Individuals with Neurodevelopmental Disabilities

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Background: The World Health Organization (2001) has presented the International Classification of Functioning, Disability, and Health (ICF) as a more comprehensive model of disability. Based on the ICF, stigma from others is one of the environmental factors and a barrier to participation for students with neurodevelopmental disabilities (ND); hence, we have to develop not only interventions for individuals with ND, but also educational programs for other students.

Furthermore, knowledge about Autism Spectrum Disorder (ASD) was shown to be an important factor in decreasing stigma toward ASD. We found that educational programs, a face-to-face program for high school students (Torii et al., 2016), and online training for undergraduates (Someki et al., 2018), decreased the misunderstanding and stigma associated with ASD.

In this study, we developed an online educational program to decrease stigma in high school students using manga, which is very popular in Japanese culture. For example, "With the light," a famous manga about ASD, has been changing knowledge of ASD all over the world. Therefore, we think an online program using manga could be useful in decreasing the stigma toward ND in high school students.

Objectives: To investigate the effects of the online educational program "Understanding Neurodevelopmental Disability -Introductory Course" (UND-IC) on high school students

Methods: Participants: A total of 476 high school students, comprising 181 males and 285 females (10 unspecified). Their grade levels were K10 (336), K11 (58), and K12 (82).

Materials: The online questionnaire consisted of 2 items on previous experiences with people with disabilities, 13 items on knowledge about ND, 6 items on social distance toward ND, and 6 items on their interest/behavior toward people with ND. The UND-IC consisted of 69 slides in which a Japanese high school student explained his Attention-Deficit/Hyperactivity Disorder (ADHD) disability, ASD disability, another ND, and the social model of disability.

Procedure: The introduction and questionnaire were posted on the SurveyMonkey website. Participants took a pre-test and a post-test with the UND-IC. All of these contents were shown on the website.

Results: About 206 students had positive experiences with people with ND, whereas 25 students had negative experiences; 192 students had neither positive nor negative experiences.

Many students answered "I have no idea" about items on knowledge of ND (symptoms, difficulties, development and course). Before the UND-IC, 65.8% of students had no experience of volunteer activities, 68.9% did not invite peers with ND to participate in activities, and 47.3% did not watch TV programs or news about ND or talk about ND with their friends or family. However, after UND-IC, over 70% of students changed their interest/behavior, although the knowledge score did not change.

Conclusions: For high school students, it was difficult for them to understand knowledge regarding ND, its symptoms, difficulties, development and course. However, an online program using manga could help them empathize with their ND peers. Explaining ND using manga characters aided high school students to develop empathy toward individuals with ND. In this study, we found that knowledge had no direct effect on decreasing stigma toward ASD.

419.016 *(Poster)* Effects of Peer-Mediated Intervention Strategy to Increase the Social Interactions of a Kindergartener with Autism Spectrum Disorder

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Background: Research has examined the role peers play in promoting social-emotional and play skill development in young children with autism spectrum disorder (ASD; Sperry et al., 2010). Peer-mediated interventions (PMIs) provide environments to promote the development of joint interactive play (JIP), which is an appropriate, functional behavior for students with ASD as play with peers helps improve social, emotional, language, academic, and cognitive abilities (Coolahan et al., 2000). Traditionally, most PMIs involve formal peer and teacher training to promote the successful engagement in positive social interactions between peers and students with ASD (McGrath et al., 2003). However, research is limited on the effects of PMIs without formal peer training related to the interactions between typical peers and students with ASD.

Objectives: The purpose of the study was to investigate the effects of a PMI strategy to increase JIP between a Latina kindergartener with ASD (Camila) and a typically-developing peer (Kate).

Methods: A withdrawal design (Gast, Ledford, & Severini, 2018) was used to evaluate the effectiveness of a PMI procedure for increasing percent engagement in JIP and/or attempts to engage in JIP. Prior to the intervention, neither Kate nor Camila received any training, and only one brief 30 min teacher training was needed to achieve reliable implementation of the PMI strategy. The intervention involved a teacher verbally prompting Kate to interact with Camila only in the instance that one minute passed without the occurrence of JIP or an attempt from Camila to interact with Kate. Data was collected on the following variables: percent engagement or attempts to engage in JIP, number of verbal prompts, and number of praise statements. The investigator and reliability data collectors gathered interobserver agreement and procedural fidelity data.

Results: Researchers evaluated the level, trend, variability, consistency, overlap, and immediacy of effects within and between baseline and intervention conditions. Figure 1 shows the percent of intervals of JIP during baseline and intervention conditions. The results indicated a functional relation between the use of the PMI strategy and an increase in JIP. Comparing the first baseline and intervention phases, an increase of 31.77% percent engagement in JIP was observed. When the intervention was withdrawn, engagement in JIP decreased to an average of 21.34% during the second baseline before increasing to an average of 47.77% during the second intervention phase.

Conclusions: Results of the current study provide a unique contribution to the literature by extending minimal research available on implementing PMIs without peer training. Findings highlight the effectiveness of an efficient, easy-to-implement PMI strategy. This is especially relevant in general education settings where teacher and instructional time is predominantly focused on academic instruction, with instruction on social-communication skills receiving lower priority. Given that teachers report limited time to plan and implement interventions as a barrier to implementation of classroom-based interventions (Wilson & Landa, 2019), it is important to identify strategies, like the one used in the current study, that are both efficient and involve others (e.g., peers) in the promotion of the social-communication of students with ASD.

419.017 *(Poster)* Emergent Literacy Profiles of Kindergarten Children with ASD: Implications for Educational Practice

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Background: There is evidence that children with autism spectrum disorder (ASD) may exhibit heterogeneous abilities in reading and reading-related skills. Though many studies have concluded that many children with ASD may conform to a “hyperlexic” profile of reading (e.g., average phonological awareness and word-reading abilities coupled with poor comprehension abilities), there is also evidence that many students with ASD demonstrate concurrent phonological awareness disturbances alongside comprehension deficits. Early precursor skills such as phonological awareness and alphabet knowledge are predictive of later reading development. Therefore, understanding emergent literacy heterogeneity in children with ASD will help inform intervention and educational practices to better support these students in their early elementary years.

Objectives: The goal of this study was to identify unique profiles of emergent literacy skills in a sample of kindergarten children with ASD.

Methods: This study uses data from *N*=626 students with ASD who were assessed using the Phonological Awareness Literacy Screening (PALS), which is a statewide screener for difficulties in phonological awareness and other emergent literacy skills (i.e., rhyme, beginning sound, alphabet knowledge, concept of word and developmental spelling). Utilizing LPA, empirically derived profiles of emergent literacy at kindergarten entry will be presented.

Results: Many of the children in this sample demonstrated below average abilities in the emergent literacy constructs, though initial results support the emergence of four distinct profiles based on discrepancies across constructs. This model allows for an examination of similarities and differences in the profile-specific performance levels across skills.

Conclusions: There is evidence that supports different emergent literacy profiles in a large sample of young children with ASD. To develop the most effective reading interventions for students with ASD, we must acknowledge that these instructional methods must be tailored to meet the specific reading needs of individual students. These findings allow for a better examination in the relationships between emergent language and reading skills in children with ASD that will be crucial in developing targeted literacy interventions to support these students.

419.018 *(Poster)* Emergent Literacy Profiles of Kindergarten Children with ASD: Implications for Educational Practice

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419.019 *(Poster)* Emergent Writing and Reading Profiles of Preschool-Age Children with Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) exhibit heterogeneous development in reading and writing skills across the school-age years. However, few large-scale empirical studies have examined how their earlier emergent literacy skills support later reading and writing skills. Examining these skills is important to understand both later reading-writing development as well as to develop appropriate, targeted literacy interventions across the school-age years that meet the literacy needs of children with ASD.

Objectives: This study used latent profile analysis (LPA) to empirically derive profiles of emergent literacy skills (i.e., early reading and writing skills) in a large, state-wide representative sample of preschool children diagnosed with ASD. This study also sought to examine how profiles differed on later 3rd-grade performance in reading and writing on state-wide Standards of Learning (SOL) assessments.

Methods: Data for this study come from de-identified, state-level data of approximately 600 children with ASD from a southeastern state in the United States. Data were collected as part of the state-wide Phonological Awareness Literacy Screening (PALS) assessment that screens for difficulties in and monitors progress across phonological awareness and emergent literacy development in children in preschool through 3rd grade. The accessed de-identified, archival data used in this study were approved under the university's Institutional Review Board. The PALS Preschool (PALS-PreK) assessment battery assesses emergent literacy skills in both early writing (name writing) and early reading (alphabet knowledge, beginning sound awareness, print and word awareness, rhyme awareness, and nursery rhyme awareness). SOL tests in reading and writing are annual assessments that measure how well students are meeting the state's expectations for learning and achievement. Pass/fail rates for reading and writing SOL tests at 3rd grade were examined in this study. LPA was used to examine if subgroups of children demonstrate varying levels of strengths and challenges across early writing and reading skills. Profiles were then compared on their pass/fail rates on 3rd-grade SOL tests.

Results: Initial results support the emergence of multiple distinct profiles based on differential performance across reading and writing skills. Findings will be discussed reflective of profile-specific performance levels across reading and writing skills to examine to what extent derived profiles differed in individual reading and writing skills. Profile comparisons on later 3rd-grade reading and writing SOL performance will be further discussed during the presentation.

Conclusions: Little empirical research has examined emergent reading and writing skills. Most prior studies have focused on individual literacy skills or relied on small, limited samples. This study drew from state-level data and supports the need for increased research in understanding the heterogeneous development of early reading and writing skills in children with ASD. Findings are beneficial to both researchers interested in understanding the relationships between language, reading, and writing in children with ASD and to educators developing and implementing instructional practices to support reading, writing, and broader literacy development in children with ASD.

419.020 *(Poster)* Estimating the Prevalence of Autism Among Postsecondary Students in the United States

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Background: How many postsecondary students have autism? Although this question is seemingly simple and straightforward, the current literature does not provide adequate evidence to provide a solid answer to this most basic of questions. To date, only two studies (Wei et al., 2015; White et al., 2011) appear to have attempted an answer, both of which have critical limitations that prevent either from yielding an authoritative figure. Extrapolation from these studies to estimate the total number of college students in the United States have autism would yield results that range from fewer than 80,000 to nearly 400,000, both of which likely underestimate the real number of students. Without a trustworthy estimate, it will remain hard to convince college administrators or policymakers that this population has reached a critical mass warranting our collective attention.

Objectives: This study's ultimate goal is to generate trustworthy estimates regarding the prevalence of autism among college students in the United States.

Methods: This study reviewed information from nationally representative federal datasets, reports from assessment instruments widely administered to college students, and empirical data presented in scholarly publications. In reviewing these sources, we examined data derived from any of four distinct approaches from which we might estimate the prevalence of autism among postsecondary students in the United States: 1) tracking autistic students after they leave high school, 2) screening for autism or requesting self-disclosure from a cross-section of college students (not just those known to have autism), 3) identifying the frequency of postsecondary attendance among a cross-section of autistic adults, and 4) asking campus disability service offices about the number of students who formally disclose an ASD diagnosis to their institution.

Results: Our examination of wide ranging data sources and employing multiple approaches to data collection reveals the paucity of empirical evidence from which we may generate plausible estimates of autism's prevalence in postsecondary education. Fewer than 20 of the 390 journal articles we screened appear to pursue any of the four approaches from which we could derive national estimates. Moreover, the vast majority of those articles draw from small or idiosyncratic samples that make them unsuitable for extrapolation. Only 1 of the 12 student surveys asked questions that would allow the disaggregation of autism from other disabilities. Among federal datasets, beyond the widely cited NLTS-2, only one USDOE study offers any data that might yield viable estimates; none of the Census Bureau's data sources appear to hold any such potential. Forthcoming analyses of these sources will allow us to generate context-specific and empirically grounded estimates of autism's prevalence in higher education.

Conclusions: Limitations affecting previous studies limit the utility of estimates derived exclusively from individual datasets. However, by combining evidence from multiple data sources--federal datasets, college student surveys, and scholarly publications--we can generate plausible estimates of autism prevalence among college students. These estimates may be critical to ensuring that the growing population of college students with autism receives appropriate attention, support, and resources from their postsecondary institutions.

419.021 *(Poster)* Evaluating the Effectiveness of a Psychoeducational Training Video for Improving Recognition of Autism

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Background: Understanding of autism in both the general population and in frontline clinical, social and educational services is often limited (e.g. Heidgerken et al., 2005; Tipton & Blacher, 2004). This partly relates to the complexity of autism; the signs of autism vary between individuals and can often be subtle. Training has been shown to effectively increase knowledge of autism (e.g. Obeid et al., 2015). However, training packages are not often evidence-based and empirical testing of their effectiveness is rarely conducted. In response to this, our group developed an 18 minute training video, The Birthday Party (see www.autismchildsigns.com). The film integrates the 14 most discriminating items (Carrington et al., 2015) from the Diagnostic Interview for Social and Communication Disorders (Leekam et al., 2002; Wing et al., 2002), supplemented by information from the UK National Institute for Clinical Excellence guidelines on autism. The film highlights five 'SIGNS' (**S**ocial interaction; **I**magination; **G**estures; **N**arrow interests; **S**ensory responses) of autism and focuses on three autistic children (two boys and one girl) attending a birthday party.

Objectives: To assess the effect of The Birthday Party psychoeducational training video on the recognition of autism in undergraduate students.

Methods: Seventy-one undergraduate students participated (55 female; mean age = 19.15 years, SD = 1.56). Half (N = 36) were shown The Birthday Party film and half (N = 35) were shown an educational film about dyslexia. At baseline, groups were matched on previous knowledge of autism (Autism Awareness Survey; Gillespie-Lynch et al., 2015; Tipton & Blacher, 2014) and previous contact with autistic people (Level of Contact Report; Holmes et al., 1999). Following video presentation, we assessed recognition of autism by presenting participants with ten clinical vignettes that described four autistic children, four children with other childhood disorders, and two with no disorder. Participants had to identify the correct diagnosis for each vignette as well as indicate confidence in their judgement.

Results: Participants who watched The Birthday Party film were significantly better at recognising autistic children from clinical descriptions compared to participants who watched the control film. The group that watched The Birthday Party film were specifically more confident than the control group in making decisions about the autistic children, although there was no overall group difference when all vignettes were considered.

Conclusions: Training materials are commonly used to support autism education, but few have an evidence-base or have their effectiveness tested empirically. Our data establish that The Birthday Party has a significant impact on the ability of undergraduate students to recognise autism, which was reflected in elevated confidence in judgments. The film is freely available film available in six languages and has been used in 12 countries to date. Future research should investigate the effect of the film on improving knowledge of frontline professionals, as well as empirically examine the effect of the film in changing attitudes about autism.

419.022 *(Poster)* Evaluating the Effects of a Commitment Emphasis Consultation Model to Increase Teacher Implementation of Autism Specific Assessment

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Background: There are several effective treatment methods and evidence based practices (EBP) for teaching children with Autism Spectrum Disorders (ASD). It is often overwhelming for teachers to identify and implement available best practices with fidelity in the absence of ongoing training and support (Alexander, Ayres & Smith, 2015). One way to affect teacher implementation and behavior change is through different consultation styles, including performance feedback or a commitment emphasis approach. Performance feedback is a widely used and effective method to improve teacher implementation and treatment fidelity (Burns, Peters & Noell, 2008). A commitment emphasis model is a social influence strategy, which also shows continuing support for teacher behavior change (Noell et al. 2005).

Objectives: To compare a performance feedback model with a commitment emphasis plus prompt model of consultation to increase teachers' completion of a curriculum-based student assessment for students with ASD.

Methods: Participants consisted of 29 new K-5 autism support teachers in an urban school setting, receiving 13, 1.5 hour consultation visits over the course of the school year. Participants were randomly assigned using a between group design. The study consisted of a control group which included teachers being coached using a performance feedback approach and given initial prompts to complete the Student Learning Profile (SLP), a curriculum based assessment, and an experimental group where teachers were coached using a performance feedback model plus commitment emphasis and given prompts throughout their consultation to complete the SLPs. All coaches followed a standardized script and met procedural fidelity. Coaches used an implementation checklist based on teacher's needs and pre-established consultation approach. Two types of outcomes were collected, assessment completion and time to completion at beginning and middle of the school year.

Results: Findings indicate a significant effect for teacher SLP completion at time-point one for teachers' in the experimental group using a commitment emphasis model. Students of teachers in the treatment group had, on average, 25.8 times the odds of SLP completion than students in the control group (*logit*=3.25; $p<.05$). Results also indicated that t teachers in the control group took 1.2 times as long to complete their students' SLPs than teachers in the treatment group.

Conclusions: The use of behavioral consultation strategies in classroom-based settings has continued to show efficacy throughout many studies. Recent research has explored the use of approaches including social influence strategies such as commitment emphasis and prompts (Noell et al. 2005). The current study shows preliminary results to support the work by Noell and colleagues, which shows the use of social influence strategies as an effective approach to changing teacher behavior, including the use of intervention implementation and assessment completion. The use of EBPs for individuals with ASD is imperative to the success of students as well as the teachers in classroom-based settings and should be a priority of all clinicians, researchers and educators and policy makers.

419.023 *(Poster)* Examining Idiographic Approaches for Monitoring IEP Goal Progress in Children with ASD across Ages

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Background: Children with ASD have shared difficulties in social, communication, and learning skills. Progress monitoring and outcome assessment is a challenge faced by special educators. Often, we measure the progress of goals with nomothetic assessment; however, nomothetic approaches may be less sensitive in observing different levels of baseline performance, intervention plans, and intervention outcomes, compared to idiographic measures.

Objectives: One objective of the study is to determine the relationship between parent and teacher report of child progress on IEP objectives and an objective assessment of the same goals from an independent observer using goal attainment scaling (GAS). Another objective of the study examines whether the relationship between parent, teacher, and an independent observer remain stable across age groups.

Methods: Data were collected from a secondary analysis of two RCT's of the Collaborative Model for Promoting Competence and Success (COMPASS). COMPASS consists of a parent-teacher consultation and four coaching sessions. A shared decision-making approach is used for goal selection and intervention planning. At the end of the year, parents and teachers completed both nomothetic and idiographic measures of IEP progress.

Parents and teachers assessed IEP goal progress with a Likert-type scale questionnaire. Parents and teachers were asked to think of where the student was at the beginning of the school year with the specific goal and rate how much progress had been made to date using a 5-point scale for each goal. Informants' judgments of goal progress were internally consistent across the three goals for the parent measure (α = .81) and the teacher measure (α = .69).

Psychometrically equivalence tested goal attainment scaling (PET-GAS) was used to evaluate IEP progress by an independent evaluator. Each GAS used a 5-point rating scale: -2 = *student's present levels of performance*, -1 = *progress*, 0 = *expected level of outcome by the end of the school year*, +1 = *somewhat more than expected*, +2 = *much more than expected*. PET-GAS pre- and post-treatment ratings were based on video demonstrations, work samples, and/or data collected.

Results: Data were analyzed using partial correlations controlling for group assignment. Significant correlations were found between parent report and independent evaluator's report on student's progress in communication and learning goals, not social goals (See Table 1) for children ages 3-8. For the same age group significant correlations were found between teacher report and independent evaluator's report on student's progress for all three goals (See Table 1). Sample size differs for each group. Data regarding transition age students will be analyzed at a later date.

Conclusions: Results indicate significant correlations between the majority of GAS ratings and teacher /parent ratings, and there is evidence supporting the use of idiographic measures for children with ASD in early childhood. Results examining transition age children will be analyzed and compared to make conclusions regarding idiographic measures across age groups.

419.024 *(Poster)* Examining the Effectiveness of a Multimodal ASD Training Program for Medical Students

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disability characterized by core deficits in social communication and restricted, repetitive behaviors[1]. Individuals with ASD have been found to utilize healthcare services at a higher rate than their typically developing peers[2–4]. However, healthcare providers have also reported a lack of knowledge on how to best interact with patients with ASD[2–4], suggesting a need for additional training for medical professionals[5]. To address this gap, The Autism Program at Boston Medical Center (BMC) integrated and delivered a 90-minute "Autism 101" training into third-year medical student curriculum at the Boston University School of Medicine during their psychiatric rotations.

Objectives: To increase self-reported familiarity with: ASD, techniques for accommodating patients, comfort examining patients, and communicating with patients.

Methods: 205 third-year medical students participated in monthly "Autism 101" trainings throughout 2018-2019, which includes a parent panel that provides critical insight into patient and family experiences. Topics covered include definition, presentations, and associated diagnostic criteria of ASD; barriers faced by patients with ASD and families in the hospital; and strategies to facilitate interactions with patients with ASD. Medical students were asked to complete a pre-training and post-training survey, consisting of quantitative and qualitative items. The survey was developed to assess the training objectives, by asking students to rate statements on a 5-point Likert Scale (1 = not at all familiar/comfortable, 5 = very familiar/comfortable) on all four aims: familiarity with ASD, techniques for accommodating patients, comfort with exam, and comfort with communication.

Results: An independent-samples t-test was conducted to compare students' familiarity with ASD, techniques for accommodating patients, comfort-level in examining patients, and communicating with patients with ASD. There were statistically significant differences in responses to all four survey items before and after the training (Table 1). In addition, medical students also provided positive qualitative feedback for the training, such as "[this training] is an invaluable resource...as we prepare to be the individuals on the other side of the bed caring for patients and their families", and requested that the training be kept "every year" for medical students.

Conclusions: Medical students found the "Autism 101" training helpful in improving their familiarity and comfort-level with ASD. Integration of ASD education and training into general medical student curriculum nationwide may be beneficial. More research is needed to further evaluate how their familiarity and comfort impacts future behavior.

419.025 *(Poster)* Examining the Practices and Experiences of General Education Teachers Including a Student with Autism

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Background: The number of students with autism included in general education (GE) has been steadily increasing. However, considerable work still needs to be done to address the multiple barriers to effective inclusion for most students with autism. GE teachers consistently report a lack of adequate training, knowledge, and resources to effectively educate students with autism. GE teachers often perceive students with autism to be difficult to teach and in need of specialized instruction that cannot be provided in GE. Linking evidence-based practices for autism to existing training initiatives is one way to address these barriers while minimizing additional burden on teachers. For example, Universal Design for Learning (UDL) is a nation-wide educational initiative with the potential to positively influence inclusion due to the many commonalities with Classroom Pivotal Response Teaching, an evidence-based approach for autism. Understanding strategies GE teachers already use that fit current GE initiatives, such as UDL, and that also overlap with autism-specific evidence-based practices may be a helpful jumping off point for successfully designing professional development opportunities that support inclusive classrooms.

Objectives: This study provides an in-depth examination of GE teacher perceptions and experiences related to including a student with autism in their classroom. We asked teachers about the strategies, tools, and modifications they used to support students with autism. Additionally, we aimed to gain more insight on GE teacher's perceptions and use of UDL and CPRT components.

Methods: Twelve GE teachers participated in focus groups conducted via Zoom, a HIPAA-compliant web-based discussion forum. Recruitment continued until we reached saturation of themes. Focus groups lasted approximately one hour, were co-facilitated by the first two authors, and included one to four GE teachers per group. Teachers taught kindergarten through grade five, had taught at least one student with autism, and represented public, private, and charter schools. We gave teachers brief information about UDL and CPRT with vignettes of hypothetical students with autism so participants had the same reference for discussion, though teachers were encouraged to share their personal experiences. The facilitators used an interview guide to ask teachers about strategies they used to support their students with autism, their perceptions and application of UDL and CPRT strategies, and challenges they encountered or anticipated when using these strategies. We transcribed focus groups and used thematic analysis guided by a grounded-theory approach to identify themes.

Results: Teachers reported using a variety of strategies, include those with a strong evidence-base, to facilitate communication, self-regulation, social interaction, and academic engagement with their students with autism. Most teachers had limited to no direct training in CPRT or UDL but still reported generally positive perceptions, with some negative responses regarding certain CPRT components. Feedback on UDL components was positive overall.

Conclusions: Many GE teachers report using research-supported educational approaches for autism. An important next step for teacher training is to link teacher's pre-existing knowledge and experiences to specific evidence-based strategies for autism to maximize teacher buy-in and minimize burden. This could help ensure good contextual fit of intervention strategies in the inclusive GE classroom.

419.026 *(Poster)* Exceptional Skills in School-Age Autistic Children – Perceptions of Parents and Teachers

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Background: Autism is commonly described in terms of deficits, with most outcome research indicating that autistic individuals have poorer quality of life than "neurotypical peers" of comparative cognitive ability. Nevertheless, the research also indicates that most autistic individuals demonstrate one or more exceptional skills. Using a strengths-based approach to educating autistic children with exceptional skills may equip them to use these skills in ways that foster greater inclusion and a better quality of life in adulthood. To assist educators develop such programs, a better understanding of the exceptional skills of autistic students is needed.

Objectives: This study aimed to examine the (1) rates of exceptional skills in autistic school-aged children: (2) associations between exceptional skills (and skill type) with autism severity and intellectual disability; correlations between parents/carers and teacher reports of exceptional skills.

Methods: Parents and teachers of 74 students attending autism-specific schools in Australia completed an online exceptional skills questionnaire. To provide a measure of autism, parents also completed the Social Responsiveness Scale. The questionnaire gave descriptions and examples of three types of exceptional skills - savant, relative strengths and giftedness. Giftedness refers to high-level abilities i.e. in the top 10% of all children of their age. Parents who had identified their child as having one or more exceptional skills (n=30) were then interviewed by a clinical psychologist to gain further insight and assign a final rating of exceptional skills according to the study criteria. Descriptive statistics identified the numbers of children reported by parents and/or teachers as having one or more exceptional skills. The Kappa coefficient was used to assess agreement between parent and teacher reports, and between parent/teacher reports and clinician ratings. The relationship between the presence of exceptional skills and a diagnosis of intellectual disability was examined using a chi-square test of independence; independent t-tests examined the relationship between skills and autism severity.

Results: Thirty parents (39.5%) and thirteen (17.1%) teachers reported their child/student had at least one exceptional skill. There was poor agreement between parent and teacher reports (Kappa=.175, p=.074). In comparison, 28.9% of the children/students were rated as having at least one exceptional skill by the clinician; the most commonly reported exceptional skills were in memory and reading. No students were rated by the clinician as displaying giftedness. For further analyses, children rated by the clinician as having savant skills or relative strengths were combined into one group. There was no significant difference in autism severity scores or diagnosis of intellectual disability for those with and without exceptional skills.

Conclusions: Parental reports confirm the presence of exceptional skills in around one third of autistic school-age students as reported in previous studies. Although there were no reports of giftedness as rated by the clinician, this may be a result of the sample only comprising students in special education schools, rather than from mainstream settings. The poor agreement between parents and teacher reports warrants further examination.

419.027 *(Poster)* Experiences of Paraprofessionals in Public School Settings

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Background: Paraprofessionals play a vital role in the instruction of students with disabilities, with more paraprofessionals employed in preschool through high school settings than special education teachers (U.S. Department of Education, 2018). Given the importance of paraprofessionals, adequate preparation and training are critical for students to achieve the best outcomes (Brock & Carter, 2013). Unfortunately, many paraprofessionals do not receive preparation or training for their roles, which can lead to low quality instruction for students with ASD (Jones et al., 2012). Professional development is needed for paraprofessionals serving students with ASD to be more successful in their roles, but first it is important to know what responsibilities paraprofessionals currently have in order to teach content that is relevant. Additionally, professional development providers need to know what barriers prevent paraprofessionals from engaging in training.

Objectives: The purpose of this study was to gather information that could serve as the foundation of the development of a professional development program for paraprofessionals working in special education. Specific research questions addressed include: (1) What are the roles and responsibilities of paraprofessionals in school settings? (2) What types of professional development result in applied knowledge for paraprofessionals? (3) What are the barriers to professional development? Secondary research questions explored whether paraprofessionals' responses to these questions differed by the setting (i.e., general education or special education) or grade level (i.e., preschool/elementary or middle/secondary) in which they primarily worked.

Methods: To answer our research questions, we designed and distributed a survey to registered AFIRM users (affirm.fpg.unc.edu) who identified as a paraprofessional working with students with autism in a PreK-12 grade public school setting. Data reflect responses to 16 questions by 325 paraprofessionals who responded to the survey. We conducted descriptive analyses on paraprofessionals' responses to each survey question, and post-hoc analyses to determine if there were differences in paraprofessionals' survey responses by grade level and setting. To correct for the multiple comparisons, we applied the Bonferroni-Holm method.

Results: Paraprofessionals engaged in the following tasks daily: providing (a) academic support, (b) self-help instruction, (c) support in instructional settings, (d) support or supervision related to behavior, and (e) supervision for non-instructional times. Paraprofessionals working in special education settings reported spending significantly more time planning and preparing for student lessons and providing self-help instruction than paraprofessionals working in general education. The major barriers to professional development included a lack of (a) employer support, (b) resources, and (c) money.

Conclusions: Information on the roles and responsibilities that paraprofessionals of students with ASD engage in on a regular basis can help professional development providers design relevant training that is socially valid. Because teachers supervise paraprofessionals on a daily basis, they are naturally the most suited for providing training to paraprofessionals. The information in this study can help researchers planning on designing a model of professional development to be implemented by teachers in school settings for paraprofessionals of students with ASD. Such a model is needed and has the potential to improve the outcomes of school-aged students with ASD (Walker & Smith, 2015).

419.028 *(Poster)* Exploring Autistic Students' Experience of Using Social Network Maps to Address Social Changes When Transitioning to University

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Background: For many autistic students, adapting to a novel social environment at university can be especially challenging. Providing information about the different aspects and functions of social networks may help autistic students carefully consider the purpose of maintaining or establishing new relationships during transition to university.

Objectives: 1) Develop a workshop to generate student discussions about different aspects of SNS in relation to accessing support.

2) Evaluate (mixed-methods) students' experience of using network maps to plan for social transitions when going to university.

3) Gather feedback about the workshop.

Methods: The goal of the workshop was to provide information about *what* a social network is, *why* networks are important for accessing support, and *how* networks might change at the time of university transition. Individualised social network maps for each student were created based on self-reported relationships over the past 3 months (Figure 1). Three groups of 8-10 students (total N= 29) participated in the one-hour workshop. Information was delivered through didactic teaching. Students completed exercises to identify key network members who provided them with support pre-university, and how they would like their social network to change during university transition. Students rated the accuracy of, and satisfaction with their own social network maps on a 5-point Likert scale, and provided written feedback about the workshop. Twenty-seven students (Age: M(SD) = 17.86(2.82) years; 18 Male) completed the personal social network exercises, and two students completed a neutral (non-personal) exercise.

Results: 59% of students rated family to be one of the most important sources of social contact based on their network map, and 40% identified at least one close friend. Students felt neutral (M(SD) = 3.37(1.04)) regarding network satisfaction (p = .097) and found their networks to be somewhat accurate (M(SD) = 3.57(0.98); p = .021). Around 60% of students reflected on losing existing friendships and seeking new peer support when going to university, and 92% expressed wanting to keep some existing relationships, mostly family (44%) and friends (52%) (Table 1a). Students rated the workshop as enjoyable (M(SD) = 3.83(0.76), p <.001) and helpful (M(SD) = 4(0.67), p < .001), especially for social transition planning in preparation for university (M(SD) = 4.07(0.77), p < .001). Students found visualising relationships through network maps both appealing and useful. 52% of students found network maps helped improve their understanding of social relationships between different groups of people within their networks. However, around 14-17% of students found the material confusing, and difficult to be confronted with the paucity of social connections in their network (Table 1b).

Conclusions: Our pilot workshop showed that social network maps allow autistic students to visualise how they access support from different network members in a clearly structured and succinct way and help them plan for social changes when going to university. Future workshops can improve clarity of information presented to match the diversity of students' learning styles and include exercises to buffer distress experienced by students who had limited social networks.

419.029 *(Poster)* Factors Associated with Academic Attainment for Autistic Individuals within a Population-Based Twin Sample.

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Background: Previous research has shown a large proportion of adults with ASD (diagnosed in childhood) leave school without formal academic qualifications (Howlin, 2000). In the non-autistic population, research has shown that factors such as socioeconomic status (Hedges et al, 1999), sex (Voyer & Voyer, 2014), mental health and behavioural difficulties (Kessler et al, 1995, Loe & Feldman, 2007, Breslau et al, 2008), and IQ (Mayes et al, 2009) have a significant impact on academic attainment.

However, there has been limited research into the effect these factors (SES, sex, mental and behavioural difficulties and IQ) have on autistic individuals' academic attainment in comparison to their non-autistic peers, and whether these factors play an equal role in academic attainment, depending on autism diagnosis, and/or degree of autistic traits.

Objectives: This study explored factors that might influence academic attainment, comparing autistic twins, their non-autistic co-twins, and a non-autistic control group selected for low autism traits.

Methods: Three groups of participants were included from a population-based twin-sample: 55 18-year-old twins who met criteria for a research diagnosis of ASD (83% male); 22 non-ASD co-twins (31% male); 50 comparison twins (64% male). Participants completed team-designed questions about education and academic attainment as part of a wider research assessment.

Multiple regression analyses were run to predict total public exam passes at age 18 from autism severity scores (ADOS calibrated severity scores or CAST scores at aged 8 for the control group), IQ, sex, maternal education, and emotional, conduct, peer, prosocial and hyperactivity (from SDQ) for each group.

Results: For the ASD group, the multiple regression model significantly predicted exam passes, $F(9,45) = 4.864$, $p < 0.00$, adj. $R^2 = 0.392$. The following variables significantly contributed to the model for the ASD group: IQ, ASD severity scores, maternal education, emotional difficulties and prosocial difficulties (all $p<0.05$).

For the co-twin group, the multiple regression model was not statistically significant, $F(7,14) = 1.906$, $p = 0.144$, adj. $R^2 = 0.232$. The small number in this group may have limited statistical power. Exam passes were significantly correlated with ASD severity scores and conduct difficulties ($p<0.05$).

For the control group, the multiple regression model significantly predicted exam passes, $F(9,40) = 4.642$, $p<0.000$, adj. $R^2 = 0.401$. On closer inspection, IQ and gender were the only coefficients that significantly contributed to the model (all $p<0.05$).

Conclusions: Academic attainment was found to be influenced by a range of factors, varying by ASD diagnostic status. The ASD group showed that severity of autistic traits and additional mental health concerns may impact on school attainment, indicting areas for possible intervention in educational settings.

419.030 *(Poster)* Following the Footprints: Making an Autism-Friendly Pediatric Emergency Department (ED) in "the Sweetest Place on Earth"

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Background: Children with autism often face negative experiences when accessing healthcare, and autism care plans have been shown to improve patient outcomes. The Autism Spectrum Ambassador Program (ASAP) aims to improve the healthcare experience for children with autism and their families by providing a trained Medical Student Ambassador and Accommodation Plan to facilitate patient-centered care, meeting the child's unique needs in the Emergency Department (ED).

Objectives: To evaluate the utility of this novel program in the ED through the assessment of family, provider, and student experiences.

Methods: Program materials were created by study personnel to educate medical student volunteers to become Ambassadors. The ASAP was initially implemented in the same-day surgery center at Penn State Children's Hospital, and it was adapted for implementation in the Pediatric ED utilizing input from a multidisciplinary team of Child Life Specialists, nurses, providers, and technicians. Parents of children with autism aged 30 months-17 years who present to the ED between 4pm-10pm, Monday-Friday will be consented and provided an iPad to complete an Autism Accommodation Survey (AAS) while in the waiting room. The Accommodation Plan is automatically generated from responses on the AAS and printed as color-coded, provider-specific accommodation cards to be displayed at the bedside (e.g., physicians/APPs, nurses, Child Life, and technicians). A footprint window cling on the patient's door will alert staff to program participation, prompting them to be mindful of the need for making accommodations during the patient encounter. Within three days, all program participants will be emailed a survey to measure program satisfaction. Satisfaction surveys will also be sent to parents of children with autism who did not have a Medical Student Ambassador available during their ED visit, serving as a control group.

Results: The program will officially launch January 2, 2020, and we anticipate preliminary data by March. Although in its infancy, this project has led to increasing the level of acuity at triage if the parent would indicate their child is at risk for aggression with prolonged wait-time as well as new ED-specific accommodations, such as an "If, then" board, social stories, headphones, weighted blankets, sunglasses, and sensory-oriented motivators.

Conclusions: The ASAP continues to work toward improving the healthcare experience for pediatric patients with autism and their families, breaking down barriers that have prevented high-quality patient-centered care through education and advocacy utilizing a multidisciplinary approach. We hope that the ASAP will inspire others to advocate for individuals with disabilities and consider implementing similar programs, following the footprints of the Autism Spectrum Ambassador Program.

419.031 *(Poster)* Heterogeneity in Math and Reading Scores in Students with ASD

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Background: The rate of students with ASD without intellectual disability (IQ > 75; ASD-WoID) has increased in recent years (Baio et al., 2018). As a result, more students with ASD-WoID are spending a majority of their time in general education classrooms (Wagner et al., 2005). However, previous research has pointed to heterogeneity in mathematics and reading performance in children with ASD-WoID and the impact that behavioral and cognitive factors have on achievement (Chen et al., 2018). Further research is needed to understand if these patterns of achievement are reproducible.

Objectives: To examine the heterogeneity of math and reading ability in children with ASD-WoID and the cognitive and behavioral factors that may impact math and reading achievement.

Methods: 121 children participated including 78 children with ASD-WoID (M = 11.33 years, SD = 2.14) and 43 neurotypical controls (M = 11.55 years, SD = 2.27). ASD diagnosis was confirmed with the ADOS-2. Attention symptoms were measured using the Connor's-3, and symptoms of anxiety and depression were measured using the BASC. To gauge academic achievement, participants completed numerical operations and problem solving measures from the WIAT-III and reading fluency and comprehension measures from the GORT-5. Participants also completed measures of verbal, symbolic, and story memory from the WRAML2 and measures of IQ from the WASI2. Participants were clustered on their math and reading scores using hierarchical cluster analysis.

Results: The cluster analysis resulted in a two cluster solution which replicated the clusters of Chen and colleagues (2018). Our two clusters also resulted in a "low achieving" group (LA) and "high achieving" group (HA). The LA group performed below the HA group on all math and reading assessments ($ps < .05$). In both the TD and ASD groups, there were significant differences in IQ between the LA and HA cluster groups, wherein the LA group had significantly lower verbal, performance, and full-scale IQ scores than the HA group ($ps < .05$). In the ASD group, the LA group performed below the HA group on verbal working memory, $t(76) = 4.55$, $p < .01$, symbolic working memory, $t(76) = 5.01$, $p < .01$, and story memory $t(76) = 4.33$, $p < .01$. In the TD group, the groups only differed on symbolic working memory performance, $t(41) = 3.07$, $p < .01$. Behavioral analyses are currently underway.

Conclusions: The findings of this study support those previously reported by Chen and colleagues (2018). There is significant heterogeneity in mathematics and reading performance in students with ASD-WoID. These students can benefit from inclusion in general education classrooms; however, the students in the lower achieving group are at risk for mathematics and reading learning difficulties, possibly related to differences in IQ and working memory. This heterogeneity needs to be anticipated in educational settings. The findings of these studies may help aid educators to identify students who may experience difficulty in mathematics and reading, and to address these issues with appropriate curricular adaptations.

419.032 *(Poster)* Latino Communities, ASD, & Parental Engagement: A Systematic Review of the Literature

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Background: Limited research exists on parental engagement among diverse parents of children with autism spectrum disorder (ASD) (Burke, 2013; Burke & Hodapp, 2016). The U.S. Census Bureau's (2017) most recent American Community Survey indicates that individuals of Hispanic origin make up 18% of the U.S. population with 25% under 18 years of age. This paper will utilize a critical sociocultural framework (Holloway, Cohen, & Domínguez-Pareto, 2018) to examine socioeconomic diversity among Latino families whose children are diagnosed with Autism Spectrum Disorder (ASD) within the parental engagement literature.

Objectives: The purpose of this study was to understand the socioeconomic diversity among Latino parents whose children are diagnosed with autism within parental engagement literature.

Methods: The systematic review met six specific qualifications. Participants/articles had to be (1) From Latin American countries (e.g. Central America, Mexico); (2) Have children with ASD; (3) Child participants of elementary age; (4) Results specific to educational engagement; (5) Published in 2008 or later; and (6) Peer reviewed. Keywords using each of the inclusion criteria were used for searching (e.g. Mexican, autism, involvement) across six databases (e.g. ERIC, PsycINFO). From these databases 1,168 total articles were collected, 17 were selected for final review. Each article was examined using the quality appraisal process (Brantlinger, Jimenez, Klingner, Pugach, & Richardson, 2005; Trainor & Graue, 2014), see Table 1. Using the critical sociocultural framework, key demographics were recorded to examine the various cultural communities of participants (see Table 2) and analyzed to understand between group differences.

Results: A total of 1,100 adult and 275 child participants were accounted for. Half of the articles reported differences across language, marriage status, and child's age but less than half included frequency counts. Additionally, over 50% of the articles did not include demographics such as income, age, or education level of adult participants. There were four key demographic findings; (1) 94% of the articles, indicated that only 20% of adult caregivers (e.g. mother, father, grandparents) are male; (2) Latinos made up 44% of all articles reported, 32% identified as Latino/Hispanic, 9% Mexican heritage, 1.3% Caribbean, 1% Central American, and .9% South American; (3) 59% of articles reported the primary language spoken by participants, 16.3% reported a language other than English, 11% indicated they were bilingual (i.e. English/Spanish); (4) 53% of articles indicated that 94% of the participants were married.

Conclusions: This study utilized a critical sociocultural framework to examine the cultural communities in the final articles selected (Holloway, Cohen, & Domínguez-Pareto, 2018). The sociopolitical and cultural factors are particularly important in the field of special education since culture is often conceptualized through overgeneralizations (Holloway et al., 2018). However, sociocultural characteristics, such as immigration, country of birth, and approximate recruitment location were missing from the majority of studies. If the field intends to move away from generalizing ethnic groups, it is important to include these more nuanced characteristics of sociocultural context given that immigration history, income, and access can vary (Cohen & Miguel, 2018; Hausmann-Stabile, Zayas, Runes, Abenis-Cintron, & Calzada, 2011).

419.033 *(Poster)* Mapping out Autism-Specific College Support Programs in the United States

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Background: Nationally representative statistics from the United States indicate that fewer than 39% of autistic students who enter college complete their degrees (Newman et al., 2011). To improve students' chances for college success, many scholars and practitioners encourage these students to disclose their diagnosis to their institution's Disability Services Office (DSO) and formally request disability accommodations. Yet, emerging research suggests that the most common accommodations (e.g., in-class note-takers, extended test time) are frequently inadequate for students with autism. In response, some postsecondary institutions have created autism-specific programs that incorporate multiple types of supports (e.g., peer mentors, social skills training, tutoring services). Little research about these programs has yet been conducted.

Objectives: This project used a collaborative, systematic approach to identify autism-specific college support programs in the United States and document both institutional and programmatic characteristics. The results will support three groups. First, students and families can pinpoint potential college options. Second, higher educational professionals can create or adapt programs upon identifying peer institutions featuring similar programs. Third, researchers can draw on this data to better contextualize current autism/higher education scholarship.

Methods: Data are drawn from all 4,567 degree-granting postsecondary institutions in the United States (Carnegie Classification of Institutions, 2015). From August 2018 to August 2019, researchers conducted searches for "autism" and "program" off of search bars on each institution's homepage. Pages returned from this search were examined to determine the existence of autism-specific programs. To ensure accurate results, each institution was examined by two different researchers. Whenever initial results were unclear, the research team sent emails seeking clarification from institutional staff and collectively met to reach consensus. To be included in our list, the program must: 1) exclusively or primarily serve autistic students currently enrolled at a college or university; 2) feature a publicly accessible webpage about the program; and 3) be currently active (e.g., not closed or under development).

Results: Only 78 of the 4,567 (1.7%) of degree-granting postsecondary institutions in the United States host autism-specific college support programs. The distribution of these programs varies dramatically across eight distinct geographical regions in the United States. The greatest concentration of programs occurred in the Mid-Eastern region (NY, NJ, PA, DE, MD, and Washington D.C.) where 24 of 722 institutions (3.3%) hosted programs. In contrast, none of the 260 institutions in the New England region (ME, VT, NH, RI, MA, CT) hosted programs. The vast majority of programs were located at 4-year (83.3%) and at public (73.1%) institutions.

Conclusions: While a number of states offer autism-specific college support programs, these are only found in 29 states and a vast majority of programs are situated in 4-year institutions, despite the prominence of autistic students attending community college (Wei et al., 2014). These findings are concerning because they point to the need for many students to attend programs at institutions located outside their home state (thus increasing costs and the emotional labor of living away from home) and within larger 4-year campuses that may not feel as comfortable to them.

419.034 *(Poster)* Measuring the Effectiveness of the Attention Autism Programme on Improving Social Communication Skills for Primary School Children with Autism.

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Background: Social skills encompass the essential socially acceptable learned behaviours that enable a person to successfully interact with others (Gresham and Elliott, 1984). For autistic people social communication situations can be challenging (Sutton et al., 2018).

Interventions which focus on developing fundamental skills in play and attention are thought to support social communication skills in all children (Toth et al., 2006). The Attention Autism Programme (AAP) created by Specialist Speech and Language therapist, Gina Davies, is a novel intervention which utilises an irresistible invitation to attend through play. However, AAP has underwent little formal investigation (McKeown, 2015).

Objectives: This study aims to investigate the effectiveness of the AAP on improving social communication skills for children with autism.

Methods: This study compared the social communication skills of 25 autistic children between of 6 – 8 years pre and post participation in a six week AAP. Certified trainers conducted the AAP with 25 children with autism. The effectiveness of the intervention was assessed using the Social Responsiveness Scale (Constantino and Gruber., 2012); The Joint Attention Task (Bean and Eigsti., 2012); and Video Analyses of the duration of attentional behaviours. Education staff were interviewed to ascertain the effect of the AAP on classroom behaviours.

Results: A Wilcoxon signed rank test revealed a statistically significant increase in the participants observed attentional behaviours between week 1 and week 5 of the AAP $z=-4.28$, $p<.001$, with a large effect size ($r = .605$). The mean observed attentional score increased from 64.2 % in week 1 to 80.7% in week 5 indicating that the participants attentional behaviours improved significantly during the AAP. A statistically significant difference in the duration of communication the participants engaged in during the AAP between week 1 ($M = 9.18\%$) and week 5 ($M = 12.8\%$), $z=-2.03$, $p<.05$, with a medium effect size ($r= .287$) was also evident.

A standard multiple regression was carried out to investigate if the participants scores on JTAT and SRS2 could predict the participants attentional scores based on observations of the AAP sessions in week 1. The results of the regression indicated that the model explained 41.1% of the variance and that the model was a significant predictor of observed attentional performance in the AAP, $F (2, 22) = 7.66$, $p= .003$. While scores on the JTAT contributed significantly to the model ($B=.554$, $p= .003$), whereas the SRS2 scores did not ($B=-.264$, $p=.124$). Further exploration of results using hierarchical multiple regression, revealed that neither the age of the participant or the participants school placement impacted on their attentional abilities during the AAP.

Conclusions: The AAP has been shown to be effective in significantly increasing observed attentional behaviours and in duration of communication in 25 autistic children aged 6-8 across educational settings.

419.035 *(Poster)* Promoting Program Quality for Students with Autism through Coaching

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Background: Federal law requires educators to provide high-quality programs for children with autism. For high school programs, Kraemer et al. (2020) found that program quality was mediocre to poor. However, little is known about program quality for children in elementary schools and the effects of interventions designed to improve quality. A key feature of professional development programs designed to promote program quality is the presence of coaching who provide training and feedback to teachers.

Objectives:

- Describe quality of programs for students with autism enrolled in elementary schools.
- Describe an intervention approach designed to improve program quality.
- Determine how coaching affect changes in program quality across a school year.

Methods: This study took place in 59 elementary schools and was part of a larger randomized control study examining the effects of a comprehensive treatment model. Data were collected in inclusive and non-inclusive programs operating at each school. At the beginning and end of the school year research staff conducted the Autism Program Environment Rating Scale—Preschool/Elementary (APERS-PE) (Odom et al., 2018). The APERS-PE is a 59 item, 5-point rating scale that yields a total mean rating and individual domain scores (across 10 domains). A rating of 5 indicates excellent quality, 3 indicates mediocre quality, and 1 indicates poorest quality.

Results: The internal consistency of the APERS-PE in this study was .93 and .96 for the inclusive and non-inclusive program APERS-PE. Inter-rater agreement checks occurred for 20% of the sample. Interclass corrections between the two raters for the inclusive and non-inclusive programs were .97 and .98 respectively. At pretest there were no differences between the treatment and control groups. For the total group, the mean total scores were 3.10 and 2.96 for the inclusive and non-inclusive programs. A characteristics pattern was for schools to score greater than 3.0 on Environment, Climate, Family and Team, and consistently lower than 3.0 on the intervention domains (Social, Communication, Independence). When changes across the school year were analyzed, the only significant difference was for the social domain in the inclusive programs. However, four of the 11 coaches in the study did not meet expectations for quality of coaching. To determine the impact of coaching on program quality, pre-post APERS effect sizes were calculated for the schools with coaches needing supervision, schools with coaches meeting expectations for competence, and control schools. Consistently, schools with competent coaches had the highest effect sizes across domains, with schools with less competent coaches having effect sizes less than the other treatment schools and often similar to the control schools.

Conclusions: A general finding of this study was that the quality of educational programs for children with autism was mediocre to high for environmental features of the program, but poor for intervention domains. An intervention designed to promote program quality across the school year did not finding consistent difference when compared to the control schools. However, the quality of coaching provided to the intervention schools appears to have a major impact on change in APERS scoring for school in the treatment group.

419.036 *(Poster)* Review of the Use of Immersive Virtual Reality Technologies in Adolescents with Autism

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Background: Autism affects 1 in 59 children and is about 4 times more common boys than girls (Baio, 2018). Children do not grow out of Autism, thus as a result, there is a critical need to identify interventions targeting the unique needs of the growing population of adolescents and adults with Autism. Technologies related to Virtual Reality has the potential to assist people with Autism in practicing and generalizing social skills that can be transferred into the real world. Research has suggested some prospective benefits of using immersed virtual reality technologies [i.e., virtual reality (VR), mixed reality (MR), and augmentative reality (AR)] to improve educational and practical outcomes for adolescents and adults with Autism (Smith et al., 2014)

Objectives: This review aims to (1) determine the number of empirical studies using VR-related interventions, (2) identify the skills targeted in these interventions, (3) describe technology features used and the overall effects, and (4) analyze scientific rigor of these studies (e.g., types of design, reliability and validity evidence related to dependent and independent variables).

Methods: The databases for PubMed, PsycINFO, CINAHL and Web of Science were searched for relevant paper between 2000 to 2018 published in peer-reviewed journals. We coded the following variables: (1) the technology used to deliver the intervention, (2) types of targeted skill(s), (3) demographics (gender, age, cognitive ability and disability), (4) experimental setting, (5) dependent and independent measures, and (6) quality of research. Three independent researchers coded all the studies and inter-rater reliability was checked for 20% of the articles.

Results: VR technology has been used to train school-aged children with Autism in the areas of social and communication skills, driving skills and employment experience. Statistically significant improvement of targeted skills has been found, indicating positive effect of immersive technology applications on students with Autism. Most studies took place in labs using a small convenient sample and very few studies were conducted in natural settings (e.g., homes and schools). The majority of studies focused on social skills and several examined employment related skills such as interviewing skills.

Conclusions: Although immersive technology, such as VR, AR and MR, has been proved to be effective in helping people with Autism improve their behavioral, cognitive and social skills, most studies focused on individuals with Autism who do not have intellectual disability. Future studies need to examine the application of immersed VR technology on improving quality of life for all students with Autism. Researchers should also examine the degree to which skills trained using VR transfer to other settings. Another suggestion for future researchers and technology designers is teacher and practitioner education about the utilization and launching immersive tools to Autism populations. Current studies focus mostly on learning experience and outcomes of students, and experiment settings are strongly context dependent. The promising effect of the VR technology can be enhanced by the aid of effective and efficient pedagogy and training methods.

419.037 *(Poster)* School-Based Autism Rates By State: An Analysis of Demographics, DSM Alignment, and Differential Identification

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Background: Rates of children served under autism spectrum disorder (ASD) special education eligibilities differ greatly by U.S. state. Previous studies indicate that socioeconomic factors, including caregiver income and education, impact ASD prevalence rates (e.g. Thomas et al., 2011; Sullivan, 2013). Additional factors that may impact these differential rates include influences of statewide policy/decision-making, such as ASD eligibility criteria and state political leanings (Barton et al., 2016; Marmor, 2017). Finally, diagnostic substitution, or use of certain labels over others, may determine how often students are being found eligible under different disability categories (Brock, 2006; Shattuck, 2006).

Objectives: First, we seek to provide updated statistics on school-based ASD rates by states and the number of U.S. states using ASD eligibility criteria aligned with medical criteria. Next, we attempt to determine what state-level demographic factors (i.e., median income, education attainment, state political leanings) predict these rates. Finally, we examine state rates of other disability categories that potentially have shared characteristics with ASD, and thus are considered part of the differential diagnosis/identification process in ASD evaluations.

Methods: Data for this study were collected from the U.S. Department of Education website. The data were analyzed for the 50 U.S. states and Washington D.C. To calculate the proportion of ASD and other disability categories, we chose to focus on the proportion of students with that eligibility out of the total number of students receiving special education in each state.

We obtained data on state-level demographic information, including median state household income and educational attainment (number of years of schooling completed for persons 25+), the American Community Survey. Additionally, we utilized the Cook Partisan Voter Index to determine political leanings of each state. Finally, we searched state department of education websites to find state ASD eligibility requirements and determine what criteria were being utilized.

Results: In terms of overall school-based "prevalence," there were 1 of 81 students nationally receiving special education services under an ASD eligibility. The proportion of special education students being served under an ASD eligibility averaged 9.16% across states, with a range of 1.12% to 14.78%. SES factors of state-level household income and adult education alone accounted for 17% of the total variance in the proportion ASD of special education students, $R^2 = .17$, $F(2, 48) = 4.83$, $p = .012$. After adding in the variable of political leaning, the combination of state-level household income, adult education, and political leanings accounted for 23% of the total variance in the proportion ASD of special education students, $R^2 = .23$, $F(4, 46) = 3.47$, $p = .015$. In looking at differential diagnosis/identification by state, higher rates of ASD were associated with lower rates of Intellectual Disability (ID) and Specific Learning Disability (SLD), and higher rates of Other Health Impairment (OHI).

Conclusions: While all of the factors that impact these differential rates are not fully known, this study provides evidence that state-level demographic factors, including education, income, and political leaning, play a role beyond child characteristics. Diagnostic substitution with other disability categories may also impact ASD rates.

419.038 *(Poster)* School-Based Health Education for U.S. Autistic Students Served By the Special Education System

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Background: In 2017, 312,000 students aged 12-21 were served by the U.S. special education system. Youth who receive special education services have the right to the same health education as their peers, including school-based sexuality education (SBSE) and substance abuse prevention education (SAPE). Only one previous study has used population representative data to investigate whether youth with autism and other disabilities receive health education. This study, the National Longitudinal Transition Study-2, indicated that autistic adolescents were the least likely to receive SBSE (28.0%) and SAPE (25.3%) across students from all IEP categories. The current study provides an update using the National Longitudinal Transition Study-2012 (NLTS2012) data.

Objectives: (1) Estimate the proportion of autistic students served in special education in public high schools who received SBSE/SAPE compared to students.

(2) Investigate factors associated with receipt of SBSE/SAPE for autistic students.

Methods: The NLTS2012 was designed to yield nationally representative estimates of the characteristics and experiences of U.S. youth receiving special education services. This study examined youth in all IEP categories, with 504 plan accommodations, and students with neither an IEP nor 504 plan. Students were 14 and over, in grades 9-13 or an ungraded class, in a school setting (not home schooled or in an institutional setting), who answered the youth questionnaire on their own behalf (parent proxy respondents were not asked questions about student experiences with SBSE/SAPE). Students were asked 1) whether they received reproductive health or pregnancy services or education, and 2) whether they received SAPE. We present prevalence estimates of the receipt of SBSE/SAPE, group comparisons of receipt of SBSE/SAPE, and multivariable logistic regression for each outcome with each of the three groups (see figure and table for examples). We examined factors relevant to receipt of services (e.g., student participation in IEP meetings, student communication ability).

Results: Less than half of autistic students received SBSE (47.4%) or SAPE (49.6%). Compared to students with no IEP/504, a significantly lower proportion of autistic students received SBSE (p=.001); significant differences were also found for ID (p<.001) and emotional disturbance (ED; p=.008). Additionally, a significantly lower proportion of autistic students received SAPE (p=.029); significant differences were also found for ID (p<.001), ED (p=.004), multiple disabilities (p=.016), and orthopedic impairment (p=.007).

For autistic students, only sex was associated with SBSE: girls received SBSE at 2.26 times the rate of boys when adjusting for age, race, income, IEP meeting attendance, and communication/adaptive skills. For students with other disabilities, inclusion in SBSE/SAPE was associated with youth participation in IEP meetings, less impaired conversation, and greater ability to go places outside of the home; less impaired receptive language predicted SBSE only.

Conclusions: Results suggest that autistic students in public high schools do not consistently receive free and appropriate health education. Given only students who could/were allowed to answer for themselves participated, results likely overestimate the degree to which autistic adolescents receive SBSE/SAPE, increasing their vulnerability for health risks. Findings can inform policy aimed at increasing inclusion of students with autism and other disabilities in health education.

419.039 *(Poster)* Serving Students with Autism in High Need School Districts: The Role of Classroom Quality and Teacher Burnout

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Background: Racial/ethnic disparities in autism spectrum disorder (ASD) identification, access to services, and quality of services have been well documented (e.g., Zuckerman et al., 2017), indicating an urgent need to develop methods to reduce them. More than 90% of children with autism are served in public schools (NCES, 2016). For students with autism from diverse backgrounds and those living in poverty, school may be the only intervention they access (Thomas, Parish, & Williams, 2014). School districts that serve many socially disadvantaged or minority students have been found to have lower quality general (Hirsch et al., 2007) and special education (Fall & Billingsley, 2011).

Objectives: Examine differences in classroom quality for students with autism and teacher burnout in districts serving many socially disadvantaged or minority students to inform our understanding of how to support the dissemination and implementation of evidence-based interventions (EBI) in these high need districts.

Methods: Public educators participating in a hybrid 3 effectiveness trial of Classroom Pivotal Response Teaching (CPRT, Suhrheinrich et al., 2019), an EBI for students with autism, completed the Maslach Burnout Inventory-Educators Survey (Maslach et al, 1986) and an adapted Autism Program Environment Rating Scale Self-Assessment Preschool and Elementary- Revised (National Professional Development Center on ASD, 2011). District indicators (i.e., percentage of minority or socially disadvantaged students) were obtained from the California Department of Education (www.ed-data.org). CPRT training outcomes (e.g., fidelity) will be also be collected. Generalized Estimating Equations were used to assess the association between district indicators and classroom quality and burnout, controlling for covariates (e.g., special or general education, study year, other district indicators) and nesting of teachers within districts. Recruitment is ongoing and data collection will be completed by the conference.

Results: Preliminary results from the 111 educators (98.2% female, 80.2% white, 89.2% special education) enrolled to date indicates district differences in classroom quality. In districts with a larger percentage of socially disadvantaged students, educators reported significantly worse: use of communication systems (B= -0.03), responsiveness to off-task student behavior (B= -0.01), consideration of student social skills (B= -0.02), and data collection on replacement behaviors (B= -0.01; all p-values < .05). In contrast, in districts with a larger percentage of minority students, teachers reported significantly better: lesson planning (B= .01), transition warnings (B= .01), responsiveness to off-task student behavior (B= .01), use of prompting (B= .01), and consideration of student social skills (B= .01; all p-values < .05). In regards to burnout, teacher-reported emotional exhaustion and depersonalization/cynicism were not associated with the percentage of socially disadvantaged or minority students (all p-values > .40).

Conclusions: Districts with a larger percentage of socially disadvantaged students reported poorer classroom quality; teachers working in these districts may need additional support to successfully work with students with autism. That teachers reported better classroom quality in districts with a larger percentage of minority students suggests that districts with many socially disadvantaged students may face different challenges than high minority districts when supporting students with autism. The impact of burnout and district indicators on CPRT training outcomes will be explored.

419.040 *(Poster)* Sexual Behavior and Gender Identity of Youth with Autism Aged 16 to 24: Are They Different from People without Autism?

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Background: Autism research on sexual behaviors and related topics began about 20 years ago (Van Bourgondien, Reichle and Palmer, 1997). Certain features of autism spectrum disorder (ASD) could affect how sexuality is experienced. For example, difficulties in decoding nonverbal cues and emotions might make it difficult to interpret another person's sexual attraction (Mintah & Parlow, 2018). Social isolation also tends to limit the sexual education and experiences of autistic youth (Locke, Ishijima, Kasari & Stagg, 2010; Pecora, Mesibov & Stokes, 2016). Individuals with autism report being more comfortable meeting and interacting online (Sallafranque St-Louis & Normand, 2017). Also people with ASD may have a more fluid gender identity and live more homosexuality (Dewinter, De Graaf & Begeer, 2017, Hillier et al., 2019). Sexuality being so personal, it is preferable to ask people directly about their reality, desires and concerns. Too often, information about sexuality in youth is gathered second hand (Hartmann et al., 2019).

Objectives: This presentation aims to describe the romantic and sexual behaviors and experiences of young people with autism compared to non-autistic peers.

Methods: Autistic and non-autistic youth 16 to 24 years of age (M: 18.79, SD: 2.4) were recruited through social media, schools, organizations, and clinics. A total of 172 respondents completed an online questionnaire on sex education, gender identity, romantic relationships, sexual orientation, unpleasant experiences, online sexual activities, socializing and friendships, sexual behaviour, attraction, initial romantic interactions, privacy, sexual exchanges, and concerns. Female respondents being overrepresented, subjects were matched on gender and age, resulting in 48 with ASD (50% female) and 48 without (50% female).

Results: The sexual behaviors of young people with autism between 16 and 24 years of age are comparable to that of their non-autistic peers. However, youth with ASD are more likely than their non-autistic peers to question their gender identity and sexual orientation. We also found that they express a certain lack of interest in sexuality despite their desire to be in a relationship. Even if they are as well informed about sexuality as their non-autistic peers, they complain that the sexual education they received was not adapted to their learning style and had difficulty understanding the concepts they were taught. A greater proportion of autistic youth and young adults say they "never" had online sexual activities such as watching explicit pornographic material or masturbating in front of their screen. In contrast to non-autistic youth, they are more worried about the interpretation of their sexual behavior by others. Finally, they are concerned that others may take advantage of them.

Conclusions: Our study with a matched comparison group allows us to put in perspective the sexual experiences and needs of autistic individuals. It appears that they may not be so different from their peers in late adolescence and young adulthood. More research is needed to investigate whether distinctions are more pronounced in early puberty, especially regarding the issue of gender identity.

419.041 *(Poster)* Social Capital and Professional Development: Investigating the Social Support Networks of Professional Trainers Who Support Special Education Teachers of Children with Autism Spectrum Disorder

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Background: Social networks in school settings can provide social capital in the forms of trust, expertise and support, (Bryk and Schneider 2002; Coburn 2001; Daly et al. 2010; Frank et al. 2004, 2011) which can improve the implementation of evidence-based practices (EBPs) in the classroom. However, few studies have investigated how social capital might impact the implementation of EBPs for children with Autism Spectrum Disorder (ASD). Special education (SPED) teachers receive instructional support from multiple school, district, county and state-level trainers. However, few studies have investigated if the social networks of professional trainers at the district or state level, with expertise in EBPs for children with ASD, might improve the implementation of EBPs by SPED teachers for children with ASD. This study seeks to address this gap in the literature by investigating the social networks of professional trainers at the district and state level and their performance coaching SPED teachers in EBPs for children with ASD. There is a pressing need for more knowledge about the kinds of social capital professional trainers need to be successful at their job.

Objectives: To test the association between the support networks of professional trainers participating in a state-wide initiative scale up to improve the implementation of evidence-based practices (EBPs) for students with autism and their job performance coaching teachers in EBPs for their students with autism.

Methods: Data were collected via Qualtrics surveys and R programing was used to reconfigure the Qualtrics file into a social network edge list to compute social network measures. R was used to create an analytical database with network variables included in the analysis and conduct descriptive analyses of network variables and Linear Network Autocorrelation Models to test for associations between the support networks of professional trainers and their job performance coaching teachers in EBPs for students with ASD, controlling for years teaching, high EBP knowledge, high authority, district type and district size.

Results: Overall, 407 support network members were identified (Table 1). Support network members provided more types and frequency of coaching supports than financial supports (2.4 types vs 1.98 types; 33.17 days vs. 16.59 days). The most frequent area of coaching support was problem solving about administrators and staff and the most frequently provided financial supports were dedicated time and materials. Support networks for professional trainers were very sparse (overall mean = approx. 1 person). However, findings suggest that trainers' networks were associated with performance. Professional trainers that had support networks performed at significantly higher levels than coaches w/out support networks. Both coaching and financial networks were associated with significantly higher performance.

Conclusions: The support networks of professional trainers can provide key systems level resources for special education teachers of children with ASD. Findings suggest that professional trainers that provide implementation support for special education teachers to use EBPs for children with ASD can significantly improve their job performance if they have coaching and financial support networks.

419.042 *(Poster)* Special School Teachers' Attitudes Towards Adopting a Multi-User Wearable System for Real-Time Monitoring of Students' Mental States: A Feasibility Study

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Background: One of the greatest challenges for special education teachers is to apprehend the mental states of their students during class. For instance, students with autism spectrum disorder (ASD) often struggle to communicate their needs due to deficits in social communication. Their relative "calm" expression may be misinterpreted as a positive sign until they are overloaded by the stressful experience and have an emotional meltdown.

To facilitate teachers in developing a better understanding of their students, we developed a multi-user wearable system that is capable of monitoring and recording the physiological indices of students. The system can analyze the collected physiological indices and provide teachers with moment-by-moment mental state indices, such as attention, relaxation and arousal. Therefore, teachers could observe the changes in mental states in a whole class of students and be aware of students' needs at an earlier stage, prior to occurrences of disruptive classroom behavior.

Objectives: To examine special school teachers' attitudes towards using this technology, and whether this system could facilitate teaching in the classroom by assisting their interaction with students.

Methods: A total of 8 teachers were recruited from a special education school in Hong Kong to participate. The school was a special school for students with mild grade intellectual disability, with over 60% of the students with ASD. A pilot trial was conducted in 3 classes, which included a total of 10 students. Before the trial, teachers were administered a questionnaire that included scales measuring their attitudes towards using wearable technologies and their perceptions of whether the technology can facilitate teaching in the classroom. Teachers were trained to use and implement the system over 3 sessions (each lasting at least 20 minutes). The same questionnaire was administered after 3 sessions. Paired t-tests were run to compare pre- versus post-trial differences in teachers' attitudes of the system.

Results: Apart from mobile device anxiety, none of the measures administered reached significance in terms of differences in the first and second administration. Elevated levels of mobile device anxiety was found among teachers after the trial. Post-hoc feedback indicated that teachers found it challenging to analyze and interpret the data after it was collected by the system. Nevertheless, the other measures indicated an increased trend in positive attitudes towards using the technology and its role in facilitating teaching.

Conclusions: As an exploratory study, providing teachers a tool to monitor real-time indices of students' mental states was shown to be potentially useful for the special education classroom. Other than training for system operation, it is also important to provide training regarding data analysis to ensure that teachers are comfortable in adopting this system when teaching. Future development will integrate further multi-modal measurements (e.g., ECG, skin conductance, blood pressure) and incorporate machine learning algorithms to increase the prediction accuracy of emotional changes in students.

419.043 *(Poster)* Student Voice in Creating Autism Support Initiatives in Higher Education: A Qualitative Study

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Background: Despite an increasing number of students identifying as autistic on college campuses, many continue to experience low graduation and employment rates. Many college support models are developed without a full understanding of the unique needs of autistic students on that campus, and do not necessarily consider the full body of autism research. Understanding student experiences and the unique needs of this population can support more rigorous research that identifies evidence-based practices for this community which, in turn, should inform campus-based intervention models. Thus, the University of Delaware (UD) conducted a survey of current autistic students in preparation for developing a comprehensive support system.

Objectives: Participants will:

- Understand barriers in higher education at one university based on survey results from autistic students.
- Discuss solutions to barriers in higher education at one university based on survey results and existing research
- Brainstorm areas for future applied research and creative ways for conducting studies in this unique setting

Methods: The quantitative and qualitative survey was sent to approximately 60 autistic students with 22 student respondents (~36% response rate) at the University of Delaware. Quantitative items were coded, and descriptive statistics were analyzed in SPSS. Qualitative questions were coded through a thematic analysis using deductive and inductive processes (Fereday & Muir-Cochrane, 2006).

Results: All students who responded identified as being on the autism spectrum. The participant ages ranged from 19 to 40, with a mean age of 24.73. Twelve respondents identified as males, eight as females, one as other/non-binary and one chose not to respond. Students rated the helpfulness of universally available resources and services on campus and their confidence in their ability to engage in a variety of academic and social activities. Results showed that most students found universally available supports (i.e. tutoring, academic enrichment, etc.) somewhat helpful, and found the counseling center somewhat unhelpful.

Through thematic content analysis, the following common themes were identified: challenges, factors for success, supports from the university, and things students wish faculty or other students knew. Specifically, students identified environmental factors like noise in residence and dining halls and shared office spaces. Many concerns regarding lack of awareness of autistic characteristics and lack of inclusive teaching practices was also apparent. Students also discussed factors for their success related to their learning, citing common themes, such as: requiring clear and explicit language; clear rubrics for assessments; and faculty acceptance of accommodations.

Conclusions: Some supports (e.g., tutoring) were found to be more helpful than others (e.g., counseling center). Students also identified common challenges (e.g., noise in residence and dining halls) and concerns (e.g., lack of awareness among professors). Opportunities for improved campus collaboration and building stronger support systems appear critical for autism support programs. The design for a new support system which incorporated these factors will be shared, as well as intended next steps for conducting research and evaluation in order to further inform the program and the field.

419.044 *(Poster)* Teachers Professional Competence: Reading Comprehension in Classes for Children with ASD

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Background: Many teachers of children with ASD report having challenges, particularly in differentiating the curriculum and providing appropriate curriculum access for their pupils. As a result, children with ASD do not receive the required instruction. The teachers often feel incompetent, leading to low feelings of efficacy. In Israel, many pupils with ASD learn in special education classes within regular schools. Most such classes have a special education counselor who assists the teachers in implementing strategies that are ASD specific, thereby enabling relevant and appropriate behavioral, social, and academic interventions.

Objectives: We conducted an intervention study aimed at examining the professional competence of teachers in the context of implementing a specific teaching model for improving reading comprehension within an ASD classroom. The goal of the model was to impart knowledge on strategies for improving pupil's reading comprehension while coping with their learning difficulties. Before developing the model, the teachers were interviewed to understand their professional needs. The model was designed accordingly, based on classroom navigation skills, incorporating strategies to improve reading comprehension which were found to be useful for pupils with ASD: The Reread-Adapt and Answer-Comprehend (Hua et al., 2012); anaphoric cueing (O'Connor & Klein, 2004); and Question-and-Answer Relationships Strategy (Whalon & Hart, 2011).

Methods: The study was designed as a qualitative case study with a participating researcher.

Participants:

- Teachers: six leading teachers in ASD classes, who had been working in special education for several years mainly with students with ASD
- The ASD special education counselor: Orit (second author), a participating researcher studying for her M.Ed. in special education. Her guidance was built into the teachers' weekly routines. After designing the model, she led learning sessions with the teachers.

Assessment Measures: a)Two semi-structured interviews with the teachers. The first was conducted before the model was applied, the second at the final stage of its implementation.

1. b) The participating researcher's reflective research journal.

Data collection was conducted pre-and post-implementation of the model. The data were analyzed in an analysis of interpretative content.

Results: The following themes emerged:

Before the implementation of the model:

- The teachers' basic understanding of their pupils' disability and its manifestation in the class.
- The accommodations and support provided in the class.
- The teachers' ability to cope with reading comprehension units.
- The teachers' feelings of frustration.
- Knowledge gaps between the ability to cope with behavioral, communication and social issues and inability to cope with academic issues.

After the implementation of the model

- Change in teaching formats in literature lessons.
- The pupils' improvement.
- Improvement in teachers' feelings of competence.

Conclusions: The findings underscore improvement in the teachers' sense of competence. They shed light on the change the teachers underwent regarding their feeling of efficacy, and underscore a need for greater access to consultative support and constant professional development for teachers in ASD classes. Disseminating best practices and implementing guidelines can enhance teachers' teaching abilities and promote their sense of competence, thus elevating their perception of self -efficacy.

419.045 *(Poster)* Technology-Based Interventions for Students with Autism: Multi-Disciplinary Professional Perspectives

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Background: The use of technology-aided interventions is on the rise for all children, and students with autism are no exception (Odom et al., 2015). Research supports using technology as a tool to address skill deficits for children with autism in multiple domains, including social problem solving, receptive language, and academics (Grynszpan et al., 2014). One of the newest intervention approaches is a robot-based curriculum that is currently being developed to teach social and communication skills. Although relatively new, school districts from Vancouver to South Carolina have already adopted a program using a robot called Milo, and the approach is spreading. Milo is a humanoid robot that can walk, model human facial expressions, speak, and is used to teach social-communication skills to children with autism. As others have pointed out, the enthusiasm for new technologies can lead to their adoption before understanding what the potential collateral effects might be (Odom et al., 2015). This study asks multi-disciplinary education professionals about their views on implementing a technology-based intervention (Milo) in Midwestern public schools.
Objectives: The purpose of this study was to determine the perspectives of educational professionals on the introduction of Milo for students with autism in K-12 schools in a Midwestern state.
Methods: A focus group was conducted with 10 multidisciplinary professionals from a Midwestern state. Participants included special education faculty, autism leaders and advocates, directors of disability-related institutions, special education district directors, and school principals. Questions explored their views about the feasibility of introducing a robot-based intervention to schools within the state. Participants were asked questions ranging from recruitment and training of teachers, to the logistics of scheduling time for students and facilitators to use the robot. Data was analyzed thematically.
Results: Data analysis indicated that, overall, participants were supportive of initiating the robot-based intervention in their schools. However, they had a number of concerns. A main concern they discussed was related to which school staff would receive training. More specifically, they were interested in the possibility of establishing a train-the-trainer model to increase competencies across school personnel to be more cost-effective. Additionally, focus group participants were apprehensive about the initial costs of training and the requirements for up-to-dates supplemental technologies (e.g., iPads). Furthermore, they were concerned with the amount and quality of external support each school would receive and what would happen to the licensure to use Milo after initial dissemination into the classrooms. Focus group members expressed interest in the possibility of extending the intervention to preschools, alternative settings, middle schools, and other settings.
Conclusions: Based on suggestions from this focus group, the next step for this project is to deploy the robot-based intervention in over a dozen schools in the state. Research will continue with an emphasis on understanding the perceptions of the school personnel who are involved with using the robot before, during, and after implementation of the curriculum, to learn how successful Milo is at improving social outcomes of students with autism in public elementary schools.

419.046 *(Poster)* Territory-Wide School Support Project for Students with Autism in Hong Kong Mainstream Primary and Secondary Schools
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Background: Hong Kong adopted integrated education which allows students with special education needs to attend mainstream schools. The Education Bureau ("EDB") promoted a 3-tier support model (Figure 1) to support their diverse needs.
The rising number of students with Autism Spectrum Disorder ("ASD") presents a great challenge to schools as they often have limited resources and expertise. To facilitate students' school adaptation, with the funding support from The Hong Kong Jockey Club Charities Trust, we collaborated with EDB and 8 non-governmental organizations to launch a six-year JC A-Connect school support project ("Project"), in 2015. The Project aims at enhancing mainstream schools' support to ASD students by:

1. Mobilizing NGOs' professionals to reach out to schools to provide school-based support to ASD students, peers, teachers and parents;
2. Providing Tier-2 small group training to students with ASD on important aspects for school adaptation: social, emotional regulation and learning skills;
3. Building the capacity of teachers and NGOs in supporting students with ASD.

The Project is the first large-scale school-based support programme in Hong Kong with a coverage of more than half of students with ASD population, benefitting 6,375 students in 2019. 503 schools, i.e. over 50% of schools have joined the Project.
The NGOs provided school-based group training to students. Teachers filled in questionnaires to assess the learning, social and emotional skills of the students, and the training objectives are set based on the need reflected. NGOs adopt evidence-based strategies in their trainings. Each group consists of four to six students and at least 18 hours of training each year. A school personnel is required to assist in the group training to facilitate skill transference in schools. The Project also provides support to other important stakeholders including teacher and parent consultations, and peer activities that promote inclusion.
Objectives: Examine the effectiveness of our Project in helping students with ASD to adjust better in school.
Methods: For initial need assessment and continuous monitoring of student's progress, teachers filled in Student Profile Checklist for School Adjustment (EDB, 2016), which consists of learning, social and emotion items (classified into 10 subdomains, see Table 1), before joining the Project and after the Project each year. As students could have improved in 4 years due to developmental changes, we compared the ratings of all participants at the beginning of our Project (i.e., without training) with ratings of all participants collected at the end of the 4th year (i.e., received 1 to 4-years of training) using independent t-test.
Results: Table 1 shows students adjusted significantly better after receiving training in most areas. Effects on primary school students are stronger than that of secondary school students.
Conclusions: Our Project effectively helps primary and secondary school students with ASD better adjust in mainstream school. It also informed policy changes in Hong Kong to regularize the support to them with reference to our service model. Educators from other regions using the 3-tier support model may find our service model useful.

419.047 *(Poster)* The Cognitive and Behavioral Profile of Chinese Autistic Children with Savant Syndrome
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Background: Autism spectrum disorder (ASD) is a type of neurodevelopmental disorder.About 0.6%-10% of autistic children have savant syndrome, and their outstanding skills in a specific field(computation, mechanics, art etc.) may exceed the normal level of ordinary people. However, parents and professionals often pay more attention to their deficiencies and neglect the recognition and support their skills. Therefore, it is necessary to explore the cognitive and behavioral characteristics of the autistic savant.

Objectives: In this context, this research aims to find more clinical features of savant group by comparing the cognitive and behavioral differences between autistic savants and autistic non-savant group.

Methods: 56 autistic individuals (30 savant and 26 non-savant) were included in the current study. All individuals were cases of idiopathic autism. The clinical diagnosis of autistic disorder was assured using the Chinese forms of the Autism Diagnostic Interview-Revised (ADI-R) and/or the Autism Diagnostic Observation Schedule. The most pronounced special abilities in the savant group (ASD-SS group) were memory and calender calculation in 18, musical in 4, arithmetic in 4, reading in 4, highly specialized knowledge in 4, drawing in 3 and machinery in 2. The average age of 30 autistic savants (29 males, 1 female) was 8.43 (S.D.=2.08). The non-savant autistic group (ASD-NSS group) consisted of 25 males and 1 female individuals., and average age of the was 9.03(S.D.=1.61). Age was matched between these two group（t=-1.19，P=0.24).Webster Intelligence Scale, Combined Raven Test, and Empathy /Systemizing Quotient Scale were used to assess the cognitive abilities and styles in different ways. Furthermore, Autism Diagnosis Observation Scale and Repetitive Behavior Scale were to confirm a prior clinical diagnosis and to provide some measure of core deficits of autism. In addition, Adaptive Behavior Assessment System-II Parent Form were filed to assess the adaptive behavior of the children.

Results: There was no significant difference between the savant group and the non-savant group in the Wechsler Intelligence Scale and the combined Raven test scores (P>0.05), but the ASD-SS group got higher score in block design subsets (P=0.02); ASD-SS group has a higher Systemizing Quotient (P=0.00) but lower Empathy Quotient than ASD-NSS group (P=0.00).The groups did not differ on the severity of social communication (P>0.05). And also, there was no significant difference between the ASD-SS group and ASD-NSS group in stereotypes, self-injury behavior, compulsive behavior and ritual behavior (P>0.05)，but ASD-SS group got higher score in interest behavior (P=0.01). In terms of the general adaptive ability, the differences between the two groups were mainly in the aspects of social interaction, communication, health and safety and self-care behavior(P<0.05).

Conclusions: The autistic children with savant syndrome have a specific cognitive and behavioral profile of superior systematizing and poor empathy ability, their narrow interest behavior is more obvious, and also have poorer adaptive ability.

419.048 *(Poster)* The Comparison of Discrete Trial Training with Two Different Error Correction Procedures in Teaching to Children with Autism Spectrum Disorder

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Background: Error correction, which is one of the important components of instruction, is that the teacher corrects the student's error in different ways immediately after the child responds incorrectly or does not respond. There are some different types of error correction procedures in the use of discrete trial training. These are; vocal feedback or error statement, a brief time-out, a model of the correct response, active student response, repeated response, re-present until independent, remove and re-present, and mixed type.

Objectives: In the current study, we aimed to compare the effectiveness and efficiency of the discrete trial training with two different error corrections, a model of the correct response and remove and re-present, in teaching community signs to children with ASD. We also aimed to determine whether children were able to generalize the behavior across materials and identified the acceptability of error correction procedures by peers with typical development.

Methods: Four children participated in the study who attended a segregated special education school. All participants had ASD diagnosis. Their age was seven to 11 years old. One of the participants was female, three of them were male. An adaptive alternating treatments design, one of the single-case experimental research designs, was used. The dependent variable was the percentage of identifying the community sign, and the independent variables were discrete trial training with two different error correction procedures. The percentage of inter-observer agreement was 100% for all participants and all sessions. The percentage of treatment integrity was 100% for all behaviors and participants in all sessions.

Results: Results indicate that discrete trial training with both the model for correct response and the remove and re-present were effective in teaching community signs to children with ASD. There was no significant difference between two discrete trial training procedures. Discrete trial training with a model for the correct response was more efficient for four children in terms of the number of sessions, trials, errors, and total time whereas discrete trial training with remove and re-present resulted in less error only for one child. The findings reveal that while the three children generalized the behavior across materials, a child could not generalize. Findings also show that a model for a correct response as an error correction procedure was more acceptable for peers with typical development.

Conclusions: Discrete trial training with error correction procedure is an effective intervention for children with ASD. In the literature, there is a limited study of error correction. The current study contributes to literature; however, there is also need a future study on comparing the error correction procedure.

419.049 *(Poster)* The Comparison of in-Vivo Modeling and Video Modeling on Teaching Symbolic Plays to Children with Autism Spectrum Disorder in Small Groups

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Background: Although children with typical development can learn to play on their own in natural environments, children with ASD cannot learn to play themselves on their own. The literature supports that the quality and quantity of play activities in preschoolers with ASD are different from their peers. Children with ASD usually play repetitive and unpurposive plays, prefer to play alone and cannot perform symbolic plays. Because of those reasons, the teachers teach the play behaviors and skills to children with ASD.

Objectives: The purpose of this study is to compare the in-vivo modeling and video modeling in terms of effectiveness and efficiency on teaching symbolic plays to children with ASD in small groups. In the current study, the following questions were sought:

1. Is there any difference between the effectiveness and efficiency of in-vivo modeling and video modeling presented in small group instructional arrangements in teaching symbolic play to children with ASD?
2. Do the children with ASD learn the target plays of their peers by observational learning during instruction sessions?
3. What are the social validity data about the purpose, method, and findings of the research?

Methods: Three children with ASD who were attending the segregated special education school. One of the participants in the study had pervasive developmental disorder diagnosis and two of them had autism diagnosis. The participants were all male at the age of 11. In the study, we used the adaptive alternating treatments design. The independent variables of the study were in-vivo video modeling and video modeling presented by small group instruction; the dependent variables of the study were two different symbolic plays.

Results: The research findings demonstrated that both in-vivo modeling and video modeling presented by small group instruction were effective in teaching, maintaining and generalization of symbolic plays to children with ASD. Video modeling was more effective than in-vivo modeling in acquisition; in-vivo modeling was more effective than video modeling in maintenance; and there was no difference between in-vivo modeling and video modeling in the generalization. The findings also revealed that video modeling was more efficient than in-vivo modeling for two participants, and in-vivo modeling was more efficient than video modeling for one participant. Moreover, observational learning was occurred in both in-vivo modeling and video modeling; and that not only the participants but also the preservice teachers had positive views about the research process.

Conclusions: Both in-vivo modeling and video modeling are effective in teaching symbolic plays to children with ASD. Children with ASD can learn symbolic plays by observing their peers. There is still a need for future research on teaching symbolic play through observational learning.

419.050 *(Poster)* The Effectiveness of the 'Star-Bus' Inclusion Intervention Programme (SIIP) for Enhancing Autism-Knowledge in the Peers of Pupils with Autism

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Background: Autism Spectrum Conditions (ASC) represent a unique challenge for mainstream education. Well-planned and -managed integration can bring about several benefits for all parties, mis-managed integration may have risks and high 'costs'. Research suggests that paucity of autism-knowledge in peers leads to limited understanding of autism-related behaviors, and this can contribute to the occasional rejection by peers and to the exclusion of the child with ASC. Peer education programmes to support autism-understanding and acceptance, therefore, are highly needed, but the available amount and quality of evidence on the effectiveness of the existing pedagogical methods of peer education in autism is limited.

Objectives: We aimed at (1) developing a complex, picture book-based peer education programme in autism for children in primary schools; and (2) evaluating its effectiveness and applicability, using a mixed-method prospective controlled study design. In the present study, we examined whether the programme was able to bring about positive changes in autism-knowledge in the test group of mainstream primary school pupils.

Methods: The intervention programme (the SIIP programme) focuses on primary school children. It includes a two-day preparatory training for teachers, and a detailed teachers' instruction guide with 25 varied and playful activities. Teachers can implement these into their daily classroom work. The main foci are: acceptance of human differences, understanding autism, strategies for relating positively to a peer with autism, strategies to prevent bullying, and raising autism-awareness in the wider public. 283 primary school pupils in 14 second- and third-grade mainstream classes (8 test and 6 control) participated in the effectiveness and applicability study. Data on their general pre- and post-test autism-knowledge were gained by the Pupils' Autism Knowledge Questionnaire (PAKQ), compiled by our research group.

Results: 2x2 (pre-test vs post-test, test vs control group) mixed ANOVA was run on data from the PAKQ. At the beginning of the programme, there was no significant difference between the two groups' knowledge of autism, while the test group showed significantly higher level of knowledge at the end of the programme. Overall, the general autism-knowledge has grown significantly in the total sample from the pre-test to the post test measurements. A significant pre-post X test-control interaction arose, demonstrating the effectiveness of the intervention programme in terms of enhancing autism-knowledge, selectively in the test group.

Conclusions: Results suggest that the SIIP programme is able to enhance knowledge about autism in pupils of mainstream primary schools, and confirm previous studies suggesting that inducing such effects requires systematically constructed and validated programmes, organized in several sessions of colorful and playful activities. Further analyses are underway on the impact of the enhanced autism-knowledge on quality of life, autism-attitudes, and social relationships.

419.051 *(Poster)* The Importance of Parent-Teacher Informant Discrepancy in Characterizing Youth with ASD: A Replication Latent Profile Analysis

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Background: Recent research about autism spectrum disorder (ASD) supports variation in symptom presentations across settings (Stratis & Lecavalier, 2015), and there is a growing literature that explicates how this variability may improve characterization of the ASD phenotype. Capitalizing on well-established literature on informant discrepancy as an index of contextual variability (De Los Reyes et al., 2015), research suggests that differing parent and teacher perceptions may impact treatment or special education-related outcomes (Frey et al., 2014; Rosen et al., 2019), and degree of discrepancy between parent and teacher ASD symptom ratings define discrete and clinically meaningful subgroups of ASD (Lerner et al., 2017). However, replication in an independent investigation with larger sample is important in supporting the validity and utility of the subgroups for use in research and practice.

Objectives: We sought to characterize patterns of parent-teacher informant discrepancies among children and adolescents with ASD to (1) determine if discrepancies relate to clinical and functional correlates and outcomes, and to (2) replicate a latent profile analysis (LPA) in a new, independent sample. We hypothesized that parent-teacher discrepancies in ratings of ASD symptom severity would better characterize ASD subgroups and these subgroups would predict clinical and functional correlates and outcomes.

Methods: Parents and teachers of 609 youth (83% male; M_{age} =9.27, SD_{age}=2.84) referred to an ASD specialty clinic completed the Child and Adolescent Symptom Inventory-4 (CASI-4; Gadow & Sprafkin, 2002). Latent profile analyses (LPA; Bartholomew, 1987) were used to determine optimal number and structure of subgroups from best-fitting model for the data. After specifying the classes, one-way multivariate analysis of variance (MANOVA) was used to compare classes for IQ and age, and a series of chi-square tests were conducted to determine if the groups derived from the LPA demonstrated meaningful differences across outcomes (i.e., receiving special education, type of class, currently receiving medication, ever received medication).

Results: Four distinct LPA groups emerged (Figure 1): two discrepancy profiles (Moderate Parent/High Teacher [1] and High Parent/Moderate Teacher Severity [2]) and two agreement profiles (Moderate [3] and High [4] Symptom Severity); these are identical to the previous LPA in this literature (Lerner et al., 2017). Class 2 and 3 participants were older than class 1 and 4 (all p<.02). Class 3 had higher IQ than all three other classes; and class 4 had lower IQ than all three other classes (all p<.004). LPA groups demonstrated significant differences in whether or not receiving special education ($\chi^2(3)=31.31$, p<.001) and type of class ($\chi^2(15)=59.56$, p<.001; Table 1), but not in medication status, either current or ever (both $\chi^2(3)<4.91$, p>.179).

Conclusions: Results from LPA from this large sample supported a four-class model consisting of two agreement profiles and two disagreement profiles, replicating findings from Lerner et al., (2017). Latent class membership differently predicted IQ and age of participants and educational outcomes. Unique, clinically-useful information about the taxonomy and clinical impact of ASD is obtained by considering informant discrepancies in symptom severity ratings, which underscores the importance of considering contextual variability assessed through multiple informants.

419.052 *(Poster)* The Self-Reported School Experiences of Autistic Students in Canada

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Background: Commonly autistic students are spoken for or their experiences are re-interpreted by well-meaning non-autistic parents, educators and advocates. While the inclusion of autistic voice in research is improving, insufficient research exists that includes perspectives of speaking and non-speaking autistic individuals. Additionally, systems of education have struggled with clear definitions of inclusive education which has led to uncertainty on how best to support autistic learners in inclusive school settings (Maciver et al., 2017; Majoko, 2016).

Objectives: The purpose of this study is to provide opportunities for speaking and non-speaking autistic students to self-report their inclusive educational experiences within a Canadian context. These self-reports will provide valuable insights into the successes, challenges and priorities of autistic learners, which are often overlooked by non-autistic individuals (Kourti & MacLeod, 2018). Improving our understanding of autistic student experiences within current inclusive education initiatives is fundamental to improving educational outcomes for autistic students and will help to inform future inclusive education design and policy (Makin, Hill & Pellicano, 2017).

Methods: Using a mixed-method interpretive phenomenology (MMPR) research design, autistic students share their unique experiences through the use of Qualtrics, an online research platform. The sequential study design begins with 18 Likert survey questions (QUAN), followed by an option for participants to participate in a follow-up email interview (QUAL). The survey questions are from the Panorama Survey (Harvard School of Education, 2014) and are based on six scales: 1. Pedagogical Effectiveness, 2. School Climate, 3. School Engagement, 4. School Teacher-Student Relationships, 5. School Belonging and 6. School Safety.

Results: Survey Closes November 30, 2019

Conclusions: Analysis and conclusions are expected to be complete by March 2020.

419.053 *(Poster)* The Utility of Classroom Observations As a Tool for Measuring Executive Functioning Skills in Adolescents: Validity and Sensitivity to Treatment Change

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Background: Executive Function (EF) impairments are well-documented in youth with ASD, as evidenced by parent report measures (e.g., Behavior Rating Inventory of Executive Function, Second Edition, BRIEF-2) and neuropsychological tasks (e.g., Block Design, Tower of London). EF problems impact academic success (Petra et al., 2011), but there are no current objective measures focusing on EF impairments in the high school classroom. Such assessment tools could provide a valid measure of behavioral progress and response to intervention. We recently developed a classroom observation measure to assess for change during a high-school effectiveness trial of a cognitive-behavioral EF intervention to improve flexibility, planning, and self-determination in adolescents with ASD. A treatment-masked assessor rated youth on the following behaviors during a 15-minute classroom observation in the general education setting pre/post-treatment: student engagement, initiation, organization, planning, transitioning, flexibility, overwhelm, self-advocacy, social reciprocity, and social appropriateness.

Objectives: To examine convergent/divergent validity of the classroom observation tool in relation to measures of EF, as well as sensitivity to treatment change.

Methods: Participants were 60 teens with ASD aged 14-20 (M=16.3, SD=1.3) with FSIQ≥80 (M=104.5, SD=15.4), who met DSM-5 criteria for ASD supported by the SCQ and/or ADOS-2. Students were recruited from 8 schools and randomized to the EF intervention or treatment-as-usual (TAU). A treatment-masked assessor rated the presence or absence of target behaviors, and a mean classroom observation score was calculated. Students completed task-based measures of EF (Block Design, ToL). Teachers (n=40) rated the severity of classroom behavior problems using the *Swanson, Kotkin, Agler, M-Flynn, and Pelham Scale* (SKAMP; Swanson, 1992) with developmental adaptations for teens, and EF problem interference in daily life was measured using the EF Interference Scale. Parents and students rated EF severity on the BRIEF-2 and EF interference on the Interference Scale. Kuder-Richadson-20 reliability coefficient was calculated for the classroom observation measure to determine its internal reliability. Bivariate correlations assessed associations between baseline observation score, demographic variables, and EF measures. Independent samples t-test were used to assess change in observation mean score pre/post treatment.

Results: The Kuder-Richardson-20 reliability coefficient for classroom observations was .64. Classroom observations were not significantly correlated with age, IQ, sex, or ASD symptom severity. Observations were significantly correlated with teacher report of EF problem severity(SKAMP; r =-.348* p<.05) and interference with daily life (r =-.501**, p<.01). Observations did not correlate significantly with parent- or self-reported EF problems on the BRIEF; or laboratory-based measures of EF. Observations were, however, sensitive to treatment change; youth receiving the EF intervention made greater improvement than the TAU group (t=-3.06, p<.01, d=0.9).

Conclusions: Baseline classroom observations correlated with teacher perception of EF difficulty and functional impairment, and were sensitive to treatment change. Additionally, they were not correlated with age, IQ, or sex. Lack of correlations with youth and parent report may be due to families' greater insight into EF difficulties beyond the classroom. Importantly, classroom observations are masked to treatment conditions whereas teacher report is subjective, making these observations a novel tool to assess EF changes in response to intervention.

419.054 *(Poster)* Training Caregivers with Limited Proficiency in the Majority of Language to Reduce Children Problem Behaviors: A Systematic Review

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Background: Parents are the primary source of education for their children, and can become the principal interventionist to prevent and treat their child's problem behavior. The present study reviewed 16 experimental studies that implemented caregiver-training for parents with limited proficiency in the majority language. Families had an offspring that presented problem behavior (e.g., aggression, disruption, drug abuse) and were from a culturally and linguistically diverse background. Adequate parent training can be a challenge with the overgrowth on international migration (258 million in 2017; United Nations, 2017) and the diversity of language spoken worldwide. For instance, just in the US 21.9% of the population speaks a language other than English (American Community Survey, 2017).

Objectives: The present systematic review had 3 purposes, first, determine different types of caregiver-training interventions, for minority families. Second, measure the impact of these interventions on parents' and children's outcome and third, to analyze the various strategies to adapt the interventions to caregivers with limited proficiency in the majority language.

Methods: PRISMA guidelines procedures were followed during the review. A search from 1970 to 2019 was conducted using five electronic databases for peer-reviewed journals. We analyzed the quality of the study in terms of What Works Clearinghouse (WWC) Standards Rating. To measure the impact of the training on parents' and child outcome, effect sizes using Cohens'*d* and a robust variance was conducted to compare the global impact of the interventions across studies.

Results: The overall findings reflected multiple interventions, the most common being "The Incredible Years Parenting Intervention," the "Parent Management Training - Oregon Training," and Family Therapy. The results suggest a non-significant small effect on (a) increasing caregiver positive parenting practices; (b) decreasing caregiver harsh discipline, (c) reducing child problem behavior, and (d) reducing youth drug use. The most prevalent adaptation to the intervention was related to the language of instruction, religion accommodations, community collaboration to adapt the training, training trainers to be culturally sensitive, and reducing access barriers to training (e.g., provide childcare, snacks, transportation, etc.).

Conclusions: Problem behaviors can have serious deleterious consequences for the child's health, social interaction, and family's quality of life. Parent training is an effective intervention to reduce children's problem behaviors. However, more research is necessary to increase the effectiveness of the intervention. Cultural adaptations were socially valid and essential to recruit participants and to reduce the attrition rate. Further analysis of which adaptation has a better outcome with different cultures is necessary to individualize interventions better. Finally, potential directions are caregiver-training for non-native language parents with children with disabilities using other behavioral interventions such as early childhood since there is a lack of research in that area.

419.055 *(Poster)* Training Special Education Teachers and Paraprofessionals to Implement Pivotal Response Treatment for Academic Tasks

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Background: Special education teachers and paraprofessionals face numerous challenges when working with students diagnosed with Autism Spectrum Disorder (ASD). These students can be difficult to engage in academic lessons, may have low motivation to learn, and often display challenging behaviors during structured academic tasks in the school setting (Cowen, Abel & Candel, 2017; Gunn & Delafield-Butt, 2016). Disengagement and challenging behaviors can create disruptions for both students and teachers. Educators may benefit from implementing positive evidence-based practices to support their students. Previous research suggests that educators can be taught to use components of Pivotal Response Treatment (PRT) in their classrooms (Robinson, 2011; Stahmer et al., 2015; Suhrheinrich, 2011). This line of research has led to adaptations of PRT to increase its implementation in the school environment (Stahmer, Suhrheinrich & Rieth, 2016; Suhrheinrich & Chan, 2017), resulting in beneficial student outcomes (Pellecchia et al., 2015). Other studies have applied PRT to structured academic tasks (Koegel, L., Singh, & Koegel, R., 2010), and have shown that students may display increased affect and on-task behaviors when PRT is incorporated specifically with academics. It is not clear, however, how the individual PRT strategies an educator might use with an individual student impact their academic performance and corresponding behavior on a moment-by-moment basis.

Objectives: The present study focused on the examining improvements to interactions between an educator (special education teacher or paraprofessional) and an individual student before, during, and after training in PRT for academic tasks.

Methods: A multiple baseline experimental design was conducted with three educators and three elementary students diagnosed with ASD. All sessions were conducted in an elementary school setting. Following baseline analyzing teacher-student interactions, educators were provided with didactic training in PRT and then received in-vivo coaching and feedback across 2-4 sessions. Videos of teacher-student interactions were scored for PRT fidelity and student challenging behavior, on-task behavior and affect. Additionally, educators completed self-report measures of ASD teaching efficacy and program acceptability/effectiveness.

Results: Preliminary data is reflective of professionals meeting 80% PRT fidelity of implementation by the end of the intervention and during a maintenance session in which no coaching was provided. Specifically the components of child choice (90% fidelity across sessions) and interspersing tasks (90% fidelity across sessions) were implemented with consistent fidelity. Data were also indicative of a significant increase in student interest and on-task behavior and decrease of challenging behavior during academic tasks.

Conclusions: This research may help to understand the interaction between educator and student during PRT implementation. Increasing educator fidelity of PRT implementation and looking at corresponding student behavior may inform the methods used to train teachers and professionals in PRT for academic tasks. Results demonstrated increased teacher self-efficacy, increased on-task behaviors, and higher affect of students. By working directly in the school and incorporating educator's input during intervention sessions, this research contributes to decreasing the research-to-practice gap in school settings.

419.056 *(Poster)* Understanding Student Attentional Profiles to Develop Better Instructional Strategies

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Background: Overlap and divergence in strengths and weaknesses may allow youth with ASD or ADHD to learn from one another when educational contexts are structured to facilitate such learning. Learning from others with disabilities can also promote self-acceptance (Salmon, 2013). Instructional strategies that are designed to provide opportunities for youth with disabilities to learn from diverse peers are highly consistent with the central focus of Universal Design for Learning (UDL) on creating instructional environments where diversity is appreciated. Tech Kids Unlimited (TKU), an informal educational not-for-profit in NYC, provides instruction to students with diverse learning challenges and may benefit from curriculum adaptations based on student attentional profiles and specific strengths.

Objectives: This study aimed to assess how student attentional profiles affect learning preferences in a classroom environment in order to better implement principles of UD and develop curriculum for students with disabilities.

Methods: In 2019, TKU served 74 adolescents (diagnosis available for 95%; 68.5% ASD, 11.1% ADHD, and 11.1% ASD + ADHD; 51% ethnically diverse). Using the AAPE as a measure of emotions (Riccio et al., under review), we conducted four brief engagement probes each week using online surveys to examine students' engagement with targeted instructional strategies: solo work, pair work, group work, hands-on work, discussion, or lectures. Students were invited to complete an attentional profile assessment (DKEFS Color Word Interference Task; n=17) and longer end-of-week surveys assessing learning preferences and goals.

Results: When asked which instructional strategies instructors should use, hands on activities (78%) and choices (67%) were popular while written text was unpopular (39%). More students preferred multiple simultaneous instructional modalities (pictures, text and speech; 36%) to speech and pictures (24%) with the fewest preferring just speech (18%). Students who preferred instructional strategies featuring multiple modalities exhibited *more* errors inhibiting and shifting attention than students with more unidimensional instructional preferences (ps < .01).

Instructional probes with the AAPE (α=.82) revealed that preferring a unidimensional instructional strategy was associated with less positive affect during group work (p=.02). Negative affect toward group activities was associated with a preference for solo activities at the end of the week (p=.008). A repeated measures analysis with difficulty inhibiting attention as a covariate revealed that students experienced the least anxiety during solo work, followed by partner work, and then group work (p=.003) and that heightened anxiety during group work was associated with less difficulty inhibiting attention (p=.003).

Conclusions: Results align with Universal Design recommendations that instructors use multiple modalities to engage diverse learners (e.g., CAST, 2011). These data provide promising initial support for the hypothesis that attentional profiles impact engagement and indicates that difficulties working with others observed among some neurodivergent youth may arise from attentional differences. This study has allowed us to develop an accessible, reliable, and socially valid measures of engagement through collaboration with autistic researchers that has been iteratively polished through feedback from neurodivergent students. Formal and informal educational programs may benefit from adjusting their instructional strategies to better meet the needs of diverse students in the classroom.

419.057 *(Poster)* Usability and Feasibility of an Enhanced Sexual Health Education Program for Individuals with Intellectual and Developmental Disabilities

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Background: Autistic individuals are at increased risk for experiencing sexual abuse and demonstrate decreased knowledge of sexual health topics (Jones et al., 2012; Spencer et al., 2005; Sullivan & Knutson, 2000), yet they are less likely to receive formal sexual health education (SHE; Barnard-Brak, Schmidt, Chesnut, Wei, & Richman, 2014).

Objectives: The purpose of this study was to: 1) identify the gaps, barriers, and recommendations for SHE as described by individuals with I/DD, parents, health providers, and educators; 2) develop and test the usability of activities that address the gaps and barriers; and 3) assess the feasibility of a five-week SHE program using these activities. This work was conducted in compliance with the guiding policies and principles for experimental procedures endorsed by the National Institutes of Health.

Methods: A grounded theory study design using mixed methods of data collection with the four stakeholder groups was used to identify gaps, barriers, and recommendations for SHE. Focus groups and interviews were analyzed using a constant comparative method to identify gaps and barriers and a thematic analysis was used to identify recommendations. Educational activities that were recommended were developed and/or sourced from available materials. Iterative usability testing confirmed the usability, usefulness, and desirability (UUD) of each activity using a pre-established set of criteria. And finally, feasibility of recruitment, data collection, and treatment protocol was assessed.

Results: Participants in the mixed methods study (n = 37) reported barriers that contribute to current SHE practices that only result from naturally occurring educational opportunities, are provided by multiple stakeholders, and only include relationships, puberty and adolescent development, and safety (Figure 1). These current practices and participants' recommendations contributed to the development of the Accessible Sexual Education Theory that proposes use of a proactive, continuous and formal comprehensive education provided by multiple stakeholders. Educational activities were developed or sourced based on participants' recommendations for videos, visuals, the use of Universal Design for Learning (UDL), and direct, explicit instruction. Seven of the nine activities were found to be acceptable. The remaining two required further revisions and a fourth iteration to confirm acceptability. These activities were incorporated into a five-week community-based SHE program and this program was found to be feasible in terms of recruitment (90%), retention (77.8%), attendance (97%), and assessment completion rates (pretest=77.8%, posttest=100%). The following changes were recommended for future programs: 1) revised treatment protocol including 10-15 minutes for review and reminders, 20-30 minutes for content, 30-50 minutes for learning activities, and 5 minutes for question and answers, 2) an updated schedule (Table 2), and 3) incorporation of UDL into consent documents and the demographics questionnaire.

Conclusions: The findings support the use of a proactive, continuous, formal education provided by multiple stakeholders. Activities were developed or sourced and were found to be accessible to this population. Additionally, the enhanced SHE program was found to be feasible with revisions to the consent procedures, treatment protocol and schedule. Future research is needed to identify the effects of the activities and program among a larger, more diverse sample size.

419.058 *(Poster)* What Autism-Specific Training Do Law Enforcement Officers Receive?: A Systematic Review

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Background: The Community Oriented Policing Services model encourages law enforcement officers (LEOs) to build relationships with all people in their communities, especially those who may differ physically, intellectually, emotionally, and socially (Price, 2005). In everyday interactions, LEOs routinely encounter individuals with developmental disabilities (Organization for Autism Research, 2014). Despite known interactions between LEOs and persons with autism spectrum disorder (ASD), research suggests that LEOs are often not knowledgeable about ASD and report concerns about appropriately handling situations involving persons with ASD (Chown, 2009; Crane et al., 2016). In addition, research suggests that LEOs often do not receive specialized training in ASD (Crane et al., 2016; Laan et al., 2013). The lack of appropriate support to individuals with ASD by LEOs could potentially lead to emotional stress, breakdowns in communication abilities, and behavioral regulation difficulties. Given the various reports of negative interactions between LEOs and persons with ASD (Copenhaver & Tewksbury, 2019), formal training on how to recognize and respond to the needs of community members with ASD is needed.

Objectives: Although previous research has focused on training to improve LEOs' awareness and knowledge of people with intellectual disability and learning disabilities, review of the efficacy of ASD-specific law enforcement training is needed. Thus, a systematic review of the literature was conducted to provide up-to-date information regarding training for LEOs related to ASD.

Methods: Adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols (PRISMA), we conducted a search of 13 professional databases and 28 journals using search terms related to both ASD and law enforcement training. Two researchers independently reviewed articles during all steps of the screening process to determine article eligibility based on inclusion and exclusion criteria set a priori. In addition, two raters independently completed the McMaster Quantitative Critical Appraisal Tool (Law et al., 1998) to appraise the identified studies.

Results: From 606 articles identified during the initial search, only two articles met inclusion criteria, which suggests that limited research exists that explores ASD and law enforcement training. *Kappa* values for both screening decisions and final inclusion were 1.0. Table 1 summarizes the main findings from both studies, including participant information, training format, content, and outcomes. Both identified studies reported statistically significant improvements in participants' self-reported awareness of ASD and confidence in supporting individuals with ASD (Murphy et al., 2018) as well as knowledge of ASD and confidence in identifying and interacting with people with ASD (Teagardin et al., 2012).

Conclusions: One of the major findings of the review is the scarcity of research concerning ASD-specific trainings for LEOs. Although both identified studies provide promising results, the review highlights the need for more empirical evidence to establish effective training protocols for teaching LEOs to support people with ASD. Findings from the present study serve as a stepping stone to understanding available literature and act as a catalyst for further research in this area.

419.059 *(Poster)* "Sometimes I Can't Keep the Mask to Myself": Social Skills Instruction from the Perspectives of Three Autistic Adolescent Girls.

M. Kofke*, Independent Scholar, Portland, OR*

Background: The social experiences of autistic[1] adolescent girls, and their perspectives of such experiences, has recently become an area of academic scrutiny (Tierney, Burns, & Kilby, 2016). Autism is expressed differently for autistic girls or women (Kirkovski, Enticott, & Fitzgerald, 2013). This study serves as a unique contribution to scholarship on the intersectional effects of experiencing being one of the only autistic girls in a high school social skills (SS) group (Saxe, 2017).

Objectives: The data for this paper was drawn from a larger dissertation study. One research question asked what are the perspectives of adolescent autistic students who identify as female, girl, or young woman, on their experiences with learning and using SS in high school? This paper focuses on desire to learn and generalizability of SS, gender isolation in SS classes and intersectional understandings of gender, and learning to mask autistic traits.

Methods: A qualitative research design using Interpretative Phenomenological Analysis (Smith, Flowers, & Larkin, 2009) and neurodiversity paradigm was applied. The participants were three white autistic girls: Maia, Ninja, and Ernie[1], who were 14/15 years old in 9^{th}/10^{th} grades while attending different public high schools. Each student was identified as having an autism label by contact personnel at their schools. Three one-on-one interviews with each participant were transcribed verbatim and coded for themes. The study was approved by university IRB. Participants had an opt-out option at any time.

Results: The participants wanted to learn SS to fit in better with neurotypical peers and as bullying prevention. Maia had direct instruction on how to mask autism and the others did not. Each student had chosen SS she valued and wanted to learn in order to build better relationships. They independently generalized these SS that were valuable to them. They experienced gender isolation as the female minority in their SS class. Topics salient to the intersection of gender and autism were not covered at school. The students did not know other autistic girls and did not think there was a distinct difference in autism among genders.

Conclusions: Extant SS research suggests autistic students struggle with generalizing SS (Laugeson, et al., 2014), however these autistic adolescent girls independently generalized SS they valued. They did not perceive autism and gender as intersectional. Knowing other autistic girls would support understanding gender differences. Concepts related to gender and the social function of masking should be incorporated into SS classes. Masking is connected to autistic well-being to prevent isolation and increase relationships with non-autistic people. (Milton & Sims, 2016), but also correlated with increased rates of depression and anxiety (Bargiela, Steward, & Mandy, 2016). Masking should be taught with this in mind. School-wide programs should work toward acceptance of autistic students and differences across genders.

[1] The use of identity-first language, with the term autistic, is used throughout this paper as indicative of the neurodiversity paradigm and is the language used by the students in this study to talk about their autistic identity.

[1] The students chose their own pseudonyms

419.060 *(Poster)* "They're like the People That Aren't Exactly, like, Normal Brained.": Neurodiversity from the Perspectives of Three Autistic Adolescent Young Women.

***M. Kofke**, Independent Scholar, Portland, OR*

Background: The school-based experiences of autistic[1] adolescent girls, and their perspectives of such experiences, has only recently become an area of academic scrutiny (Cridland, Jones, Magee, & Caputi, 2013; Jamison & Schuttler, 2015; Tierney, Burns, & Kilby, 2016). Due to the increased social and emotional vulnerability inherent with this population, much still needs to be learned of their experiences (Shefcyk, 2015)

Objectives: The data for this paper was drawn from a larger dissertation study. One of research questions asked: How does the ongoing work of learning social skills (SS) at school, via instruction or otherwise, contribute to the students' perspectives on the development of an autistic identity? This paper focuses on the students' interpretations of neurodiversity and implications for school-based instruction on neurodiversity.

Methods: Interpretative Phenomenological Analysis, a qualitative method (Smith, Flowers, & Larkin, 2009) was applied to this study. The primary participants were three white autistic adolescent girls: Maia, Ninja, and Ernie[1], who were 14/15 years old in 9^{th}/10^{th} grades while attending different public high schools. Each student was identified as having an autism label by contact personnel at their schools. Three one-on-one interviews with each participant were transcribed verbatim and coded for themes. The study was approved by university IRB. Participants had an opt-out option at any time.

Results: Maia read autism books like *Thinking in Pictures* by Temple Grandin where she learned about the term *neurotypical*, but she was not familiar with the term *neurodiversity*. She deduced the meaning of neurodiversity, concluding "They're like the people that aren't exactly, like, normal brained." Maia tried to mask being autistic at school.

Outside of school, Ninja was exposed to autism books from her parents. She said her teacher "...talks more about like, social skills than autism itself." and she would "like it if [teacher] talked more about autism, so I could know more about it." While Ninja identified as autistic, she had not been exposed to concepts or resources that supported learning about autism from the perspectives of autistic people. She did not like being autistic.

Ernie completed a project at school about autism and learned about it from other autistic students in her school. She learned about neurodiversity from autistic people's social media pages online and liked identifying as an autistic person.

Conclusions: Learning about neurodiversity at school has potential to support a positive autistic identity. The deficit perspective Maia and Ninja had can lead to negative effects on well-being. Ernie's autistic identity was more positive and informed by other autistic people. Curricular materials developed from the perspectives of autistic people on how to teach autistic students about neurodiversity and autistic culture need to be available to educators.

[1] The use of identity-first language, with the term autistic, is used throughout this paper as a marker of the neurodiversity paradigm and the language used by the students in this study.

[1] The students chose their own pseudonyms

Emotion

PANEL SESSION — **EMOTION**

212 - Without Addressing Our Daughter's Emotion Regulation Issues, Nothing Else Was Possible: Determinants, Outcomes, and Treatment of Emotion Dysregulation in ASD

Panel Chair: Carla Mazefsky, *Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA*

Discussant: Carla Mazefsky, *Department of Psychiatry, University of Pittsburgh School of Medicine, Pittsburgh, PA*

Emotion regulation (ER) has been steadily gaining attention in autism, with an emphasis on its association with psychiatric symptoms. Less is known about how ER impacts other outcomes, processes that contribute to impaired ER, and its treatment. This session addresses these questions using methods spanning affective neuroscience to a clinical trial. The first presentation examines the stability of ER impairment from kindergarten entry to exit and its association with peer problems and behavior, in ASD and non-ASD kindergarteners. The second presentation establishes that ER impairment, more than ASD or ADHD symptom severity, markedly increases the odds of crisis (e.g., hospitalization, police contact) and outpatient service utilization in large (1000+) non-referred ASD and US census-matched samples. The third presentation highlights autonomic nervous system activity as playing a role in the biology of ER in ASD, finding differences in both physiological and facial responses to emotional stimuli in ASD youth. The fourth presentation will share promising outcomes from a randomized clinical trial of a group-based ER intervention. All panelists consider how characteristics such as gender, age, IQ, and race, may impact ER-related difficulties. Finally, the discussant will highlight themes emerging from this research and important future directions for ER studies.

212.001 *(Panel)* Diagnostic and Gender Differences in Physiological and Facial Reactivity to Positive and Negative Emotional Stimuli

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Background: Emotions are brief, multi-system responses that are accompanied by rapid changes in autonomic nervous system activity, facial expression and subjective experience. Emotions facilitate adaptive behaviors, helping us to navigate the physical environment and social world. Kanner (1943) suggested an affective basis for social impairments in children with ASD. To date, most studies have focused on emotion recognition (e.g., identification of emotions in others' faces) and regulation (e.g., modulation of one's own emotions). Few studies, however, have examined whether children with Autism Spectrum Disorder (ASD) exhibit aberrant emotional reactivity in response to affective stimuli.

Objectives: 1) To compare autonomic nervous system reactivity and facial behavior in response to emotion-inducing film clips in school-age children with ASD and typically developing controls. 2) To explore the relationship between laboratory-based measures of emotional reactivity and clinical assessments of social behavior and autism symptoms.

Methods: Eighteen children with ASD (*M* Age=11.0 SD=2.3 years, 78% male) and 17 age- and IQ-matched controls (*M* Age=10.8 SD=1.6 years; 41% male) completed a laboratory-based paradigm that included watching film clips that elicit specific negative (sadness, disgust) and positive (amusement, awe, love) emotions. Continuous recordings of autonomic nervous system activity (7 channels measuring cardiac, respiratory and electrodermal responses) were collected using a Biopac system. Standardized change scores (trial – baseline) for each channel were averaged to yield a single measure of autonomic reactivity for each emotion trial. Facial behavior was coded using a modified version of the Emotion Expressive Behavior System (Gross, 1996); intensity scores were summed for each trial to yield composites for negative (anger, disgust, contempt, sadness, fear, concentration) and positive (happiness/amusement) facial expressions. Multivariate ANOVAs were used to explore effects of diagnosis and gender on autonomic reactivity and facial behavior across trials (5x2x2). Linear regression was used to explore whether autonomic reactivity and facial behavior predicted autism symptoms on the Autism Diagnostic Observation Schedule in the children with ASD.

Results: The MANOVA reflected a tendency for ASD participants to be less physiologically reactive to the disgust and sad films (η_p^2=.07 and .09, respectively). Main effects of gender (η_p^2=.57) and diagnosis (η_p^2=.31) were observed for facial behavior. Univariate tests indicated that females showed greater positive facial behavior during the awe (η_p^2=.27) and love (η_p^2=.24) films than the males. The ASD group showed greater positive facial behavior during the disgust film than the controls (η_p^2=.15). Lower physiological reactivity (r_{part}=-.62) and positive facial behavior (r_{part}=-.40) to the disgust film predicted greater autism severity.

Conclusions: Taken together, these results suggest that children with ASD show aberrant responses to negative emotional stimuli, including lower physiological reactivity and context-incongruent facial behavior. Gender differences in physiological reactivity and facial behavior underscore the importance of accounting for the gender imbalance often found in ASD studies. Further analyses will be conducted to identify the specific physiological indices (e.g., cardiac, respiratory) driving the trends for autonomic differences.

212.002 *(Panel)* Exploring Differences, Change, and the Predictive Role of Emotion Regulation in ASD and TD at Kindergarten Entry and Exit

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Background: Children with ASD consistently show impairment in emotion regulation (ER), the ability to monitor and modify emotional experiences (Gross, 2013), compared to typically developing (TD) peers (Cibralic et al., 2019). Despite several significant findings linking poor ER to heightened behavioral problems and social difficulties, few studies have explored the longitudinal changes of ER in young children ASD compared to TD.

Objectives: 1) Examine if children with ASD show significantly more impairments in ER compared to TD children after controlling for age, gender, NVIQ at kindergarten entry; 2) Explore if children with ASD demonstrate significant improvements in ER over the kindergarten year; and 3) Examine the effects of school-entry ER on concurrent peer play and behavior in children with ASD.

Methods: Parents of sixty-eight children (30 ASD) completed questionnaires at kindergarten entry (T1) and exit (T2) for the following variables/measures: emotion regulation (Emotion Regulation Index (ERI) and two associated sub-scales (Shift, the ability to respond flexibly to changes in one's environment, and Emotional Control (EC)) from BRIEF-2, Gioia et al., 2000), internalizing and externalizing behaviors (CBCL/6-18; Achenbach, 2009) and peer play behavior (Disruption, Interaction and Disconnect sub-domains from PIPPS, Fantuzzo & McWayne, 2002)). Across groups, children were similar in age, race, and maternal education but significantly different in NVIQ and gender. One-way ANCOVAs were conducted to determine group differences (ASD vs. TD) in ERI while controlling for child clinical and demographic characteristics (see below). A Generalized Linear Mixed Model (GLMM) was used to measure change in ERI over time in ASD only sample. Finally, regressions were run to analyze the predictive nature of ERI subscales on peer play and child behaviors.

Results: At T1, after controlling for age, gender, and NVIQ, children with ASD showed significantly more impairments in ERI (F=16.07,*p*<.001), EC (F=11.45,*p*=.001), and Shift (F=30.84,*p*<.001) compared to TD children. Controlling for age, gender, NVIQ and Calibrated Severity Score (CSS) from the ADOS-2 in an ASD only sample, results from the GLMM showed no significant changes in ER scores over time. For ERI and EC, there was a significant main effect of NVIQ (F=4.12,*p*=.048, and F=5.53,p=.023 respectively), such that higher NVIQ corresponded to better ER abilities at both T1 and T2. For ERI and Shift, a main effect of CSS emerged (F=2.82, *p*=.026, and F=2.49,*p*=.044 respectively), with higher ASD symptomology linked to increased ER impairment. Controlling for age, gender, NVIQ, and CSS, T1 EC significantly predicted T1 Play Disruption (β=.68,*p*=.009) and T1 Externalizing behavior (β=.81,*p*=.001), such that greater difficulty modulating emotions led to more aggressive/antisocial behaviors that interfered with play interactions. Shift was a significant predictor of T1 internalizing behavior (β=.56,*p*=.006).

Conclusions: The current study supports previous findings that children with ASD demonstrate increased difficulty with ER, compared to TD children. These high levels of ER difficulties remained constant after completing Kindergarten and may be exacerbated by lower NVIQ and higher ASD symptomology. Given the predictive nature of ER on social and emotional outcomes, providing interventions that target ER to young children with ASD appears imperative, even before school-entry.

212.003 *(Panel)* Initial Trial Outcomes of Regulating Together: Emotion Regulation Treatment for Children and Teens with ASD in an Intensive, Group, Parent-Assisted Program

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Background: At age 8, >95% of youth with Autism Spectrum Disorder (ASD) demonstrate co-occurring behavioral and emotional symptoms that are related to negative outcomes throughout their development (Soke et al. 2018). These clinical issues are hypothesized to arise from difficulties in *emotion regulation* (ER,(Mazefsky et al. 2013). Inadequate ER skills in ASD have been linked to higher rates of hospitalizations, school disciplinary action, peer rejection, failed transitions to college and employment, and use of psychotropic medications (Turcotte et al. 2018; Mazefsky et al. 2013). Due to the severity of concerns associated with weak ER skills in ASD, traditional school- and outpatient-based programs are not equipped to deal with this population, and thus children with ASD are often excluded from treatment. Traditional interventions are typically individual-based without caregiver inclusion. Given the lack of empirically-validated interventions to address this impactful issue in ASD, our group developed Regulating Together, a group-based, parent-assisted model utilizing elements of CBT, ABA, and Mindfulness approaches (Shaffer et al. 2018). Pilot data indicated feasibility, acceptability, and positive improvements in participants.

Objectives: We are conducting a 2-year trial of RT for youth ages 8-18 with ASD to investigate the effectiveness of the program using measures of reactivity, irritability, flexibility, and parental confidence for Year 1 of the trial.

Methods: Forty-six children and teens (8-18 years) enrolled in the study with 5 withdrawals (Table 1). By the time of the conference, a total of 70 participants will have completed the study. To test the effects of the intervention, we used a within-subjects-design with a 5-week waitlist control period, 5-week RT treatment, and 10-week follow up. Primary outcome measures include the Aberrant Behavior Checklist-2 Irritability Subscale (ABC-I) and the Emotion Dysregulation Inventory- Reactivity Scale (EDI-R). Secondary outcome measures include the Flexibility Scale and parent confidence in behavior management.

Results: Preliminary analyses were completed for treatment and follow-up measures for the 23 participants that have currently completed the study (see Table 2). For the primary outcome measures, repeated measures ANOVAs found a significant decrease for ABC-I from the pre-intervention time point to the initial post-intervention time point (F(1,20)= 8.68, p<.01; Eta Squared=.30) and at the follow-up time point. At the initial post-intervention time point (ABC-I F(1,12)=12.70, p<.01; Eta Squared=.51), EDI-R was marginally reduced (F(1,20)=3.90, p=.06; Eta Squared=.16), but significantly reduced at the follow-up time point compared to the pre-intervention for both outcome measures (EDI-R (F(1,12)=9.84, p<.01; Eta Squared=.45). For the secondary outcome measures, improvements in flexibility and parental confidence managing behavior were found at the initial post-intervention period and at follow-up.

Conclusions: ER is a critically under-studied and under-treated issue in ASD leading to high rates of hospitalizations and social and academic difficulties. Thus, we developed a short-term parent-assisted group intervention approach aimed at increasing ER skills. Initial findings from year 1 of our 2 year trial indicate promising findings with excellent enrollment, retention, and improvements post-treatment and follow up in ER, irritability, flexibility, and parental confidence in managing their child's behavior.

212.004 *(Panel)* Emotion Dysregulation Drives Utilization of Acute and Outpatient Psychiatric Services in ASD More so Than ADHD or ASD Symptom Severity

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Background: Prior research indicates that youth with ASD require high rates of inpatient hospitalization, police contact, and emergency room visits for psychiatric or behavioral concerns, and that these negative outcomes are likely to co-occur within the same individual[1–3]. Emotion regulation (ER) may be important to consider as a potentially modifiable risk factor given mounting evidence that it is impaired in ASD and associated with a higher likelihood of co-occurring psychiatric problems[4].

Objectives: This study aimed to investigate whether ER impairment increases risk of using acute and outpatient psychiatric services in ASD and non-ASD samples, and to explore whether ER is predictive when accounting for ASD and ADHD symptom severity and demographics.

Methods: Participants were 6-to 18-year-olds recruited via the Interactive Autism Network (IAN; n=1,165) and US-census matched youth (n = 1000). Parents completed the Emotion Dysregulation Inventory (EDI)[5], that produces theta scores (M= 0, SD= 1) for Reactivity (EDI-R; poor ER and high emotional intensity) and Dysphoria (EDI-D) based on autism norms as well as a clinical-cut off score based on a general US sample. The ASD group parents completed the Social Responsiveness Scale (SRS-2)[6] and Child Behavior Checklist (CBCL)[7] ADHD scale. Information regarding lifetime psychiatric hospitalization, recent crisis services (police contact, in-home evaluation, or ER visit), prescriptions (antipsychotic, mood stabilizer, or antidepressant), and participation in therapy (individual or group) was gathered. Logistic regressions were run to predict these outcomes based on group, EDI cut-off scores, and EDI-group interactions. Follow-up analyses in the ASD group explored whether EDI scales were significant when ASD and ADHD symptoms were included. All analyses included age, gender, race, and intellectual disability as covariates.

Results: After controlling for other variables, bivariate odds ratios indicated that those with clinically elevated EDI-R are 4.91 times more likely to have been hospitalized, 8.97 times more likely to use crisis services, 20.39 times more likely to be prescribed psychotropic medication, and 20.01 times more likely to be attending therapy than those below EDI-R clinical cut-offs. Similarly, those with elevated EDI-D were 7.43 times more likely to have been hospitalized, 15.39 times more likely to use crisis services, 6.48 times more likely to be prescribed psychotropic medications, and 7.36 times more likely to be attending therapy. With one exception, group and group-EDI interactions were non-significant, suggesting ER's association with outcomes is transdiagnostic. Other significant covariates varied by outcome and included older age (hospitalization, prescriptions), being non-White (crisis services), and being female (therapy).

Follow-up analyses in the ASD group including ASD and ADHD symptoms further supported the importance of ER. Higher SRS-2 scores were only a significant predictor of hospitalizations, and higher ADHD symptoms only significantly predicted psychotropic prescriptions, whereas higher EDI-R and EDI-D scores significantly predicted all four outcomes.

Conclusions: Results indicate that higher ER impairment is strongly associated with use of acute and outpatient psychiatric services beyond ASD symptom severity and ADHD symptoms in a sample of non-clinically referred youth. ER impairment may be an important treatment target in ASD to reduce service utilization and improve outcomes.

POSTER SESSION — **EMOTION**
420 - Emotion Posters

420.001 *(Poster)* Alexithymia and Perception of Attachment Security to Parents: A Preliminary Study on School-Age Children with High-Functioning Autism Spectrum Disorder

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Background: Alexithymia refers to individual difficulties in identifying, describing and distinguishing one's own feelings, which are often accompanied by an externally oriented thinking. Literature has documented the negative influence of alexithymia on parent-child interaction and interpersonal relationships as well as its frequent co-occurrence with Autism Spectrum Disorder (ASD). However, the majority of the studies on this topic have focused on adulthood and little is known about alexithymia and its impact on child socioemotional outcomes in school-age children with ASD.

Objectives: The general aim of this study is to examine explicit cognitive emotion processing and child attachment in school-age children with High-functioning ASD. In the first place, we explored potential differences between groups with respect to perceived attachment to parents and alexithymia. For this purpose, we also estimated the percentage of children above the normative cut-off of alexithymia. Secondly, in order to investigate which mechanisms intervene in shaping perception of attachment security to parents in ASD, we tested the predictive effect of child age, verbal intelligence and alexithymia.

Methods: This study included twenty-four children with High-Functioning ASD and 24 matched typically developing children (mean age 10 years). We assessed child alexithymia and attachment by using respectively two self-reported measures: the Children Alexithymia Questionnaire (CAQ) and the Inventory of Parent and Peer Attachment (IPPA). Measures of family Socioeconomic Status as well as verbal and non-verbal intelligence were collected. In order to screen children for socio-communicational symptoms we asked the mothers to complete the Social Responsiveness Scale (SRS-2). In addition, the Autism Diagnostic Observation Schedule (ADOS-2) was used to confirm ASD diagnosis in the clinical group.

Results: We observed that ASD children showed higher levels of alexithymia compared to the matched control group. In particular, 27% of children with ASD exceed the alexithymia normative cut-off. By contrast, no difference between groups emerged in the perception of attachment to parents. Moreover, self-reported alexithymia, but not the presence of ASD diagnosis, showed a negative predictive effect on child perception of attachment security to parents. Moreover, data revealed no significant effect of child age and verbal IQ on child outcome.

Conclusions:

Our findings highlighted that alexithymia is more common in school-age children with ASD, whereas perceived attachment to parents was similar between groups. These results are consistent with previous ASD literature on both alexithymia and attachment. With respect to alexithymia predictive value, difficulties in explicit cognitive emotion processing may hamper the development of a positive explicit representation of parent-child attachment relationship. Thus, alexithymia seems to play a crucial role on the way school-age children with and without ASD perceive their relationship with their parents. Limitations and directions for future research are discussed.

420.002 *(Poster)* An Examination of Temperament Traits in School-Age Children with ASD Using Parent-Reported Temperament

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Background: Temperament is a biologically-based characteristic that is highly associated with emotional functioning, behavioural adjustment, and psychopathology. While temperament is considered largely stable over time, it can be influenced by development and maturation. Research on temperament in autism spectrum disorder (ASD) has largely focused on early stages of development and has demonstrated a temperamental profile for infants with ASD characterized by lower effortful control, higher negative affect, and lower surgency compared to typically developing (TD) peers. Few studies have assessed temperament profiles in older children with ASD. To address this gap, we examined temperamental traits in school-age children with ASD compared to TD controls using the Temperament in Middle Childhood Questionnaire (TMCQ).

Objectives: To examine the temperament profiles of children with ASD compared to TD, and to explore the relationship between temperament traits and ASD symptoms.

Methods: Fourteen children with ADOS-confirmed ASD (mean age=10.4, 12 males) and fifteen TD (mean age=9.1, 8 males) between ages 8-12 have participated in the study thus far. All participants had IQ >85 ($FSIQ_{ASD}$=104.21±11.11; $FSIQ_{TD}$=117.00±12.21). Parents completed the Social Communication Questionnaire (SCQ), a measure of ASD symptoms, and the TMCQ. The TMCQ is a widely used 17 subscale parent-report measure; however there has been little research on its application in an ASD population. The subscales are clustered into 3 higher-order factors: Effortful Control, representing self-regulation of emotional reactivity, attention and behaviour; Negative Affect, reflecting a capacity for a variety of negative emotions; and Surgency, representing high levels of positive affect and behavioural action. We examined the effect of diagnosis (ASD, TD) on 3 higher-order factors of the TMCQ using t-tests or nonparametric Wilcoxon tests (as appropriate). We then examined the correlations of the SCQ with each of the 3 TMCQ factors: Effortful Control, Negative Affect, and Surgency, using ordinary linear regression.

Results: Scores on two of the higher-order factors differed significantly across groups, revealing higher levels of Effortful Control in the TD group (p<0.001), and higher levels of Negative Affect in ASD (p=0.005). Analyses of associations between ASD symptoms and higher-order temperament dimensions in the ASD group revealed a positive correlation between symptom severity and Negative Affect (R^2=0.29, p<0.05).

Conclusions: Results indicate higher negative affectivity and lower effortful control for the ASD group, consistent with previous research on temperament in infants and toddlers with ASD, and supportive of a unique and stable temperament profile in ASD. If replicated in larger samples, the positive correlation between ASD symptom severity and Negative Affect for the ASD group could suggest an underlying risk factor or brain network similarly influencing both ASD symptomatology and negative affectivity, or possibly that core ASD symptoms inherently resemble negative affectivity. Results of this preliminary analysis support an emerging temperamental pattern in ASD and warrent further investigation of this parent-report measure in a school-age ASD sample.

420.003 *(Poster)* Attention to Fear Signals in Toddlers with ASD

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Background: Toddlers with ASD show diminished *fear reactivity* compared to developmentally delayed and typically developing (TD) controls (Macari et al., 2018), impacting their ability to react to potentially dangerous situations. The factors driving this effect remain unknown. Emotion processing includes constructs of emotional reactivity (i.e., intensity of emotional responses to potential triggers) but also emotional attention (i.e., preferential processing of others' emotional signals). Here we examine whether diminished fear reactivity is driven by limited attention to fear signals from conspecifics, which may prevent toddlers with ASD from learning which stimuli are potentially threatening.

Objectives: We examined (1) if toddlers with ASD and TD controls attend preferentially to fear signals conveyed through facial expressions, body movement, and vocalizations, and (2) whether attention to fear signals is related to fear reactivity measured via parent report and observation.

Methods: Participants were toddlers with ASD (n=67, M_{age}=22.26mo, SD=3.3mo) and TD controls (n=49, M_{age}=20.99mo, SD=3.5mo). Attention to fear signals was tested using the Visual Paired Comparison (PC) paradigm implemented on the eye-tracking platform. Fear signals were conveyed through dynamic facial, bodily (biomotion) and vocal expressions and paired and presented paired with corresponding neutral signals. The preference ratio for fear signals (FearPrefRatio) was computed for each modality. Intensity of fear reactivity was assessed using the Laboratory Temperament Assessment Battery Fear Probes (LabTAB_Fear) and the parent-report Early Childhood Behavior Questionnaire (ECBQ) Fear Scale. We compared FearPrefRatio to a chance level (.50) to determine if fear signals elicited preferential attention. Then, we compared FearPrefRatio across groups and conditions using linear mixed models and examined the relationship between FearPrefRatio and LabTAB_Fear and ECBQ_Fear using Pearson's correlations.

Results: *Fear signal preference.* Both groups preferably allocated their attention to the fear signals regardless of modality (all ps<.001, **Figure 1**). However, toddlers with ASD had lower FearPrefRatio than TD toddlers across all modalities (p<.001). Both groups showed greater FearPrefRatio in the Face condition compared to the Bodily and Vocalizations conditions (ps<.001). The interaction between group and condition was not significant (p=.313). Preferential attention to facial and vocal but not bodily fear signals was associated with lower autism severity in the ASD group (Face: r(54)=-.295, p=.030; Vocalizations: r(63)=-.239, p=.058).

Correlations with intensity of fear reactivity. The associations between FearPrefRatio and parent-reported Fear (ECBQ_Fear)(all ps >.223) as well as intensity of fear expression during LabTAB (LabTAB_Fear) (all ps>.383) were negligible in both groups and in all conditions.

Conclusions: Toddlers with and without ASD attend preferentially to fear signals regardless of the modality through which fear is expressed. However, toddlers with ASD spent less time monitoring fear signals. There was no association between attention to fear signals and intensity of fear reactivity in either group. This suggests that attention to fear signals represents a dimension of emotional processing distinct from behavioral fear reactivity. Future work will need to consider not only the role of attention to fear signals but also what type of information is extracted from the signals, how it is processed, and subsequently used in modulating responses to threat in ASD.

420.004 *(Poster)* Bullying and Suicidal Ideation in Children with Autism Spectrum Disorder

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Background: Youth with autism spectrum disorder (ASD) are at elevated risk for suicide (Mayes et al., 2013). Bullying and social exclusion are key risk factors, both in the general population (van Geel et al., 2014) and in adults with ASD (Hedley et al., 2018). Though experiences of bullying are prevalent among children with ASD (Humphrey & Hebron, 2014), no study to date has examined whether bullying is associated with suicidal ideation (i.e., suicidal thoughts with or without plan or intent) in this population. Depression and anxiety are also associated with suicidal ideation in children with ASD (Horowitz et al., 2018; Storch et al., 2013), but whether bullying plays a role in this association is unclear.

Objectives: This study examined whether parent-reported bullying experiences are associated with suicidal ideation (SI) across middle childhood in ASD.

Methods: Data collected from 195 families from the Canadian *Pathways in ASD* study were included in current analyses. Parents completed the *Child Behaviour Checklist 6-18* (CBCL) and a modified version of the *Olweus Bully/Victim Questionnaire* (BVQ) at four time points (T1: 7.3 – T4: 11.9 years). SI was assessed via Item 91 on the CBCL: Talks about killing self, with a rating of 1 “sometimes true” or 2 “often true” at any time point considered endorsement. The most frequent bullying (range: “not at all” to “many times per week”) reported on the BVQ across T1-T4 was used to estimate bullying severity. Mood problems were assessed via *T*-scores on the Anxiety Problems and Affective Problems subscales of the CBCL at T1 (M_{Age}= 7.7 years). All participants had complete data on the CBCL at T1 and BVQ at ≥ 1 time point.

Results: Per parent report, 38.2% children were bullied regularly (1+ times a month) and 9.2% expressed SI at least once across T1-T4. In addition, 10.1% demonstrated clinical levels of depression and 12.3% demonstrated clinical levels of anxiety as measured by the CBCL at T1.

A sequential logistic regression examined the independent contribution of bullying severity to SI in children with ASD, controlling for T1 anxiety and affective problems. In the final model, anxiety problems (β = .10, OR = 1.10, 95% CI [1.03, 1.18]), but not affective problems (β = -.02, OR = 0.99, 95% CI [0.91, 1.06]), were significantly associated with SI. Controlling for these variables, bullying severity was also significantly associated with SI (β = .40, OR = 1.49, 95% CI [1.06, 2.08]).

Conclusions: Findings suggest that bullying severity during middle childhood is significantly associated with SI in children with ASD, even after controlling for anxiety and affective problems at age 7. Additionally, anxiety problems were associated with SI above and beyond the influence of bullying, suggesting that bullying and anxiety represent distinct risk factors for SI in this population. Further longitudinal research is needed to clarify the extent to which bullying and anxiety predict or covary with the emergence and persistence of suicide-related outcomes in youth with ASD.

420.005 *(Poster)* Child Depressive Symptoms and Child Adaptability in Young Children with Autism

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Background: Adaptability involves regulating emotion and coping through change and transitions (Sparrow et al., 2005). Adaptability in adolescents has been associated positively with agreeableness and educational achievement, and negatively with peer conflict and neuroticism (Martin et al., 2012). Children with autism spectrum disorder (ASD) often have difficulty adapting readily to unexpected changes in their environments (Lee & Park, 2007). Many children with autism also experience depressive symptoms which may impact their ability to effectively adapt (Hollocks et al., 2014).

Objectives: We sought to examine the differential effect of child depressive symptoms on adaptability in children with ASD and typical development (TD). We hypothesized that depressive symptoms would moderate the relation between child developmental status (ASD vs. TD) and child adaptability. Specifically, we predicted that higher depressive symptoms would predict lower adaptability for both status groups and that this effect would be more pronounced for our ASD group.

Methods: Participants were 31 children between ages 3 and 6, including 20 TD children (60% female) and 11 children with ASD (18% female). Parent ratings from The Behavioral Assessment System for Children--Second Edition (BASC-2; Reynolds & Kamphaus, 2006) were used to measure child depressive symptoms and adaptability.

Results: A moderated multiple regression was conducted to evaluate the relation between child status and parent report of child depression on parent-reported child adaptability. Our overall finding indicated a trend with the total effect (p = .06, B = -.662, CI_{95} = -1.345 to .021), which we explored further by looking at the conditional effects of our predictor at different values of our moderator. These results indicated a significant conditional effect when depressive symptoms levels reached at-risk to clinically significant (t scores = 62 and above; p > .001, B = -17.8, CI_{95} = -29.77 to -5.82). The negative valence means that those with ASD and high depressive symptoms demonstrated, on average, 17.8 units less adaptability than the TD group.

Conclusions: Results supported our hypothesis that at high levels of depressive symptoms, children with ASD would demonstrate more pronounced challenges in adaptability compared to TD peers. Given that our moderator (depressive symptoms) showed a significant conditional effect only at near-clinically significant levels, it may be that ASD children demonstrate unique resilience in adaptability compared to those with TD. That is, among children with ASD, depressive symptoms did not appear to interfere in effectively adapting to environments until depressive symptoms reached near-clinical levels. Future research should prospectively examine adaptability trajectories for children with ASD, particularly as demands increase within school settings. Given that our overall findings trended towards significance, future research should also utilize adequately powered analyses with a larger sample of young children.

420.006 *(Poster)* Children with Autism Spectrum Disorder Show Typical Levels of Accuracy on a Task of Basic Multimodal Emotion Recognition

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Background: Social and communication challenges central to autism spectrum disorder (ASD) are often thought to be associated with deficits in emotion recognition (ER) skills. In order to study the universality of these disparities, they might best be studied within a modality, such as music, that is of specific interest to children with ASD.

Objectives: The objective was to provide an initial comparison of basic ER skills among children with ASD and typically developing (TD) children across the modalities of face, vocalizations, and music.

Methods: Twenty-five children with ASD and 21 TD children between the ages of 6-13 years (*M*=10.42, *SD*=1.54) completed tasks associated with identifying emotions in faces, vocalizations, and music. Each modality included 8 happy, 8 sad, and 8 fearful emotional expressions from validated stimuli sets for a total of 72 stimuli. After each stimulus was presented on a computer screen for 1.5-2 seconds, the participants selected the verbal label that best described the stimulus from among these three possible expressions.

Results: Overall median accuracy ratings did not differ significantly between the children with ASD (*Mdn* = .86) and TD children (*Mdn* = .85). However, additional analyses revealed differences in emotion recognition accuracy across modalities ($p < .0001$) and emotions ($p < .0001$). Post hoc analyses with Wilcoxon signed rank tests (Bonferroni $p < .017$) revealed that the participants more accurately identified emotions from voices than faces and music, all $ps < .0001$. Across modalities, the participants also more accurately identified happy expressions than fear, and sad expressions than fear, $ps < .005$. No significant difference in overall accuracy was found for identification of happy versus sad emotions, $p = .06$. Further, happy faces and voices, and sad faces and voices were more accurately identified than happy and sad music, respectively, $ps < .01$. Conversely, fearful voices were more accurately identified than fearful faces or music, $ps < .0001$. No differences in accuracy were found for happy faces and voices ($p = .33$), sad faces and voices ($p = .67$), and fearful faces and music ($p = .98$).

Conclusions: The children with ASD and TD children were similarly able to identify emotions from faces, voices, and music in our experimental paradigm. However, significant differences in accurately identifying emotions across modalities were found, as the participants across both groups more accurately identified emotions from voices and faces than from music, and more accurately identified happy and sad emotions than fear. Further, happy emotions were more easily identified via social modalities (faces and voices) than music, but fear was less accurately identified by the participants in facial expressions and music compared to voices. These findings are contrary to the generally accepted literature on reduced emotion recognition capabilities of children with ASD, suggesting a potential for typical patterns of strengths and challenges in ER across modalities and emotions.

420.007 *(Poster)* Clinical Validation of the Emotion Dysregulation Inventory for Autism

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Background: Recently, the Emotion Dysregulation Inventory (EDI) was developed and validated as the first parent-report of emotion regulation (ER) impairment for children and adolescents with ASD (Mazefsky et al., 2018).Because the EDI was designed to be useful across the full range of functioning, measures of ER strategy use were not included in the evaluation of its initial psychometrics. Prior research has identified ER strategies that appear to be more commonly reported in ASD (e.g., rumination, suppression) and have shown their association with specific psychiatric symptoms (e.g., depression, anxiety; Cai et al., 2018). It remains unclear how ER strategy use corresponds to observable indicators of emotion dysregulation more broadly.

Objectives: We investigated the associations between ER impairment measured by the EDI and ER strategy use measured by the Response to Social Stress Questionnaire (RSQ) in adolescents and young adults with ASD. We hypothesized that EDI Reactivity would be associated with involuntary engagement (e.g. rumination, sustained arousal), whereas EDI Dysphoria would be associated with involuntary disengagement (e.g., shutting down).

Methods: 68 teens and young adults (12-21 years old) with ADOS-confirmed ASD and verbal IQ scores above 80 were recruited to participate in an open and randomized control trials of the EASE program (Emotional Awareness and Skills Enhancement- a mindfulness-based intervention). Parents completed the EDI and RSQ prior to treatment. The EDI provides scores for Reactivity (intense and poorly regulated negative emotional reactivity) and Dysphoria, and the RSQ measures coping strategies and involuntary stress responses. The EDI also provides clinical cut-offs based on norms from a sample of 1000 general youth matched to the US census.

Results: Higher Reactivity was associated with more Involuntary Engagement, (r=.323, p=.008), which includes strategies such as rumination, intrusive thoughts, emotional arousal, physiological arousal, and impulsive involuntary action. While higher Dysphoria was associated, (r=.295, p=.015), with Involuntary Disengagement (emotional numbing, cognitive interference, inaction and escape strategies). Additionally, higher Dysphoria was associated with less acceptance-focused coping strategies (Secondary Control Coping; r=-.279, p=.022). By means of logistic regression, the use of these positively correlated strategies contributing to the EDI clinical cut offs for reactivity and dysphoria was assessed, while controlling for age and IQ. Higher scores on Involuntary Engagement influenced the chances of meeting criteria for clinical levels of Reactivity on the EDI (p=.016), and exceeding the clinical cut-offs for Dysphoria on the EDI was influenced by increased Involuntary Disengagement (p=.014). Further analyses explored the significance of the subtests within these strategy categories.

Conclusions: These findings provide further validity support for the EDI by demonstrating expected associations between ER strategies and EDI scores. Further, the patterns are generally consistent with prior research on the association between ER strategy use and specific psychiatric symptoms (Cai et al.). This emerging picture suggests largely nonspecific effects of aberrant ER strategy use on a range of poor outcomes. Although longitudinal studies are needed to understand the direction of these effects, these findings could be used to inform future interventions to target the specific strategies that are most maladaptive for emotion regulation in this population.

420.008 *(Poster)* Developing a Multidimensional Visual Scale of Emotions (AAPE) and Autistic Identity through a Research Partnership with Autistic Scholars

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Background: Measures that are accessible to individuals across the autism constellation are needed so that a more representative group of autistics may share their experiences using communication methods designed around their abilities and challenges. Given that autism is often associated with visual strengths (Kaldy et al., 2016), picture-based options may increase comprehension of survey items and may allow more diverse autistic individuals, who have traditionally been underrepresented within the autism research literature (Jack & Pelphrey, 2017), to participate in research. Picture-based measures may be especially useful for research concerning autistic identity, a key area where representation of diverse autistic perspectives is greatly needed. Thus, picture-based tools may improve the accuracy and generalizability of findings.

Objectives: We, members of a participatory research group of autistic and non-autistic researchers, developed and evaluated 1) a picture-based measure of autistic identity which depicts experiences common to autistic people and 2) an emotion rating scale including 4 emotional dimensions (AAPE, under review).

Methods: Our participatory research group developed and revised the Multidimensional Scale Assessing Affect, Anxiety, Pride and Energy (AAPE; Figure 1a) guided by pilot testing with autistic high school (*n*=15) and college (*n*=16) students using online surveys. In final testing, autistic university students (*n*=72) rated comprehension of each emotional dimension using both open-ended response and an agreement scale from 1-to-5.

Ten visual representations of autistic experiences (Figure 1b), agreed upon by autistic members of our research group and drawn by an artist, were qualitatively and quantitatively rated by autistic university students (n=72) through an online survey.

Results: Open-ended responses indicated that the AAPE was well-comprehended on dimensions of affect (97.2%), anxiety (79.2%), and energy (84.7%) with potential for improvement in representation of pride (52.8%). Quantitatively, participants agreed that affect (*M*=4.28±.92) and anxiety (*M*=4.29±.86) depicted the intended emotional dimensions, followed by energy (*M*=4.08±1.00) and pride (*M*=3.50±1.20) on an agreement scale from 1-to-5.

Analysis of participant comprehension of ten autistic experiences is presented in Table 1. Depictions of sensory overload, making patterns, and experiencing miscommunication were best understood by participants in this sample. After being informed of the experience depicted, participants generally agreed that experiences were well-represented (Table 1). Cronbach's alphas as a visual autistic identity scale rated on each emotional dimension were somewhat questionable (affect α=.63; anxiety α=.63; pride α=.62; energy α=.67).

Conclusions: The AAPE was well-received by participants and has utility for use in future research studies to assess diverse participants' feelings in various contexts. Cross-checking how participants interpret scales, as we did here, is recommended for all dimensions, but particularly pride. This study took a first step towards developing a picture-based measure of autistic identity rooted in personal feelings about autistic experiences. Alphas were similar to widely used autism knowledge scales (e.g., Campbell et al., 1996), suggesting that the construct "autism" is multidimensional. Quantitative feedback indicates that autistic experiences and emotions were well-comprehended as a multimodal scale including both images and explanatory text.

420.009 *(Poster)* Do Different Aspects of Anxiety Symptomatology Have Differing Impact for Children and Youth on the Autism Spectrum?

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Background: Anxiety is recognised as one of the most common co-occurring conditions for individuals with a diagnosis on the autism spectrum, with approximately 40% of children on the spectrum receiving a clinical diagnosis of an anxiety disorder. To date, research has tended to focus upon understanding presentation and evaluating interventions, with little focus on understanding the impact that the anxiety may be having on the individual and their family.

Objectives: This study aimed to describe the profile of scores on a standardised measure of impact of anxiety and investigate which, if any, aspects of parent and child anxiety levels predict the different aspects of parent-reported impact of the child's anxiety in and outside of the home.

Methods: A community sample (*n*= 131) of parents of children on the spectrum completed questionnaires on their child's autism characteristics and anxiety symptomatology (the Anxiety Scale for Children - Autism Spectrum Disorder; ASC-ASD-P) as well as their own levels of anxiety (DASS) and a standardised questionnaire on impact of anxiety; the Child Anxiety Life Impact Scale (CALIS). A series of Hierarchial Multiple Regressions were undertaken, with autism characteristics and anxiety symtomatology subscale scores as the predictor variables and CALIS impact subscales as the outcome variables.

Results: Parents reported that their child's anxiety has the highest impact upon the child doing daily or enjoyable activities, including attending activities or events with their caregiver. A significant proportion (85%) also noted that their child's anxiety impacts their classroom performance at least sometimes. Hierarchical Multivariate Regression models identified that specific aspects of child anxiety as well as parent anxiety predicted different subscales of the CALIS. The child's anxious arousal significantly predicted the impact of anxiety at home, the child's difficulties with uncertainty significantly predicted the impact of anxiety outside the home and the combination of the child's difficulties with uncertainty and parental anxiety significantly predicted the impact the child's anxiety has on the parents.

Conclusions: In order to understand anxiety, researchers need to move beyond just measuring anxiety symptomatology to exploring the impact that this may be having on the individual or on those who live with and/or support them. Identifying the aspects of anxiety which have the biggest impact on the home, school and community has important clinical and research implications, as it may be the interventions and/or supports for these aspects of anxiety should be prioritised. As this study is only based on parent-report, the importance of further work incorporating self-report is explored.

420.010 *(Poster)* Enhanced Anger Recognition in ASD Children with Internalizing Symptoms

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Background: One key inconsistency of facial emotion recognition (FER) investigations is the employment of various paradigms (e.g., static, dynamic, high-intensity, low-intensity, cartoon, face-in-the-crowd). While Bal and colleagues (2010) found that children with autism spectrum disorder (ASD) were less able to detect anger compared to typically developing (TD) controls when viewing dynamic expression videos, other studies demonstrate no significant group differences in static anger recognition (Lacroix, Guidetti, Roge, & Reilly, 2009). Much is left to explore regarding accurate emotion recognition among young children within ecologically valid tasks (e.g., dynamic paradigms). Although individuals with ASD often have concurrent internalizing symptoms (Volker et al., 2010), the role of internalizing symptoms have been understudied in FER investigations. Recent evidence from a longitudinal investigation suggests children with ASD and concurrent internalizing symptoms demonstrate enhanced FER accuracy (Rosen & Lerner, 20016). Given inconsistencies within the anger recognition literature, we sought to clarify these associations in the context of internalizing symptoms in young children with ASD and TD.

Objectives: Our overall objective was to examine factors associated with accurate recognition of anger among young children with ASD. We hypothesized that internalizing symptoms would moderate the relation between developmental status and anger recognition.

Methods: Participants were 151 children (ages 3:0 to 6:11) and their parents. Eighty-four TD children (42% female) and 67 children with ASD (19% female) participated. Parent ratings from the Behavioral Assessment System for Children - Second Edition (BASC-2; Reynolds & Kamphaus, 2004) were used to measure internalizing symptoms. Children completed a dynamic emotion recognition task via laptops in a laboratory setting. Two trials of twenty slides were presented. Scores reflect the mean slide number of first accurate recognition; higher scores indicate slower recognition.

Results: A moderation analysis was conducted using the macro PROCESS (Hayes, 2013) for SPSS 26 to evaluate whether the association between developmental status and recognition of anger was moderated by parent-reported child internalizing symptoms. Children's age and gender were controlled for in the analysis. Results indicated a significant main effect of status on emotion recognition (B = 6.222, CI95 [1.763, 10.681], p = .006). The main effect of internalizing symptoms on emotion recognition was not significant (B = .022, CI95 [-0.048, 0.928], p = .532). The contribution of the interaction between status and internalizing symptoms was significant (B = -0.09, CI95 [-0.176, -0.003], $\Delta R2$ = .022, $F(1,145)$ = 4.251, p = .041. Our model explained 19.32% of the variance in accurate identification of anger.

Conclusions: Overall, children with ASD demonstrated slower recognition of anger. However, as internalizing symptoms increased, the difference between TD children and children with ASD for first identifying anger decreased. This suggests that internalizing symptoms may have a sensitizing effect on anger recognition ability for children with ASD. Internalizing symptoms may be an important factor in anger recognition, possibly accounting for the mixed findings within the literature. Future investigations should focus on examining the role of internalizing problems on the processing of emotions across other facial recognition paradigms in young children with ASD.

420.011 *(Poster)* Evidence of Feasibility and Acceptability of the Parent Mediated Group Intervention Coping with Uncertainty in Everyday Situations (CUES) from Parents Attending a Pilot Randomised Controlled Trial

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Background: Anxiety is common in autistic children. One key mechanism underlying anxiety is intolerance of uncertainty (IU), a tendency to react negatively on an emotional, cognitive, and behavioural level to uncertain situations. We have worked with clinicians and parents to develop a parent-based intervention to assist autistic children to manage uncertain situations more effectively: Coping with Uncertainty in Everyday Situations (CUES© 2016 Newcastle University). We are conducting a pilot randomised controlled trial of this intervention.

Objectives: We aimed to ascertain whether CUES© is feasible to deliver through NHS services by trained therapists, and whether it was acceptable and well-received by families.

Methods: Eight trained NHS therapists facilitated four CUES© groups. Fifty-three families were recruited to the study through clinical services. The children were aged 6 – 16 years, had a diagnosis of ASD, and were experiencing anxiety related to IU. Parents were allocated by chance to either receive CUES© or attend a psychoeducation group in a small group setting. Four months after the programme, parents and therapists completed a semi-structured interview about their experiences of the intervention. The data from the semi-structured interviews were then analysed thematically.

Results: Retention and attendance at the group was good. Feedback from parents demonstrated that taking part in the CUES© group was useful: it allowed parents to understand their child's anxiety, to identify uncertain situations and apply the strategies they learned during the programme. Also, taking part in the study helped parents to feel less isolated, because they were able to connect with other parents in a similar situation. Parents who had a child with intellectual disability found the group helpful, but thought it would be useful to attend a group with others parents whose children had similar abilities. All parents that the reported programme highlighted the role of uncertainty in their child's anxiety and they felt better equipped to manage it.

Therapists reported that they had positive experiences of delivering the CUES© programme. They reported the content was appropriate and well-paced. They observed a particular strength of the programme was that the content built incrementally each week to consolidate the parents' knowledge, as IU was a new concept for them. Most families found the 'homework' useful but not all had the time to complete it depending on individual circumstances.

Conclusions: Our data support the acceptability and feasibility of CUES©. The findings indicate that parents valued a range of aspects of the programme, including the content and pace of the programme, the small group setting which was beneficial for peer support, repetition of concepts to consolidate learning, and the focus on IU, which had face validity for parents. Therapists found the materials to be deliverable and the content appropriate for the families they are working with. Our pilot trial has established parents were willing to be recruited and randomised, the format and content of the groups were feasible and acceptable and the outcome measures were appropriate for use in a future definitive trial.

420.012 *(Poster)* Examining the Effect of Family Functioning on Emotion Regulation in Autism Spectrum Disorder

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Background: Emotion regulation difficulties are highly prevalent in autism spectrum disorder (ASD) and have been associated with adverse mental and physical health outcomes. Among the many factors contributing to these difficulties, family functioning may play a key role. In the general population, the family context is suggested to impact children's emotion regulation abilities through observational learning, parenting practices related to emotion management, and the emotional climate of the family (Morris et al, 2007). However, the association of emotion regulation abilities and family functioning has not been explored in children with ASD.

Objectives: To examine the association between family functioning and emotion regulation abilities in children with ASD.

Methods: The study sample consisted of 28 children aged 8 to 12 years who were typically developing (n=15, mean age=9.1, SD=1.2, 8 male) or had a diagnosis of ASD (n=13, mean age=10.5, SD=1.5, 11 male). All children had full-scale IQ greater than 85. Emotion regulation ability was measured using the total score on the Emotion Dysregulation Inventory (EDI), a 64-item parent-reported questionnaire validated in samples of children with ASD, in which a higher score reflects higher emotion dysregulation. Family functioning was measured by the Family General Functioning Scale (FGFS), a 12-item parent-reported questionnaire, on which a higher score indicates poorer family functioning. Wilcoxon-Mann-Whitney tests and linear regression analyses were used to examine group differences and EDI-FGFS associations. respectively.

Results: The ASD group had significantly higher scores than the TD group on all 3 EDI indices namely, short ($p<0.005$) and full ($p<0.005$) reactivity, and dysphoria ($p<0.05$). Over all participants, FGFS was significantly associated with the dysphoria index (Linear Regression, $\beta=2.55 \pm 0.72$, $p<0.005$, $R^2=0.32$). Significant FGFS x diagnoses (ASD/TD) interactions were found for the reactivity indices (full, $F(3,24)=16.86$, $p<0.0001$; short, $F(3,24)=9.42$, $p<0.0005$), suggesting a positive association in the ASD group, but a weak negative association in the TD group (Figures 1 and 2).

Conclusions: Consistent with previous literature, our results showed that children with ASD had significantly greater emotion regulation difficulties when compared to the TD children. Better family functioning was associated with greater emotion regulation abilities across both ASD and TD groups, although our results suggest the nature of this association may be different in ASD. In particular, for the ASD group, poorer family functioning was associated with lower emotion regulation. These results highlight the role of family functioning in emotion regulation. If replicated in larger samples, these results may suggest family functioning as a potential intervention target for emotion regulation difficulties in children with ASD. Future longitudinal studies can help tease out the direction of causality between emotion dysregulation and family functioning.

420.013 *(Poster)* Exploring Sources of Childhood Trauma for Individuals with ASD: Perspectives from Adults on the Spectrum and Caregivers

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Background: Trauma occurs when an event or series events are experienced as physically or emotionally harmful or life threatening and have lasting adverse effects on individual functioning and well-being (SAMSA, 2014). That is, trauma is defined by not only experience, but also an individual's appraisal and ability to cope with what they experience. Given the subjective nature of trauma, it has been hypothesized that the types of stressors individuals with ASD encounter and experience as traumatic may vary from those experienced by neurotypical populations (Kerns, Newschaffer & Berkowitz, 2015).

Objectives: To test this hypothesis, we conducted a qualitative study to describe (1) sources of childhood trauma as identified by adults with ASD and caregivers; (2) agreement between qualitative findings and the results of a standard traumatic events questionnaire.

Methods: Stratified purposeful sampling was used to enroll autistic adults (N=14) and parents of children and adults with ASD (N=15) with varied adverse experiences, functional outcomes and socio-demographic characteristics. ASD was confirmed with standard scales. Participants completed the Trauma History Questionnaire (THQ), standard measures of ASD and mental health symptoms, and qualitative interviews, which were audio-recorded, transcribed and submitted to inductive (e.g.,codes derived from review of interviews) and theoretical (e.g.,premeditated code) thematic analysis through Nvivo. In each interview, participants were asked to describe events and circumstances they considered traumatic given the SAMSHA definition (as above) using a semi-structured protocol. Each transcript was coded by two raters, who met regularly to compare ratings, clarify codes and reconcile inconsistencies.

Results: Participants described a range of both traditional and distinct trauma sources in the lives of people with ASD on both the THQ and qualitative interviews (see Table 1). Cited sources of trauma included neglect, physical, sexual and emotional abuse as well as more chronic traumatic stressors, such as bullying, discrimination/stigma, marginalization, betrayal and experiences that may be more specific to ASD, such as sensory-related trauma, social confusion, seclusion/restraint and social isolation. Distinct sources of trauma bore many hallmarks of traumatic experience, including feelings of helplessness, chaos, and unpredictability. All adults and 87% of parents described sources of trauma (both traditional and distinct) in their qualitative interviews that were not reported on the THQ, though the item “other trauma” was frequently endorsed on this measure (71% adults, 47% parents).

Conclusions: Adults with ASD and caregivers described a varied array of experiences as having a lasting, deleterious impact on their functioning and well-being that were not detected by a standard measure of adversity. Whereas some of these experiences reflect commonly recognized sources of trauma and PTSD, others may reflect particular vulnerabilities associated with having an autism diagnosis. Disclosure and thus comprehensive assessment of potential trauma in ASD may be influenced by the format (i.e. questionnaire, interview) as well as content (traditional v. ASD-related stressors) of inquiry. Results have important implications for the assessment of adverse and potentially traumatic events for individuals with ASD and for inquiries into the potential role of childhood adversities in the high rate of psychiatric comorbidity observed in ASD.

420.014 *(Poster)* Fear Potentiated Startle in Children with Autism: Relationship to Anxiety Symptoms and Development of the Amygdala

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Background: The development of biologically meaningful probes of brain function in order to phenotype the behavioral heterogeneity of autism has become a major initiative of modern research in the field. Anxiety disorders have been estimated to affect more than 50% of individuals with autism, yet the presence, severity and mechanisms underlying anxiety has been challenging to characterize. We have been focusing on efforts to diagnose anxiety in autism and to establish biological or physiological biomarkers of increased anxiety. Fear potentiated startle (FPS) is a biobehavioral response mediated by the amygdala that provides an index of fear conditioning and has been associated with anxiety in human and animal studies.

Objectives: The purpose of the present study was to evaluate FPS in a cohort of 8-12-year-old children with autism compared to typically developing controls who are part of the longitudinal Autism Phenome Project, and to examine the association between FPS, amygdala growth and anxiety.

Methods: Participants were 145 children (15 females and 68 males with autism; 23 females and 38 males with typical development) between 9 and 13 years. Children with autism met ADOS and ADI criteria, and had DAS Global Cognitive Composites ranging from 24 to 170 (mean = 79 +/- 31). Anxiety was evaluated by a trained and reliable clinical interviewer with the primary caregiver using the Anxiety Disorder Interview Schedule (ADIS), Autism Spectrum Addendum. Longitudinal structural MRI for determination of amygdala volume were collected throughout early childhood.

The FPS stimuli included an air puff (the US), a burst of air for 200ms at 60psi from tubing pointing at the base of the throat, and an acoustic startle stimulus (SS; 100dB white noise, 50ms) presented in a set of headphones. The conditioning phase consisted of 20 presentations of the CS, a red screen presented on the computer in front of the participant, paired with the US for 50ms, to facilitate fear conditioning. The testing phase included 30 randomized trials of three types: (1) 6 CS-US pairings, (2) 12 CS-SS “threat” trials, (3) 12 SS alone “safe” trials. The startle reflex was measured via electromyographic activity (EMG) recorded using two Ag/AgCl surface electrodes placed under the left eye (orbicularis oculi). The FPS response is analyzed from the 12 “threat” and “safe trials”; potentiation is indicated by a greater response in the threat condition compared to the safe condition, measured as percentage startle potentiation.

Results: Analyses pending will include comparisons of FPS between children with autism and controls, the correlation between severity of anxiety symptoms from the ADIS interview and FPS level in each group. FPS in relation to amygdala growth trajectory and the emergence of clinically significant anxiety in middle childhood also will be examined.

Conclusions: Establishment of links between FPS and anxiety in autism will provide evidence that brain mechanisms known to underlie fear conditioning in animal models and humans generally play an important role in this sub-phenotype of the condition. In addition, FPS may provide a useful objective biomarker for examining response to treatment and target engagement.

420.015 *(Poster)* Fear-Induced Arousal in Toddlers with Autism Spectrum Disorder Depends on the Social Nature of the Situation

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Background: Physiological arousal quantified by the measure of changes in skin conductance levels (ΔSCL) (Vernetti et al., under review), and behavioral responses measured by the intensity of facial and vocal expressions (Macari et al., 2018) have recently shown under-reactivity to nonsocial threat in toddlers with ASD. However, it is not clear if this physiological phenomenon is specific to the (non)social nature of fear-inducing episodes. While, social fear (fear of stranger) in children with and without ASD has widely been studied, the stranger fear as a universal phenomenon has been questioned as it may depend on contexts and developmental level (Rheingold & Eckerman,1974, Lobue et al.,2019). This study aims to examine threat-induced arousal in toddlers with autism in different social, nonsocial and socially-ambiguous contexts.

Objectives: (1) To test whether toddlers with ASD differ from typically developing (TYP) controls in the magnitude of ΔSCL to real-world Nonsocial (mechanical objects), Social (stranger wearing sunglasses/cap), Socially-Ambiguous (person wearing mask/cloak) episodes. (2) To test whether ΔSCL is associated with intensity of behavioral fear reactivity.

Methods: Participants included 40 toddlers with ASD (Mage=22.5mo, SD=3.5) and 34 age-matched TYP controls (Mage=20.8mo, SD=3.6). ΔSCL during the Laboratory-Temperament Assessment Battery (Goldsmith&Rothbart, 1999) using an ankle sensor Affectiva Q-Sensor. ΔSCL was computed between a 10-sec baseline preceding each episode, and the fear-inducing episodes. Peak of intensity of fear expression across facial, vocal, and bodily channels was computed. Autism severity was assessed using the Autism Diagnostic Observation Schedule, 2ndEdition (ADOS-2).

Results: A GLM analysis of ΔSCL indicated a significant diagnosisXepisode interaction ($F(2,123)=5.38, p=.006$). In the TYP group, ΔSCL was not significantly different between Social, Nonsocial and Socially-ambiguous episodes (all $p>.339$). However, in the ASD group, ΔSCL was lower during the Nonsocial ($t=2.55, p=.013, d=.60$) and Socially-ambiguous episodes ($t=2.79, p=.007, d=.65$) compared to the Social episode. ΔSCL in the ASD group was lower compared to the TYP group during Nonsocial ($t=2.78, p=.007, d=.69$) and Socially-ambiguous ($t=2.60, p=.011, d=.62$) but not during Social episodes ($t=1.06, p=.296, d=.29$). In the TYP group, greater ΔSCL was associated with greater intensity of fear expression during Nonsocial ($r(31)=.39, p=.024$)) and Socially-ambiguous ($r(32)=.39, p=.022$) episodes but not in the Social episode. In the ASD group, greater ΔSCL was associated with intensity of fear expression only during the Social episode ($r(27)=.51, p=.005$) (Figure 1).

Conclusions: The social nature of threat moderated arousal response differently in TYP and ASD groups. In the TYP group, increase in arousal was most pronounced in the nonsocial and ambiguously social episodes and the magnitude of increase in arousal was correlated with intensity of behavioral fear reactivity. The stranger episode elicited little changes in arousal. In contrast, toddlers with ASD showed attenuated arousal in response to nonsocial and socially-ambiguous triggers, but their arousal increased in response to the stranger episode. However, as a group, toddlers with ASD did not exhibit elevated physiological response to stranger compared to TYP controls. Given the precursory roles of nonsocial and social fear in the emergence of anxiety in the general population, this study emphasizes the need to further examine the contextual factors influencing fear reactivity in ASD.

420.016 *(Poster)* Going to the Museum Makes You Happy: A PILOT Study at the Teatro Alla Scala Museum.

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Background: Recent studies have shown that subjects with autism are able to perceive aesthetic stimuli of artistic beauty. Therefore, by making art accessible to the, potential benefits such as greater self-esteem, mental stimulation and greater social interaction may potentially ensue.

Objectives: The aim of this pilot experience is to explore the impact on wellbeing of a special museum and performing arts experience in adolescents with autism.

Methods: Twelve adolescents with autism (age 10-17) took part to this study. The ASD subjects were diagnosed with autism according to the DSM V criteria, confirmed through ADOS-2 and under observation at our Institute. Their mean ADOS severity score was 7.8 (range 4-10). The experience consisted in a guided visit to the Teatro Alla Scala Museum by a cultural mediator with experience in the field of inclusion for people with cognitive disabilities. At the end of the visit, the guests were made to sit in the Exedra hall, which houses the famous Steinway piano that belonged to Franz Liszt. Here a team from the Conservatory "Giuseppe Verdi" in Como presented a special reduction of “The Magic Flute” by Mozart, illustrating the history and individual characters with drawings and objects such as the music box, and singing the famous arias accompanied by piano and flute along with stage movements and dances. The performance lasted about half an hour. The measurement of the impact of this experience on psychological well-being was done by using a special continuous chromatic analogue scale presented as a 10 cm rule. The ruler has a sliding cursor that the subject is invited to position at the level corresponding to his current perceived psychological well-being. Before visiting the museum, well-being measurements were taken for five consecutive days, to establish a basic level of reference by asking subjects to use the ruler to determine the level of their momentary psychological well-being at a given time of day, between 10 a.m. and 11 a.m. On the day dedicated to the theatre experience, the same type of evaluation was carried out at 11 a.m., immediately before the experience, at 12.30 p.m., immediately after the experience, and at 2.30 p.m. on return to the Institute.

Results: Measuring well-being immediately after the aesthetic experience highlighted a strong emotional impact with a 47% increase in the momentary psychological well-being (from 64 mm to 94 mm). The increase resulted similar to that obtained in a control group of twelve adolescent with other forms of neuropsychiatric disorders.

Conclusions: This pilot study confirms that adolescents with autism are keen to receiving enjoyment when exposed to beauty, art and music and that the measurement of their momentary well-being is feasible despite the presence of an important cognitive deficit.

420.017 *(Poster)* How Are Teachers Recognizing and Supporting Anxiety in Students on the Autism Spectrum?

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Background: It is well recognized that anxiety is elevated in students on the autism spectrum. However, the presentation of anxiety symptomatology in students on the spectrum remains debated, with suggestions that traditional checklists do not assess the entire range of symptomatology.

A systematic review (Adams, Young & Keen, 2019) has identified that there is very limited research exploring anxiety in autism in the school setting and the available research to date has tended to report mean scores on broad measures of emotion and behavior, rather than detail the symptoms presenting in the school setting. There is also no research documenting the strategies teachers are using to support or reduce anxiety levels in their students on the spectrum.

Objectives: This study aimed to address the gaps in the previous research by firstly documenting the signs of anxiety noted by teachers of students on the spectrum and secondly explore the strategies that teachers report finding useful to reduce anxiety in students with autism.

Methods: Teachers of 63 students (aged 6-13) on the spectrum were asked a combination of open-ended and closed questions about signs of the student's anxiety as well as a standardised measure of school anxiety (School Anxiety Scale). The data were analyzed using quantitative and qualitative methods (content analysis) in order to document teacher descriptors of the student's anxiety at in the classroom and playground and explore how these may change with student age or gender.

Results: Approximately half of teachers (50.8%) felt their student was anxious in the classroom and a little over a third (34.9%) felt their student was anxiety out in the playground. Teachers most commonly reported increased activity levels as an indicator of anxiety in the classroom and peer interaction difficulties as an indicator of anxiety in the playground. The student withdrawing or hiding was frequently noted as an indicator of anxiety across both the classroom and playground.

When asked about the strategies they find effective to help support/reduce anxiety in the student on the spectrum, teachers most frequently identified simplified, calm communication and a calm, quiet or safe location for the child as effective strategies to reduce anxiety in the classroom. Strategies to support anxiety in the playground were more variable across the cohort.

Conclusions: Through the combination of standardised questionnaires and teacher-led, open-ended responses, this study adds to the small but growing literature base reporting on the presentation of anxiety in students on the spectrum and the ways in which this anxiety is currently being managed or supported in the school setting. Given that anxiety is highlighted as one of the top three factors influencing school performance (Saggers et al., 2019), these results highlight the importance of understanding each student's profile of anxiety symptomatology, which may include behavioral, cognitive and/or emotional indicators. The results also document the variability in strategies being used by teachers both across students and between settings, with few being evidence-based and some being known to increase anxiety in neurotypical children, highlighting the need for more research into this area.

420.018 *(Poster)* Identification of Novel Risk Factors for Depressive Symptomatology in Autism: An Ecological Momentary Assessment Study

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Background: Depression is a commonly reported and concerning mental health comorbidity in autism spectrum disorder (ASD; Mazefsky, Kao, & Oswald, 2011), with estimates as high as 44% (Strang et al., 2012). Despite the US Preventative Services Task (USPSTF) (Siu & Bibbins, 2016) recommendations for universal screening, depression is often overlooked in adolescence who are both typically developing (Leaf et al., 1996) and those with ASD (DeFilippis, 2018). Thus, identification of markers of depressive symptomatology in ASD is an urgent concern.

Objectives: (1) Evaluate the role of ecological momentary assessment (EMA) in identifying individuals with ASD at risk for depression. (2) identify predictors of negative affect (depression risk factors) and positive affect (protective factors) in this population. (3) test the hypothesis that affective instability predicts depressive symptomatology in this population.

Methods: 18 adolescents (ages 11 to 17) and their caregivers were recruited to the study. Of these 18, 17 were eligible to complete based on intelligence quotient (IQ) above 85 and the adolescent has regular access to mobile phone. In addition to several behavioral assessments, adolescents completed an EMA of depressive symptoms (six times per day for seven consecutive days). To analyse the data, we took a data driven approach by generating random forests, inputting all numeric variables as predictors to model the importance of each variable to current positive affect score measure and negative affect score separately. Next, we use influential variables as predictors to fit linear mixed-effects model for momentary mean positive score and momentary mean negative score, with a random effect for intercept added to each participant. We then take a theory driven approach to estimate the importance of mean square successive difference (MSSD) (see Thompson et al., 2012) to parent-reported depressive symptomatology.

Results: Predictor variables level of current social interaction, quality of current social interaction, parent-reported overall health, and parent-reported voice changes have significant effects ($p<.01$) on participants' momentary positive affect. For momentary negative affect score, only the predictor variable *quality of current social interaction* had significant effects on participants' momentary negative affect ($p=.02$). We then examined the effect of overall current pubertal status on momentary positive and negative affect. For momentary positive score endpoint, significant interactive effects ($p <0.05$) are detected on the interaction of level of social interaction and early pubertal stage. Positive affective instability, as calculated by MSSD of positive affect, was significantly related to parent-reported depressive symptomatology ($p=0.02$, $B=6.8$, $SE=2.83$).

Conclusions: First, we identified reduced quality of social interaction as a risk factors that may increase momentary negative affect. For those in the early pubertal stages, higher levels of social interaction (i.e., being around more people) was related to positive affect. Interestingly, though, for children at later pubertal stages, only the quality of social interaction was identified as a significant predictor. This may suggest protective social mechanisms will vary with pubertal status. Our findings also suggest that emotional dysregulation, namely affective instability, may be an important key factor in the phenotype of depressive symptomatology and a potential useful treatment target.

420.019 *(Poster)* Manipulating Identity of Threat in Fear Reactivity Paradigms: Effect of Social Nature of Triggering Stimuli in Toddlers with and without ASD

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Background: Atypical fear reactivity in early childhood has been linked to a wide range of later psychopathology. Findings regarding fear reactivity in toddlers with ASD are conflicting. Toddlers exposed to largely nonsocial triggers exhibited lower fear reactivity than TD and developmentally-delayed peers (Macari et al., 2018). However, when exposed to a social threat (Stranger Approach, a task used for decades to study fear in infants and young children (Rheingold & Eckerman, 1974)), preschoolers with ASD exhibited higher fear reactivity compared to Fragile X and TD peers (Scherr et al., 2017). In the current study, we examine, for the first time in the same participants, whether fear reactivity in toddlers with ASD is modulated by the social nature of triggering stimuli.

Objectives: To examine whether the social nature (social, nonsocial, socially-ambiguous) of threatening stimuli affects the intensity of fear expressions in ASD and TD groups.

Methods: Participants were 76 age-matched toddlers (M_{age}=22.1 months; SD=3.6) with ASD (n=42) or typical development (TD; n=34). We administered Fear episodes adapted from the Laboratory Temperament Assessment Battery: Stranger Approach-Social (person wearing sunglasses/cap), Objects-Nonsocial (mechanical spider/dinosaur), and Masks-Socially ambiguous (person wearing mask/cloak). Sessions were coded for intensity of emotion expression (iEE) and mean peak iEE Fear across facial, vocal, and bodily channels was computed.

Results: Linear mixed models revealed significant main effects of group (F(1,73)=5.60, p=.02), episode (F(2, 145)=3.61, p=.03), and a significant interaction (F(2,145)=9.94, p<.001). (Figures 1&2). Within-group comparisons: In ASD, iEE Fear was greater in the Social than in the Nonsocial episode (p=.01), equal in the Social compared to the Socially-ambiguous episode (p=.21), and lower in the Nonsocial compared to the Socially-ambiguous episode (p=.05). In TD, iEE Fear was lower in the Social compared to Nonsocial episode (p=.02), lower in the Social compared to the Socially-ambiguous episode (p<.001), and equal in the Nonsocial versus Socially-ambiguous episode (p=.12) (Figure1). Between-group comparisons: iEE fear was significantly lower in ASD than in TD during Nonsocial (p<.001) and Socially-ambiguous (p=.002) episodes; there was no difference between groups in iEE fear during the Social (p=.36) episode.

Conclusions: This study suggests a divergent response to threats varying in social characteristics in toddlers with ASD compared to TD at the level of emotional expressivity. TD toddlers exhibited the strongest fear reactivity in response to novel nonsocial and ambiguous stimuli – rapidly-approaching mechanical objects and a person dressed in a long dark cloak and scary masks. In comparison, their response to the Stranger was muted. In contrast, toddlers with ASD responded more strongly to the Stranger and socially-ambiguous triggers compared to the objects. But the ASD toddlers' fear reactivity to the Stranger resembled that of TD controls, while their response to socially-ambiguous and nonsocial threat was diminished compared to controls. Taken together, results reveal atypical patterns of fear reactivity in toddlers with ASD that are inconsistent with accounts of either general underreactivity to threat or increased social fear. Careful consideration should be given to design of fear induction tasks as fear reactivity is highly context-dependent and effects vary across populations.

420.020 *(Poster)* Modifying the Emotion Dysregulation Inventory for Use in Young Children with ASD

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Background: Early childhood is a formative time for emotion regulation development. However, there is a dearth of measures to characterize the developmentally-normative variation in emotion dysregulation (ED) and, more importantly, when ED deviates from typical development. Previous research has demonstrated that rates of ED are especially high and impairing among those with ASD. To address measurement of ED in school-aged children with ASD, the *Emotion Dysregulation Inventory* (EDI) was designed and validated to optimize sensitivity across a wide range of ED severity, independent of functional ability levels (Mazefsky et al., 2016, 2018). Given that the EDI was created to capture *observable* indicators of ED, extending the original measure to include children ages 2-5 appears to be a promising avenue for measurement of ED in young children.

Objectives: This presentation will describe the creation of items tapping early manifestations of ED in children with ASD, following PROMISÒ guidelines, and their preliminary utility. These represent the initial steps in the development of the *EDI-Young Child* (EDI-YC).

Methods: The EDI-YC item bank development included a 3-stage process: (1) drafting of candidate items; (2) review by experts in early ED; (3) qualitative interviews with 10 parents of 2-5-year-olds with ASD, *M*=3.30yrs, *SD*=1.16yrs, using a combined think-aloud and debriefing methodology (will be detailed further). The final item bank was evaluated in the first author's (TD) dissertation sample of toddlers, range=22-28mo, *M*=25.44mo, *SD*=1.85mo, with ASD diagnosed (*n*=17) or ruled out (*n*=17) via a gold-standard evaluation.

Results: As depicted in Figure 1, items were added, removed, and modified based on input from experts and parents of young children with ASD. The final item bank was 48 items. In the sample for preliminary testing, the EDI-YC appeared sensitive to a wide range of ED with a high degree of variability (range=6-157). Relative to non-ASD toddlers, toddlers with ASD had significantly higher total scores (non-ASD: *M*=26.47, *SD*=16.97; ASD: *M*=62.59, *SD*=35.31) and were rated higher on 34 of the 48 items. Additionally, the total score demonstrated expected correlations with the CBCL emotionally reactive subscale (*r* =0.74) and internalizing (*r*=.64) and externalizing composites (*r*=.70). However, the total score was not related to ADOS-T CSS (*r*=-.05) or Mullen ELC (*r*=.17) in the ASD sample.

Conclusions: The strategy used to develop the EDI-YC was effective in creating an item bank with sufficient content coverage and ease of understanding. Preliminarily, the EDI-YC appears to characterize a range of ED in young children, demonstrate construct validity, and differentiate toddlers with and without ASD. The total score and many items were rated higher in the ASD than the non-ASD sample. Importantly, severity of ED in toddlers with ASD was independent of ASD symptom severity and developmental level. The senior author (CM) plans to conduct psychometric analyses in samples of young children with (*n*=1000) and without ASD (*n*=1000) to establish the factor structure and final items. These steps are in effort to support the EDI-YC's use in characterizing early manifestations of ED and in developing and testing early interventions targeting ED as the mechanism of change.

420.021 *(Poster)* Opposite Developmental Trend in Processing Happy Facial and Bodily Expressions in Children with and without ASD

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Background: One of the core features of Autism Spectrum Disorder (ASD) is a difficulty in processing the emotional expressions. Previous studies in ASD have focused on facial expressions. However, the human body is as important as face in conveying emotional cues. Therefore, the investigation of both emotional face and body processing in ASD is desirable.

The ability to recognize emotions through faces and bodies improves with age in typical developing children (TD). During preschool years, children are increasingly exposed to peer interactions. Deficit in visual exploration of emotional cues could prevent children with ASD to exploit this massive opportunity for social interactions, which in turn may result in a lack of emotion processing's refinement. Thus, the investigation of visual preference for emotional stimuli during development is crucial to understand the origin of the difficulty in interpreting others' emotional signals in ASD.

Objectives: On these premises, we investigated the spontaneous visual preference of pre-school children with and without ASD for facial and bodily expressions of anger and happiness.

Methods: The sample included 20 children with ASD (Mean=5.52, SD=1.9), and 20 chronologically matched children with TD (Mean Age=5.4, SD=1.87).

We used a spontaneous, visual preference paradigm with the technique of eye-tracking. We presented pictures of faces and body postures upright and inverted on the two sides of the screen. Rectangular areas of interest (AOIs) were manually drawn on the upright and inverted stimuli. Time to First Fixation (TTF) and the number of fixations (NF) to the AOIs were used as dependent variables. Analyses of Covariance (ANCOVAs) were performed separately for faces and bodies, with Group as between factor, Emotion and Orientation as within factors, and Age as covariate.

Results: FACE: Overall, we found faster TTFF ($F(1,30)= 9.684$, p-value=0.004) and greater NF ($F(1,30)=10.30$, p=0.003) for upright than inverted faces (i.e., inversion effect). TTFF became faster ($F(1,30)=4.257$, p-value=0.048) and NF increased with age, but only for upright faces ($F(1,30)= 6.487$, p=0.016). Furthermore, NF to happy faces increased significantly with age in the TD group, but not in the ASD group ($F(1,30)=4.27$, p-value=0.048).

BODY: NF to the upright bodies increased with age in children with TD, while it significantly decreased in children with ASD ($F(1,30)= 5.613$, p-value=0.025). Furthermore, NF to happy bodies decreased in the ASD group, while it increased in the TD group ($F(1,30)=5.416$, p-value=0.03).

Conclusions: We found that, differently from TD, children with ASD made fewer fixations to happy faces and bodies with increasing age. This opposite developmental trend in children with TD and ASD may reflect increasing social motivation in TD and a lack of it in children with ASD, which would not sustain further development of emotional and social abilities. Alternatively, it might be a consequence of progressive social isolation that prevent children with ASD from social encounters. Crucially, results showed a cross-modal alterations in the visual preference (both in facial and bodily expressions), suggesting that the difficulty in ASD is not limited to face processing. This have implication for interventions that should hence include facial as well as bodily expressions.

420.022 *(Poster)* Perioperative Program for Children with ASD- the Experience at Boston Children's Hospital

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Background: Children with ASD face significant difficulties when in need of different hospital based procedures, studies and visits. Changing their daily routines, being exposed to the loud and bright Hospital environment often tests their coping mechanisms to a great extended. Research has shown that children with ASD need general anesthesia more often to complete simple procedures and exams because of their baseline behavioral anxiety. At Boston Children's Hospital (BCH) we developed a program geared toward improving and streamlining their hospital stays. Objectives: To improve Hospital experiences of patients with ASD and their families.

Methods: Multidisciplinary perioperative team was assembled to address the needs and specifics of our patients with ASD. We reviewed the existent practices and identified areas for improvement based of parental and staff feedback. The fallowing changes were made:

1. Children with ASD are scheduled as first cases in the morning.
2. Their arrival time was decreased to 1h instead of the usual 1.5h to minimize unnecessary wait and decrease perioperative agitation.
3. For children with aggressive or unpredictable behavior an isolated room is available where they are protected from the noise, bright light and personnel traffic
4. Favorite toys, communication devices, comforting items are strongly encouraged and provided based on prior discussion upon patient arrival.
5. Certain changes were made in our NPO guidelines for children with ASD- favorite drinks like soda are now allowed.
6. All necessary discussions about the perioperative plan are performed with caregivers and families outside the patient's room to avoid escalating negative behavior.

We included a child life specialist with expertise in working with children with ASD. The Hospital Behavioral team is involved on as needed base in preparing a patient specific behavioral plan. We reviewed the existing literature and with the help of the Division of Developmental Medicine we prepared social stories that describe the perioperative process in details. The stories are available online with free access given to the families to facilitate the preoperative preparation of the children. We also provide a printed version to be used in the preoperative areas. Structured education to staff was provided by the Division of Developmental Medicine and other specialists with interest and expertise in care for children with ASD.

Results: The changes we made allowed us to build a well structured pathway for the care of children with ASD at BCH. The evaluation of the program is based on families' satisfaction, feedback from perioperative teams and duration of perioperative stay. The diagram (see attached as image) describes the different steps of the program.

Conclusions: Children with ASD present significant challenges to the perioperative teams. Patient specific approach is a recommended way to help them and their families cope with the challenging process. For successful implementation a multidisciplinary approach as well as in advance planning and preparation are of utmost importance.

420.023 *(Poster)* Positive but Not Negative Facial Expressions Modify Behavior in Adolescents with ASD.

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Background: Emotional expressions play an important role in social interactions by providing cues that help regulate behavior. Sensitivity to the emotional context may contribute to more adaptive social functioning. Prior studies noted that the ability to detect and label emotional expressions might be altered in persons with autism spectrum disorder (ASD), with emotion processing differences being most apparent in adolescence. However, the question of how emotional expressions affect behavior regulation in ASD remains largely unexplored.

Objectives: The goal of the study was to examine the effect of positive and negative facial emotion expressions on behavioral and neural markers of inhibition (Go/NoGo N200 response) and target detection (target vs. standard P300 response) in 47 adolescents with ASD. Based on published evidence in typical populations, we hypothesized that negative vs. positive emotional expressions will be associated with more successful inhibition of behavioral responses and larger N200 responses, while both positive and negative emotions will elicit larger target P300 responses compared to the standard stimuli.

Methods: Brain responses associated with inhibition and target detection in the context of emotional cues were evaluated using visual event-related potentials (ERPs) in adolescents with ASD (age 10-16 years). Following the procedures of Taylor et al. (2018), all subjects completed the inhibition (Go/NoGo) and target detection (active oddball) blocks where they viewed a series of color photographs depicting unfamiliar young adults with happy (50%) or angry (50%) facial expressions. The subjects were instructed to attend to the color of the stimulus picture frame and respond (target trials) or withhold the response (NoGo trials) to the designated color (blue or purple) only (25% of trials/block). Inhibition was quantified as the amplitude of anterior N200 (200-300ms) response to NoGo trials. Target detection was assessed as the parietal P300 (300-600ms) amplitude to target trials. Behavioral measures included accuracy and reaction time for each block as well as standardized assessments of autism symptomatology (ADOS) and social skills (Social Communication Questionnaire, Social Responsiveness Scale).

Results: Behavioral performance was better than chance (>75%), with no significant differences in accuracy or reaction time between the inhibition and target detection blocks. Contrary to the expectation, increased anterior N200 inhibition responses were present only for the NoGo trials with happy faces. Similarly, increased parietal P300 responses were observed only for the target color frames that contained happy faces. The ongoing work is examining the association between these neural responses and behavioral measures of social functioning.

Conclusions: The findings indicate that adolescents with ASD can successfully regulate behavior based on nonsocial cues (picture frame color). The emotional context of the task affects performance in ASD, but contrary to the prior results in the typical populations, only the positive facial expressions increase neural responses associated with inhibition and target detection. While it is not yet clear whether this pattern of results may be related to difficulties with processing negative emotions in ASD, our findings indicate that positive emotional cues may be particularly effective for regulating behavior in adolescents with ASD.

420.024 *(Poster)* Predictors of Severity and Stability in Emotional Reactivity Among Youth with ASD

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Background: Problems with emotional reactivity (ER) are prevalent and disruptive in the lives of individuals with ASD and their families. While ER is common in ASD, it is neither universal nor stable. Understanding what individual features predict both severity and stability in ER is important for treatment planning and may be a first step toward understanding the function of ER in this population.

Objectives: 1) Describe the relationship between severity and stability in ER in two samples of youth, one with ASD and one census-matched community sample. 2) Probe predictors of severity and stability in ER among youth with ASD.

Methods: Participants were 6-18 year-olds recruited from two sources: 1) 1,215 youth with ASD (Mean Age = 12.05) recruited via Interactive Autism Network; and 2) 1,015 US-census matched youth (Mean Age = 12.05) recruited through YouGov, a polling company.

All parents completed the Emotion Dysregulation Inventory (EDI), a caregiver report measure of ER. Items are rated on a 5-point scale based on severity of behavior (0= Not at all to 4 = Very Severe) and on a 3-point scale indicating whether current behavior is worse, the same, or better compared to behavior over the child's lifetime. A measure of stability was created by coding 1 for no change and 0 when a behavior was marked either better or worse, then averaging these responses across items (higher scores = greater stability).

In addition to the EDI, parents filled out the Social Communication Questionnaire (SCQ), a measure of autism symptom severity with scores in Social, Communication, and Restricted, Repetitive Behavior (RRB) domains (higher scores indicate more difficulty). Parents also reported child's verbal ability on a 5-point scale (5 = nonverbal; 1 = meaningful, fluent speech) and presence of intellectual disability (ID; none, mild, moderate-severe).

Linear regressions predicted 1) Mean EDI reactivity (severity); and 2) Mean stability scores, controlling for severity. Predictor variables included age, gender, SCQ domain scores, ID, and verbal ability.

Results: Figure 1 displays density plots describing the relationship between severity and stability in the two samples. As can be seen in the Figure, the ASD sample was much more variable with regards to both severity and stability of ER compared to the community sample.

Table 1 reports results of two regressions predicting EDI severity and EDI stability (controlling for severity) in the ASD sample. As can be seen in the Table, younger age, higher scores on the SCQ social and RRB domains, and presence of moderate-severe ID were all unique predictors of EDI severity. Controlling for severity, younger age, lower scores on the SCQ social domain, higher scores on SCQ RRB, and higher EDI severity scores were predictive of *changing* EDI severity.

Conclusions: Severity of ER was predicted by severity of ASD symptoms in the social and RRB domains, as well as the presence of moderate-severe ID, but not by measures of communication or verbal ability. Individuals with better social skills were more likely to show changing ER, while greater restricted and repetitive behaviors predicted greater stability.

420.025 *(Poster)* Proximity to Threat As an Index of Fear Reactivity in Children with ASD

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Background: Recent work (Macari et al, 2018) suggests that children with ASD exhibit reduced emotional reactivity to threat compared to children with and without other developmental disorders as measured by intensity of facial and vocal expressions. Here we examine yet another measure of emotional reactivity, proximity to threat, and evaluate if the Kinect sensor can be used to characterize differences between children with ASD and typically developing (TD) controls in how they, in the context of free exploration, regulate their distance to potential threat and to their parents. We manipulated the nature of threat by including both social and nonsocial conditions.

Objectives: 1) to explore the feasibility of using Kinect to measure the proximity between children and threat stimuli during free exploration; and 2) to examine whether children with and without ASD respond differently to fear-inducing stimuli in social and nonsocial conditions.

Methods: Participants included children with ASD (n=16, Age=48.47mo, SD=12.40) and typically developing (TD) controls (n=11, Age=38.60mo, SD=2.27). Proximity to threat was assessed using the Risk Room probe from the Laboratory Temperament Assessment Battery (LabTAB). The children the in two conditions. In the social condition, a Stranger is prominently present while the child explores the room. In the nonsocial condition, the stranger the by a human-size Gorilla. The child's proximity to threat and the parent was measured using the Kinect sensor placed above the head of the Stranger and Gorilla. Kinect is a depth sensor that can detect 3D positions of 27 joints of a human. The child-threat proximity and child-parent proximity were analyzed using group (ASD vs. TD) s condition (Gorilla vs. Strange) linear mixed model approach.

Results: For the child-threat proximity measure there was a significant effect of condition with children staying closer to the Gorilla than to the Stranger ($F(1,25) = 10.06$, $p = 0.004$) and a significant effect of group, with children with ASD maintaining closer proximity to Stranger and Gorilla than TD controls, ($F(1,24)=5.927$, $p = 0.023$). The group x condition interaction was not significant, ($F(1,25)=2.286$, $p = 0.143$). Age as the covariate was not significant ($F(1,24)=0.008$, $p = 0.931$).

For the child-parent proximity measure there was a significant effect of condition as the children in both groups maintained closer proximity to their parents in the Stranger than in the Gorilla condition ($F(1,25) = 10.987$, $p = 0.003$). There was also a significant effect of the group with TD children maintaining closer proximity to their parents than children with ASD, ($F(1,24)=6.640$, $p =0.017$). There was no interaction between condition and diagnosis ($F(1,25)=1.845$, $p = 0.186$). Age as the covariate was not significant ($F(1,24)=0.342$, $p = 0.94$).

Conclusions: In a context of free exploration young children with ASD maintain closer proximity to novel and potentially threatening stimuli and stay farther away from their parents compared to typically developing controls. The study supports the use of the Kinect sensor for extracting proximity measures between free-moving humans and stationary stimuli.

420.026 *(Poster)* Pupil Dilation Responses in Autism: The Impact of Emotional Category and Intensity

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Background: Autistic individuals exhibit different pupillary responses to emotional faces than their neurotypical (NT) peers, suggesting differences in autonomic arousal. It has been proposed that altered pupillary responses in ASD are more pronounced for particular emotions, specifically that fear and happiness elicit greater differences in pupillary reactions across autistic and NT individuals. These previous studies of emotion processing have, however, shown mixed results. We suspect that autistic individuals are able to process emotions relatively well when they are extremely salient but may have more difficulty with more subtle displays of emotion.

Objectives: By presenting autistic and NT individuals with dynamic displays of emotion while varying levels of emotional intensity and recording pupil dilations, we aim to assess whether pupillary responses to specific emotions differ between autistic and NT individuals. We also aim to determine whether the intensity of the emotion differentially effects pupillary responses across autistic and NT individuals.

Methods: Autistic (n=16, M=19.0 years, SD=7.73, 6 females) and NT (n=99, M=19.04 years, SD=3.42, 75 females) individuals viewed videos of actors that uttered the phrase "kids are talking by the door". Actors expressed both high- and low-intensity emotions including anger, disgust, fear, happiness, and sadness through both visual facial expression and auditory prosody, as well as a non-emotive control condition. Pupil diameters were collected, and both mean pupillary response and pupillary time courses were compared across emotion, intensity level, and diagnostic groups.

Results: A 5x2x2 (Emotion, Intensity, and Group) mixed-model ANOVA was conducted. An emotion*group interaction demonstrated that autistic individuals showed a different pattern of pupillary responses across emotions than did their TD peers ($F(4,452)=2.852$, $p=0.023$, $\eta_p^2=0.084$). Pupillary responses to fear ($d=0.418$) and happiness ($d=0.632$) showed the largest between-group differences, with the NT group having larger pupillary responses than the ASD group (Figure 1a). An intensity*group interaction approached significance, with autistic individuals showing a greater reduction in pupillary response to low-intensity emotional expressions (Figure 1b; $F(1,113)=2.804$, $p=0.097$, $\eta_p^2=0.024$). Continuing data collection will clarify this trending result.

Conclusions: These data suggest that autistic individuals exhibit differences in autonomic arousal in response to specific emotions. Less pronounced pupillary responses to fear and happy expressions in autistic individuals indicate that responses to both negative and positive valence emotions produce reduced arousal in this group. It is possible that these results are being influenced by altered amygdala activity for fear processing, and less interest in rewarding social interactions for happy expressions. These results are in line with the social motivation hypothesis of autism, which suggests that autistic individuals are less interested in social interactions and find social stimuli less engaging than their NT peers, thereby leading to reduced interactions that allow for the fine-tuning of emotion processing skills throughout development.

Additionally, increased pupil diameter is considered an index of emotional arousal, where the most valent emotions elicit the largest pupillary responses. Autistic individuals showed a larger decrease in pupillary responses with low-intensity emotional stimuli. This suggests that autistic individuals may have more difficulty processing subtle displays of emotion than highly explicit displays of emotion.

420.027 *(Poster)* Relationships between Dysregulation, Intolerance of Uncertainty, and Autism Symptoms in Preschool Children with Autism Spectrum Disorder

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Background: Dysregulation is characterized by difficulty managing behaviors, thoughts, and affect in different situations (Mick et al., 2011), and is commonly observed in individuals with autism spectrum disorder (ASD; Mazefsky et al., 2018). Dysregulation exacerbates a variety of core ASD symptoms, i.e., social functioning, repetitive behaviors, and sensory responses (Samson et al., 2014; Berkovitis et al., 2016; Joshi et al., 2018; Uljarevic et al., 2018). Additionally, preliminary evidence suggests that dysregulation may contribute to intolerance of uncertainty (IU), a dispositional trait characterized by negative reactions to situations and events that are uncertain (Vasa et al., 2018; Uljarvic et al., 2018). The underlying hypothesis is that children with dysregulation may have difficulty regulating emotional and behavioral responses when confronting uncertain situations. Despite elevated levels of dysregulation in children with ASD, few studies have examined the prevalence of dysregulation, as well as how dysregulation and IU interact to affect ASD symptoms in preschool children with ASD. Understanding these relationships when children are young can inform specific treatment targets that could improve outcomes both short term and potentially in the future.

Objectives: 1) To determine the prevalence of dysregulation in children, 3-5 years old, with ASD. 2) To examine relationships between dysregulation, IU, and ASD symptoms.

Methods: A cohort of 51 children with ASD (*M* = 53.96 months, *SD* = 10.59), who have been rigorously characterized and have a broad range of IQ levels (*M* = 76.5, *SD* = 24.34), have thus far been enrolled in this study, with the plan of enrolling 30 more children by May 2020. The Child Behavior Checklist Dysregulation Profile (CBCL-DP; Althoff et al., 2012) was used to assess dysregulation. The CBCL-DP scale is comprised of the CBCL Attention Problems, Anxious/Depressed, and the Aggressive Behavior subscales. The total score of these three subscales was used to classify children as having mild (T score ³ 179), moderate (T score 180 - 209), or severe (T score £ 210) dysregulation (Althoff et al., 2012). The Response to Uncertainty and Low Environmental Structure Scale was used to assess IU, and the Social Responsiveness Scale-Revised and the Short Sensory Profile -2 were used to assess ASD symptoms. All measures were completed by the parent.

Results: Forty percent of children had moderate (32%) or severe (8%) dysregulation. Strong to moderate correlations were present between dysregulation and social communication (r=.42, p <.01), repetitive behaviors (r = .63, p<.01), sensory over-responsivity (r = .59, p<.01), sensory seeking behaviors (r = .70, p<.01), and IU (r = .60, p <.01). IU was also strongly correlated with overall ASD severity (r = .67, p<.01). Multivariate analyses will be used to examine associations between dysregulation and IU, and how interactions between these variables affect ASD symptoms.

Conclusions: Dysregulation is common in preschool children with ASD and was present in 40% of this sample. Preliminary findings indicate that dysregulation and IU are both associated with ASD symptoms. Targeting these two processes could potentially improve social and behavioral outcomes in young children with ASD.

420.028 *(Poster)* Self-Determination and Emotion Regulation in Adults with Autism Spectrum Disorder: A Possible Mechanism for Change

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Background: Self-determination (SD) has been defined as the attitude and ability of an individual to make their own choices without undue assistance (Michael L Wehmeyer, 1992), and previous research has shown that individuals with autism spectrum disorder (ASD) demonstrate less SD than their neurotypical peers (M L Wehmeyer & Shogren, 2008). Additionally, research has shown a strong relationship between poor emotion regulation (ER) and greater risk for increased psychopathology(Mazefsky & White, 2014). Improvement in SD and ER have the potential to decrease problems behaviors and increase better life outcomes in individuals with ASD. Perception and understanding of the self, a Research Domain Criteria (RDoC) construct, involves processes related to self-awareness and knowledge, including recognition of one's emotions, behaviors, and cognitions (*fig. 1)*.

Objectives: This study investigates the relationship between SD and ER to better understand if the relationship is stronger than SD with other constructs. Based on the RDoC model of perception and self-understanding, we'd expect to see an association between ER and SD in the perception and understanding of self model. A better understanding of this mechanism could be important when considering future mechanisms for change in intervention research.

Methods: There were a total of *n* = 59 participants with ASD and without intellectual disability. This sample was 81.4% male and 86.4% white with an average age of *M* = 18.84yrs (*SD* = 2.06) and an average IQ of *M* = 104.88 (*SD* = 13.20). Self-report measures were collected within a clinical trial investigating improving college readiness in ASD. This study uses baseline SD, as measured by the AIR-SD (Wolman, Campeau, Dubois, Mithaug, & Stolarski, 1994), to draw relationships to ER, social skills, and goal directed behavior. ER in this study is measured using the Emotion Regulation Difficulties Scale(Gratz & Tull, n.d.) emotion awareness and strategies subscales. A path analysis was used to measure relationships between SD and social skills, ER, and goal-directed behavior while controlling for autism symptomology using the Social Responsiveness Scale (Constantino, 2005).

Results: The path analysis model was fully saturated and therefore model of fit indices could not be obtained. SD was significantly associated with emotional awareness (unstandardized b = -.12, p = .01, standardized β = -.38) and emotional regulation strategies (b = -15, p = .02, β = -.30) while controlling for ASD symptomology. However, self-determination was not significantly associated with social skills (b = 11, p = .17, β = .19) or goal directed behavior (b = -.02, p = .67, β = -.06) while controlling for ASD symptomatology (*fig. 2)*.

Conclusions: Results indicate a significant relationship between SD and ER while SD, social skills, and goal directed behavior were not significantly associated. In this model, greater SD, was associated with less ER related problems. Additionally, these results are aligned with the RDoC construct of SD and self-regulation, which includes ER, as important factors in one's perception and understanding of self. These findings demonstrate the importance of further investigating this relationship as a potential mechanism of change for downstream effects.

420.029 *(Poster)* Similarities and Differences in Emotion Regulation Strategies during a Frustrating Situation in Parent-Child Dyads with and without ASD

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Background: Emotion dysregulation is hypothesized to be an inherent aspect of ASD (Mazefsky et al., 2013). Previous research comparing preschool children with and without ASD suggests that parents of children with ASD use simpler strategies than parents of typically developing (TD) children, and TD children display a wider variety of emotional expression than children with ASD (Hirschler-Guttenberg et al., 2015). However, little is known about the emotion regulation strategies of parents and school-aged children with and without ASD.

Objectives: The objectives of this study were to 1) examine similarities and differences across groups in emotion regulation behaviour, and 2) examine which parent behaviour is helpful for school-aged children during a frustrating situation.

Methods: Twenty-one children with ASD and 20 typically developing children (age 7-12; IQ > 70) and a parent were recruited as a part of a larger social interaction study. Parent-child dyads participated in a task adapted from Melnick & Hinshaw (2000), where they were asked to build two Lego animals. Pieces were stuck together to make the task frustrating. The dyads' behaviour was coded for two minutes after they noticed the stuck pieces. The presence of the behaviours in every ten second interval was coded: parent or child problem-solving (looking at instructions, using other pieces, persisting to unstick the pieces) or cognitive reappraisal, child venting, child asking for social support, parent praise and encouragement, parent unhelpful behaviour, and parent emotional support. Child emotional expression was also coded in each interval: positive, neutral, or negative.

Results: There were no mean group differences in coded parent behaviour. As presented in Table 1, typically developing children were more likely to *use instructions* (exp(B) = 1.44, Wald χ^2 = 5.43, p = .02), *display positive emotions* (exp(B) = 3.79, Wald χ^2 = 9.75; p = .002), and *vent* (exp(B) = 1.78, Wald χ2 = 3.03, p = .08) compared to children with ASD. For children with ASD, helpful parent strategies (i.e., associated with a decrease in child negative emotion in the next 10 second interval) included working on the stuck Lego pieces (Yule's Q = .24) and cognitive reappraisal (Fisher's Exact Test p = .04, V = .20). For TD children, helpful parenting strategies included emotional support (Fisher's exact test p = .08, V = .23) and focusing on other Lego pieces to solve the problem (Yule's Q = .44). Please see Table 2 for more information

Conclusions: Although parenting behaviours were similar for both groups, different parent strategies were associated with a decrease in negative emotion in children with and without ASD. Typically developing children displayed more variety in their emotion during the task (i.e., more positive expressions and more venting) suggesting that emotion regulation difficulties in school-age children with ASD may not be restricted to a problem with negative emotions. The findings have implications for the design of emotion regulation interventions in identifying common parenting strategies that work for all dyads and those that are especially effective for children with ASD and their parents.

420.030 *(Poster)* Symptom Profiles and Correlates of Anxiety and Depression Among Parents of ASD Girls and ASD Boys

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Background: Parents of a child with Autism Spectrum Disorder (ASD) also experience greater anxiety and depression than parents of non-ASD children. To date, no study has directly compared the anxiety and depression levels of parents of ASD boys compared to ASD girls.

Objectives: Four research questions were addressed: 1. Were there any significant differences in the anxiety or depression severity between parents whose ASD child was female versus those whose ASD child was male? 2. Were there any significant differences in the anxiety and depression symptom profile severity of parents whose ASD child was female than those whose ASD child was male? 3. Were age, IQ or ASD severity significant correlates of parental anxiety or depression when examined within child sex subgroups? 4. Were age, IQ and ASD severity significant correlates of the symptom profiles of anxiety or depression for either subgroup of parents, and did those correlations differ across parents of males versus females?

Methods: Fifty-one parents of young ASD males (*M* age = 10.2yr, SD = 2.8yr, range to 6 to 17yr) and 51 parents of ASD females (*M* age = 10.1yr, SD = 2.7yr, range to 6 to 17yr), completed the GAD7 and PHQ9. Their children were matched on age and WASI-II Full Scale IQ, but the girls had significantly higher ADOS-2 scores than the boys. Statistical processes covaried age, IQ and ADOS-2 scores out of the analyses to address Research questions 1 to 4.

Results: Research question 1. There was no significant effect for sex of child, nor any significant univariate effects for GAD7 or PHQ9; Research question 2. There were two significant univariate effects for child's age at the Bonferroni-corrected *p* value of .05/7 = .007. These were *Being so restless it's hard to sit still*, and *I have trouble relaxing*, both of which were medium to large effects; Research question 3. IQ was significantly and inversely associated with the GAD7 total scores of parents of ASD boys but not for ASD girls' parents; Research question 4. The Pearson correlation coefficient between WASI-II FS IQ and the GAD7 item *I have trouble relaxing* for ASD girls' parents was -.022, which was significantly lower than that for the ASD boys' parents.

Conclusions: These data report the absence of widespread differences in the overall global levels of anxiety and depression across parents of ASD boys and ASD girls, although there were some differences in the ways that aspects of the ASD child interacted with their sex to influence specific parental somatic symptoms of GAD and MDD. The findings regarding differential correlates to parents' GAD7 and PHQ9 symptoms are particularly novel, and suggest that (as with non-ASD children) different aspects of their sons' or daughters' age, cognitive ability, and neurological profiles may contribute to different manifestations of some of the key symptoms of anxiety and depression in parents.

420.031 *(Poster)* The Association between Autism Traits and Maladaptive Daydreaming

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Background: Daydreaming is a common and often useful mental activity. Some individuals immerse themselves in elaborate mental narratives and worlds, to the extent that it interferes with daily functioning. “Maladaptive daydreaming” may be more prevalent in those who experience difficulties with social interaction and emotion regulation, and who have stereotyped repetitive behaviors (Somer et al., 2017; West & Somer, 2019). These features are similar to some of the core characteristics of autism spectrum disorder (ASD); However, the overlap in symptoms between these conditions has not been tested. Although deficits in imagination have been reported (e.g., reduced creative fluency), individuals with ASD are reported to generate ideas that are more original and novel compared to individuals with typical development (Best et al., 2015; Liu et al., 2011). More broadly, little is known about the internal mental experiences of individuals with ASD. Here, we theorize that the tendency to fixate on unique thoughts or daydreams is related to autism traits. Daydreaming may serve to supplement difficult real-life relationships in ASD.

Objectives: The current study investigated the association between maladaptive daydreaming and broad ASD traits. Further, we tested whether the association between ASD traits and maladaptive daydreaming was mediated by loneliness, emotion regulation difficulties, and restrictive and repetitive behaviors. Exploratory items probed whether the content and context of daydreaming activity varies with ASD traits.

Methods: Adult participants (N = 386, 278 females; M_{age} = 25), recruited online, completed an online survey consisting of the following previously-validated measures: The Autism-Spectrum Quotient (AQ), Maladaptive Daydreaming Scale (MDS), UCLA Loneliness Scale, Difficulties in Emotion Regulation Scale – short form (DERS-SF), and the Adult Repetitive Behavior Questionnaire-2 (RBQ-2A). We also included novel exploratory questions about daydreams.

Results: All standard measures were significantly positively correlated. The level of ASD traits significantly predicted maladaptive daydreaming symptoms (Figure 1), controlling for demographic variables. Moreover, loneliness and difficulties with emotion regulation were significant mediators of the relationship between ASD traits and maladaptive daydreaming (see Table 1).

Individuals with higher levels of ASD traits reported greater prevalence of violent or tragic content in daydreams compared to individuals with lower levels of ASD traits. However, there were no differences in the level of detail and degree of realism of daydreams, nor in the reasons for or triggers of daydreaming. Participants reported that their most common imagined identities were a “better version” of oneself (63% of the time) or a novel identity (54% of the time), rather than imagining their “real” self (29% of the time), a celebrity (18% of the time), or someone they know (7% of the time). Identities did not differ according to ASD traits.

Conclusions: Results support the hypothesis that ASD traits and maladaptive daydreaming symptoms are associated, and further suggest that the ability to imagine detailed fantasy scenarios is not limited by ASD traits. These two conditions may reflect similar mechanisms, particularly regarding social isolation and emotion regulation difficulties. A fixation on internal narratives may simulate social and emotional needs in those with higher levels of ASD traits.

420.032 *(Poster)* The Differential Impact of Emotion Intensity on Speech and Song-Evoked Emotion Recognition Among Children with ASD and TD

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Background: The commonly accepted dogma of difficulties in inferring others’ emotions from various social cues among persons with ASD needs to be recast in relation to context. For example, the emotion recognition abilities of persons with ASD, like those of others, are highly influenced by factors such as the intensity to which emotions are conveyed and the level of social pragmatic language skills. Emotion recognition also varies across modality. For example, persons with ASD can accurately recognize music-evoked emotions.

Objectives: In order to fine-tune our understanding of emotion recognition in ASD, we examined the relation between specific emotions, emotion intensity, and social pragmatic language skills on the recognition of speech and song-evoked emotions.

Methods: Twenty-six children with ASD (mean age = 10.9 years; VCI = 77.8) and 21 TD children (mean age = 9.0 years; VCI = 101.6) completed a computerized task in which they identified emotions of high or normal intensity from spoken or sung sentences with neutral semantic content. The Verbal Comprehension Index (VCI) of the WISC-V was administered to the participants and caregivers completed three subscales of the Child Communication Checklist-2 measuring quality of initiating social conversations, scripted language, and adapting conversation to different contexts.

Results: A repeated-measures ANOVA with stimuli modality (speech vs. song), emotion (happy, sad, angry), and intensity (high vs. normal) as within-subject factors, participant group (ASD vs. TD) as a between-subject factor, VCI as a covariate, and emotion recognition accuracy as the dependent variable revealed a significant main effect of emotion (p = .046), in which anger was the most easily recognized emotion. VCI, and not participant group, had a significant effect on emotion recognition accuracy. A significant group X intensity interaction (p = .035) indicated that children with ASD, but not those with TD, responded more accurately in recognizing high intensity as compared to normal intensity emotions. A separate repeated-measures ANOVA with response time as the dependent variable revealed a marginally significant group X intensity X stimuli interaction (p = .05) such that the ASD group showed faster response times for high (vs. normal) intensity emotions conveyed in speech but not in song, while the response times of the TD group showed similar response times across intensity and modalities. A regression analysis revealed that a component of social pragmatic skills (i.e., quality of initiating social conversations) was associated with emotion recognition accuracy for the TD group but not for the ASD group.

Conclusions: These findings suggest that emotion recognition among children with ASD is impacted by intensity, particularly for speech-evoked emotions, while an effect was not observed among the children with TD, who performed comparably across intensity conditions and modalities. Findings replicate previous work showing associations between verbal skills and emotion recognition of children with ASD. In contrast, social pragmatic language skills were not related to emotion recognition of children with ASD. These findings suggest that interventions targeting emotion recognition of children with ASD may be ameliorated by first teaching emotions that are intensely conveyed followed by those that are more subtle.

420.033 *(Poster)* The Relationship between Social Anxiety and N170 ERP Responses to Emotional Faces in Young Adults Along the Broader Autism Phenotype

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by deficits in communication and social interaction. Trait social anxiety is often co-morbid with ASD. Individuals with ASD show impairments in emotion identification, especially for negative emotions and complex emotions. Adults with social anxiety also show impairments at identifying emotional expressions but attribute more intense emotions to faces than neurotypical adults. Deficits in emotion identification may be related to differences in brain activity necessary for facial recognition. In particular, the N170 event-related potential of electroencephalograph (EEG) is sensitive to the neural processing of faces. Thus, examining N170 activity during face processing may help reveal the neural correlates of early emotion identification in individuals varying in social anxiety and give insight into the neural mechanisms associated with face processing challenges in ASD.

Objectives: The purpose of the current study was to test whether the neural processing of facial expressions differs as a function of levels of social anxiety and task type in individuals along the broader autism phenotype (BAP) in order to better understand emotion processing related to ASD and its co-morbid conditions. The current study uses both full-face and eye region stimuli to control for known behavioral scanning differences and to isolate the resulting impact on neural activity.

Methods: Neurotypical participants varying in autistic traits (n=34) completed an emotion identification task while EEG data were recorded. For each trial, a face depicting an emotion (i.e., happy, angry, fear, surprise) or a neutral expression was presented for 1000 ms; an inter-stimulus interval of 500 ms was used between trials. In half of the trials, participants indicated if the emotion of the face matched that of the face presented before it (matching task). In the other trials, participants indicated if the emotion of the face was positive or negative (valence task). Each participant completed the Social Phobia and Anxiety Inventory (SPAI) to measure their level of social anxiety.

Results: A 5 (Emotion: Angry, Fear, Happy, Neutral, Surprise) x 2 (Task: Valence, Matching) x 2 (SPAI: Low, High) mixed model Analysis of Variance (ANOVA) was conducted and a significant three-way interaction emerged. For the matching trials, there were no significant effects. For the valence task, however, there was a significant Emotion x SPAI interaction revealing an effect for surprise, such that participants with greater social anxiety showed larger N170 amplitudes to surprised faces compared with participants with lower social anxiety.

Conclusions: These results provide a better understanding of neural activity during emotion processing for those on the BAP and add to work investigating the neural underpinnings of emotion processing deficits in individuals with conditions co-occurring with ASD.

Epidemiology/Population Studies

ORAL SESSION — EPIDEMIOLOGY/POPULATION STUDIES
313 - Early and Prenatal Risk

313.001 *(Oral)* Differentiating Pop and DD Controls in Autism Research: New Findings from the Study to Explore Early Development

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Background: Studies investigating autism spectrum disorder (ASD) phenotypes rely on contrasting samples of individuals described as typically developing population controls (POP) and/or developmentally delayed *without* ASD (DD). However, this case-control approach presupposes categorical distinctions between these samples and often neglects robust characterization of the control groups, despite evidence that ASD traits are continuously distributed throughout the population (Constantino and Todd, 2003). Investigation of the overlapping distributions of ASD traits and other cognitive/behavioral features of control samples can highlight this issue, and present opportunities to derive meaningful observations that go beyond subtype characterization.

Objectives: Extending Wiggins et al.'s (2015) description of ASD symptomatology in Phase 1 of the Study to Explore Early Development (SEED 1), the objective of this study is to investigate the overlapping phenotypes in SEED 1&2 participants.

Methods: SEED (Schendel et al., 2012) is a multi-site case-control study of children ages 2-5 with well-defined POP, DD and ASD samples. The Social Communication Questionnaire (SCQ) was administered to all participants regardless of recruitment source (clinic, school, population, etc.), and any participant with SCQ >=11 received a comprehensive evaluation. ASD case status was based on Autism Diagnostic Observation Schedule (ADOS) and Autism Diagnostic Interview-Revised (ADI-R) results; participants not meeting the ASD case definition received a final case status based on recruitment source (DD or POP). As a result, the DD comparison group includes a sub-group of children with ASD symptoms. In the current analysis the DD group was sub-divided into DD with and without ASD symptoms. One-way Analysis of Variance was used to asses mean differences in SRS and Mullen scores between groups.

Results: The SEED 1/2 dataset contains 6,222 participants, including those with a final case status of ASD (1,499), DD (602 with ASD symptoms, 1,763 without ASD symptoms) and POP (2,358). Mean SRS total raw scores differed significantly (n=4,136, F=2017.84, p<.01) by group: ASD (M=92.6, SD=29.3), DD with ASD symptoms (M=68.3, SD=27.9), DD without ASD symptoms (M=35.3, SD=21.4) and POP (M=25.5, SD=17.6). A similar statistically significant pattern (n= 5,039, F=1,153, p<.0001) was observed in the Early Learning Composite (ELC) standard score from the Mullen: ASD (M=65.8. SD=20.7), DD with ASD symptoms (M=79.6, SD= 19.1), DD without ASD symptoms (M=88.4, SD= 21.4), and POP (M=102.7, SD=16.6). These results are consistent with those reported by Wiggins et al. (2015) for SEED 1. However, despite significant mean differences on these measures across study groups, the distributions of these measures for the four study groups overlap considerably for both males and females (Figure 1 & 2) and suggest a pathological shift in score distribution for each group as expected by categorical classification.

Conclusions: The POP, DD, and ASD groups derived in SEED 1/2 for case-control purposes demonstrate the expected phenotypic differences, but rigorous phenotyping of the DD group allows for more meaningful characterization of individuals based on symptom profile rather than assigned final case category. The patterns of overlap in the distributions for autistic traits and cognitive abilities are highly homologous, supporting the need to derive profiles based on multiaxial symptom quantification.

313.002 *(Oral)* The Family Morbidity Risk Score for Autism

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Background: Family morbidity history is an important predictor of autism and likely reflects both genetic and environmental risk factors. However, systematic investigations of different morbidities and family members to elucidate the underlying structure of family morbidity risk for autism are lacking.

Objectives: Identify the optimal family morbidity history model to predict autism risk based on multiple psychiatric, neurologic and somatic disorders across six family member types.

Methods: Using linked Danish national registries, we identified all Danish live births, 1980-2012 (n=1,697,231), their 3-generation family members and morbidity diagnoses reported prospectively for each family member through April 10, 2017. 353 morbidity indicators were included in the analyses. They comprised of 73 mutually exclusive psychiatric, neurologic, cardiometabolic, congenital defect, autoimmune, asthma, and allergy conditions across six family member types (mother, father, full siblings, grandparents, cousins, aunts/uncles). Using a machine learning approach, we tested a variety of competing models to determine the optimal model for predicting autism risk across different algorithms: Random Forest, Extreme Gradient Boosting, the traditional generalized linear model, Neural Networks, Support Vector Machines, K nearest neighbors and three ensemble learning techniques. We calculated a family morbidity risk score (FMRS) based on the best performing model and estimated odds ratios and 95% confidence intervals (95%CI) for the risk of receiving an autism diagnosis adjusting for gender, birth year, birth weight, gestational age and parental ages.

Results: 26,840 (1.6%) cohort members received an autism diagnosis during follow-up. The best model included 41 morbidity indicators and performed better on all investigated performance measures compared to considering parental psychiatric history alone. For example, the FMRS demonstrated a 50% increase in sensitivity and a 27% increase in observed vs predicted accuracy. Table 1 presents an overview of the 41 morbidity indicators in the best performing model. It comprised all family member types, 8 mental morbidities (e.g., neurotic/stress disorders, personality disorders, different child onset disorders,) and 9 somatic morbidities (e.g., obesity, hypertension). We observed a dose-response relationship between the FMRS and autism (see figure 1). On average, 1 in 154 cohort members in the lowest FMRS group had an autism diagnosis vs 1 out of 6 in the highest group. Cohort members in the highest compared to the lowest FMRS group had a 15-fold increase in autism risk (OR: 15.4; 95%CI: 14.0-17.1). In contrast, autism risk was 2-fold (OR: 1.98; 95%CI, 1.97-2.08) considering only parental psychiatric history and 6-fold (OR: 6.1; 95%CI, 5.86-6.38) considering only full sibling autism history. There was no evidence of sex differences in FMRS-based risk estimates.

Conclusions: A machine-learning based FMRS based on 17 morbidities in 6 family member types outperformed traditional, single measures of family morbidity history in terms of associated autism risk and risk prediction. Although individual risk prediction is still poor, these results indicate family morbidity history relevant to autism risk may extend beyond psychiatric conditions in parents and siblings. We view this as one approach to a better understanding of familial morbidity liability patterns underlying autism risk, which may elucidate both autism etiology and future individual risk prediction algorithms.

313.003 *(Oral)* The Association between Birth Order and Clinical Phenotypes at Autism Diagnosis

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Background: Birth order effects have been linked to a wide variety of outcomes, including intelligence, educational attainment, and sexual orientation. Although there is evidence that increasing birth order is associated with decreased intellectual functioning in ASD, effects on other aspects of clinical phenotype are less well understood, and no study has used a whole of population dataset to examine this relationship.

Objectives: In this study, we investigated the association between order of birth and clinical diagnostic phenotypes in large cohort of children diagnosed with ASD in Western Australia.

Methods: Clinical data on cases (n = 5941) were obtained from an ongoing prospectively collected registry (the 'Western Australian Autism Register'), with cases notified to the register by clinicians at the time of diagnosis, between 1999 to 2017. Data reported included demographic characteristics, diagnostic criteria met, IQ, and functional abilities. Information about any siblings, relationship (full/half), sex, and diagnosis of ASD were also recorded. Birth order was calculated by ranking sibling's year of birth against case year of birth to establish order within a family. Due to smaller numbers of cases born fifth or later (<2%), cases were only included for analysis for birth order up to four. Linear regression models were used to test whether birth order predicted adaptive functioning and IQ scores, and generalised linear models used to test associations between birth order and categorical outcomes (having an intellectual disability, being male, having a sibling diagnosed with ASD, having a female sibling diagnosed with ASD). All models were adjusted for age and year of diagnosis, with first-born cases the reference group.

Results: After adjusting for age and year of diagnosis, relative to being First Born, there were significant associations between birth order and adaptive functioning. On average, later born children had lower adaptive functioning scores, which became more pronounced with increasing birth order. For example, Second Born cases on average had a -1.83 (95% CI -2.93, -0.73) reduction in adaptive functioning scores while Fourth Born cases exhibited an average -4.28 reduction (95% CI -6.60, -1.95), relative to those First Born. No statistically significant association was found between birth order and IQ or having an intellectual disability. Increasing birth order was significantly associated with an increased proportion of siblings diagnosed with ASD. 4.8% of First-Born cases had a sibling diagnosed with ASD compared to 13.1% and 17.0% of Second or later-born cases, respectively. There was also a significantly higher proportion of female siblings diagnosed with ASD in later born children (48.1%), compared to those born first (14.8%).

Conclusions: The current study provides convincing evidence in a very large and representative sample that variability in ASD diagnostic phenotypes is associated with an individual's birth order. Children born later have increased adaptive functioning impairments relative to first-born children and are more likely to be in a family with other siblings also diagnosed with ASD. These data have significant implications for understanding underlying mechanisms that contribute to heterogeneity in ASD clinical presentations as a function of birth order and family size.

313.004 *(Oral)* Maternal Peri-Pregnancy Cannabis Use and Problem Behaviors in Children with and without Features of Autism Spectrum Disorder: Study to Explore Early Development (SEED)

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Background: Past-month cannabis (marijuana) use by pregnant women in the US doubled between 2015 (3.4%) and 2017 (7.1%). In several longitudinal studies, prenatal cannabis use adversely affected child behavior and development. Such effects may present differently in children with features of autism spectrum disorder (ASD).

Objectives: Examine associations of maternal peri-pregnancy cannabis use with child behavior and development; explore whether associations are modified by ASD features.

Methods: Participants were children 30-68 months-old, born in 2003-2006 or 2008-2011, and their mothers. "Children with ASD features" (N=2052) either met study criteria for ASD based on standardized diagnostic instruments or had a developmental delay or disorder (DD) and one of the following: previous ASD diagnosis, ASD risk on a standardized screening tool at enrollment, or clinician suspicion of ASD during study evaluation. "Children without ASD features" (N=2966) had a known DD without any criteria noted above or were from the general population. Mothers were asked about their cannabis use from 3 months preconception through delivery ("peri-pregnancy use"). Outcomes were child behavior (including sleep problems) assessed via the Child Behavior Checklist and developmental level via the Mullen Scales of Early Learning. Linear mixed-effects models estimated adjusted mean differences (AMD) in T-scores between offspring of peri-pregnancy cannabis users and offspring of non-users, controlling for study site, maternal education, and prenatal alcohol and tobacco use; likelihood ratio tests were used to assess interaction with ASD features.

Results: Peri-pregnancy cannabis use was reported by 5.4% (n=118) of mothers whose children had ASD features and 4.0% (n=111) of mothers whose children did not. Peri-pregnancy cannabis use was associated with a higher mean aggressive behavior score among children with ASD features (AMD between offspring of cannabis users vs. non-users=2.60 [95%CI:0.97, 4.23]) but not children without ASD features (AMD=0.19 [-1.34, 1.72]; test for interaction, p=0.029). Peri-pregnancy cannabis use was associated with a higher mean sleep problems score among children with ASD features (AMD=2.33 [0.77, 3.90]) but not children without ASD features (AMD=-0.43 [-1.09, 1.04]; test for interaction, p=0.009). Associations between peri-pregnancy cannabis use and attention problems, internalizing behaviors and developmental level did not differ for children with and without ASD features (tests for interaction, p=0.247, p=0.709, p=0.721, respectively). The mean attention problems score was significantly higher among offspring of peri-pregnancy cannabis users (AMD=1.09 [0.04, 2.13]). Mean internalizing behavior score and developmental level did not differ by peri-pregnancy cannabis use.

Conclusions: Maternal peri-pregnancy cannabis use was associated with more aggressive behaviors and sleep problems only among children with ASD features. Several potential explanations warrant further research. Cannabis use may act synergistically with other factors, such as underlying genetic risk or environmental exposures, to amplify regulatory problems in children with ASD features. Alternatively, there may be a common underlying etiology (e.g., genetic predisposition) resulting in mothers using cannabis and having children with ASD features and problem behaviors. Mothers who use cannabis may also differentially report both ASD features and problem behaviors in their offspring. With rising cannabis use among pregnant women, future studies should monitor behavioral outcomes among children with ASD features.

POSTER SESSION — **EPIDEMIOLOGY/POPULATION STUDIES**

421 - Epidemiology/population studies Posters

421.001 *(Poster)* Assessing the Associations between Autism, Autistic Traits and Multiple Risk Behaviours in Adolescence: A Population-Based Birth Cohort Study

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Background: Multiple risk behaviours (MRBs), engagement in two or more risk behaviours, typically begin in adolescence, often co-occurring in individuals. Risk behaviours include: smoking, alcohol consumption, cannabis use, illicit drug use, risky sexual behaviour and anti-social/criminal behaviour, among others. Considering the multiplicity and diversity of risk behaviours is of public health importance as MRBs are associated with increased risk of downstream adverse health and social outcomes. There is mixed evidence relating to autism/autistic traits and MRBs. With a dearth of literature on this topic, there is little understanding of the relationships between autism and autistic traits and MRBs, which should be addressed.

Objectives: To investigate whether autism cases and autistic traits predict engagement in MRBs across adolescence in a large cohort study in England.

Methods: ***Study setting and participants***

Data were from child participants in the Avon Longitudinal study of Parents and Children (ALSPAC), a longitudinal birth cohort study, established in Bristol and the surrounding areas in 1991. The sample includes 14,601 children who were alive at 1 year of age.

Exposure measures

Autism diagnosis and severe presentation of four autistic traits were the exposures of interest. Autism diagnoses were identified via a multi-source approach, including clinical record review, educational record review and validation by a consultant paediatrician using the *International Statistical Classification of Disease, 10th revision*. The top 'high risk' decile of each autistic trait distribution in participants who completed questionnaires were also selected. The traits were: social and communication difficulties as measured by the Social Communications Disorder Checklist (SCDC), assessed at 91 months; coherence assessed at 115 months; repetitive behaviours assessed at 69 months and sociability assessed at 38 months.

Outcome measures

Continuous measures of participation in up to 13 risk behaviours at ages ~ 12, 14, 16 and 18 years were derived from participants' responses during ALSPAC data collections.

Statistical analysis

We used structural equation (SEM) modelling approaches to investigate the associations between (i) autism cases and (ii) severe presentation of four autistic traits, and MRB total score at ages ~ 12, 14, 16 and 18 years. SEM approaches included latent growth curve and latent basis growth curve modelling techniques. The latter was used to test non-linearity. We also tested whether these relationships are moderated by sex.

Results: Analysis using both SEM approaches led to similar estimates. As illustrated in Table 1, the results suggest that when compared to population-based controls, social interaction and communication difficulties, repetitive behaviours and coherence issues are all positively associated with MRBs at age ~12 years. Social communication difficulties are also positively associated with MRBs over adolescence. Having an autism diagnosis and reduced social temperament are both negatively associated with MRBs over adolescence. There was evidence for sex-specific differences; males rather than females with autism or autistic traits are at greater risk of MRBs, particularly at ~12 years of age.

Conclusions: The effect of having a diagnosis of autism and autistic traits appears to have different effects on risk of engaging in MRBs during adolescence. These associations are moderated by sex.

421.002 *(Poster)* Association between Neighbourhood Socioeconomic Status and Developmental Vulnerability of Kindergarten Children with Autism Spectrum Disorder across Canada

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Background: There is increasing consensus that inequalities in health outcomes of a population may be attributable to factors that operate at an aggregate level, such as neighbourhood characteristics. The relationship between neighbourhood socioeconomic status (SES) and health of children with Autism Spectrum Disorder (ASD) remains poorly understood.

Objectives: To examine the association between neighbourhood SES and developmental vulnerability at the individual level across neighbourhoods, while controlling for individual SES, among kindergarten children with ASD living in Canada.

Methods: This study used data from a population-level database of child development in kindergarten, collected with the Early Development Instrument (EDI). The EDI is completed by kindergarten teachers, includes records of medical diagnoses, and has been administered at the population level in most Canadian provinces and territories. The EDI data provide information on children's developmental status in 5 domains: physical health and well-being, social competence, emotional maturity, language and cognitive development, and communication skills and general knowledge. Scores below a baseline 10th percent cut-off on any of the 5 domains indicate vulnerability. Neighbourhood SES was assessed using an SES index created using 10 variables from the 2011 Canadian Census and 2010 Taxfiler data. Individual SES was assessed using 4 variables from the 2016 Canadian Census data. Multilevel logistic regression analyses were used to examine the association between neighbourhood SES and developmental vulnerability of the child, while controlling for individual SES and demographic characteristics and accounting for clustering of children in neighbourhoods.

Results: Higher neighbourhood SES was associated with lower odds of vulnerability in most domains, but not in all provinces. Specifically, higher neighbourhood SES was associated with lower odds of vulnerability in the Physical Health and Well-Being domain in Ontario (OR: 0.90, 95% CI: 0.83 to 0.98; $p<0.05$); in the Social Competence domain in Ontario (OR: 0.89, 95% CI: 0.81 to 0.98; $p<0.05$), in the Emotional Maturity domain in British Columbia (OR: 0.73, 95% CI: 0.58 to 0.91; $p<0.05$); in the Language and Cognitive Development domain in Ontario (OR: 0.87, 95% CI: 0.79 to 0.95; $p<0.01$), and in Manitoba (OR: 0.73, 95% CI: 0.55 to 0.99; $p<0.05$); and in the Communication Skills and General Knowledge domain in Ontario (OR: 0.85, 95% CI: 0.78 to 0.94; $p<0.01$). In Nova Scotia only, higher neighbourhood SES was associated with higher odds of vulnerability in the Social Competence domain (OR: 2.20, 95% CI: 1.14 to 4.22; $p<0.05$) and in the Communication Skills and General Knowledge domain (OR: 2.27, 95% CI: 1.15 to 4.53; $p<0.05$).

Conclusions: Meaningful associations between higher neighbourhood SES and better developmental health of children with ASD were found for most domains, but not consistently in all Canadian jurisdictions. Children with ASD living in neighbourhoods with higher SES are less likely to demonstrate developmental vulnerability, emphasizing the importance of addressing neighbourhood deprivation to support the development of children with this disorder. The nation-wide implementation of the EDI provides a large representative sample, improving generalizability of study findings.

421.003 *(Poster)* Association of Adverse Birth Outcomes of Parents with Autism Spectrum Disorder in Their Offspring

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Background: Preterm birth and low birth weight in children are considered risk factors for ASD. However, the relationship between adverse birth outcomes of the parents, likely resulted from unfavorable intrauterine growth and development, and ASD risk in their offspring have remained unexplored.

Objectives: We conducted a nationwide register-based cohort study in Denmark of three generations to investigate whether parental preterm birth and/or low birth weight was associated with increased risk of autism spectrum disorder (ASD) in their offspring.

Methods: Danish mothers and fathers born since 1978 who have had singleton live-born offspring registered in Denmark during 1990-2013. We identified 230,180 mother-child pairs and 157,926 father-child pairs for statistical analyses. Information of preterm birth (<37 weeks gestation) and low birth weight (<2500 gram) of parents were obtained from the Danish Medical Birth Register. ASD diagnoses in offspring were ascertained from the Danish Central Psychiatric Registry. We estimated Odds Ratio (OR) and 95% confidence intervals (CI) for offspring ASD according to the parental preterm and low birth weight status, with or without adjustment for grandmaternal sociodemographic factors including age, parity and education level.

Results: Children of mothers with adverse birth outcomes were associated with about 30% higher risk for ASD (low birth weight, OR=1.35, 95% CI: 1.17-1.57; preterm birth, OR=1.31, 95% CI= 1.12-1.55) compared with mothers who were born with normal birth weight or born at term. Paternal adverse birth outcomes were also associated with about 40% elevated risks for ASD in the offspring (low birth weight, OR=1.38, 95% CI= 1.12, 1.55; preterm birth, OR=1.43, 95% CI=1.18, 1.73). These associations were slightly attenuated upon adjustment for grandmaternal sociodemographic factors. A small portion of these associations was found to be mediated through parental health and perinatal risk factors for the offspring.

Conclusions: Offspring of parents born preterm or low birth weight showed slightly elevated risks for ASD. Adverse birth outcomes in parents might act as a proxy that indicates harmful in-utero exposures of parents that transmitted disease risks to the next generations through germlines effect. In addition, parents with adverse birth outcomes could result in poorer overall health and persistent sociodemographic disadvantages that impact their reproductive health and disease risks in their offspring. Transgenerational risks for ASD should be considered in future research of ASD etiology.

421.004 *(Poster)* Association of Grandparental and Parental Age with ASD: A Multi-Generational Cohort Study in Denmark

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Background: Advanced parental age has been linked with increased risk of Autistic Spectrum Disorders (ASD) in children. However, little is known for the relationship between grandparental age at the time of birth of the parent and risks for ASD in children.

Objectives: We conducted a population-based multigenerational cohort study in Denmark and investigate the associations between parental and grandparental age and ASD risks in children.

Methods: We conducted a linkage study using multiple Danish national health registers. We first constructed a parental age cohort and evaluated the association between parental age and ASD risks in 1,476,783 singleton children born from 1990 to 2013 with available information on parental age. We additionally constructed a multigenerational cohort to study grandparental age by following 362,438 fathers and 458,234 mothers born from 1973 to 1990 whose information on grandparental age were available and evaluated the risks of ASD in grandchildren. Exposures of interests were parental age at childbirth and grandparental age at the time of the birth of the parent. Diagnoses of ASD in children were obtained from the Danish Psychiatric Central Research Register (1994-2017) based on the International Classification of Disease, Tenth Revision. Logistic regression was used to estimate the associations between parental or grandparental age and ASD in children.

Results: Advanced paternal or maternal age over 30 years was monotonically related to increased ASD risks among children. We additionally observed U-shaped relationships between paternal grandparental age and ASD risks in the grandchildren e.g. about 12-40% elevated risks of ASD in children of fathers born to younger (≤19 years) or older (≥40 years) grandparents, compared to children of parents born to grandparents between age 25 to 29 years. Moreover, children with young maternal grandparents (≤19 years) also had 50-68% elevated risks for ASD, but no apparent associations were observed for older grandparental age.

Conclusions: Our study corroborated previous findings that advanced parental age was independently related to increased ASD risks in children. We additionally observed that children with young maternal grandparents, and children with young and old paternal grandparents had elevated ASD risks. Our findings suggested possible transmission of ASD risks across generations, which should be considered in future etiological research on ASD.

421.005 *(Poster)* Association of Maternal Plasma Biomarkers of Oxidative Stress with Autism Related Traits in the EARLI Study

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Background: Oxidative stress is known to induce cellular effects including protein oxidation, lipid peroxidation, and DNA damage, each of which have been related to dysregulated fetal brain development. Glutathione (GSH) is an antioxidant important in preventing damage due to reactive oxygen species. The oxidized form of GSH, glutathione disulfide (GSSG), is increased when cells are experiencing oxidative stress. The ratio of GSH:GSSG, a marker of oxidative stress, decreases during periods of oxidative stress. Though oxidative stress is a key mechanism hypothesized in the etiology of autism spectrum disorder (ASD), studies examining biomarkers of oxidative stress during critical windows of neurodevelopment are lacking.

Objectives: To examine whether maternal prenatal levels of oxidative stress biomarkers are associated with later ASD traits in children.

Methods: Participants were drawn from the Early Autism Risk Longitudinal Investigation (EARLI) study, an ASD enriched-risk cohort that enrolled pregnant mothers who already had a child with ASD, and then followed the subsequent child to age three. Biomarkers of oxidative stress, including GSH and GSSG, and 3-nitrotyrosine were measured in 3rd trimester plasma samples from 183 mothers with outcome information available in their children. Continuous ASD traits were measured using the Social Responsiveness Scale (SRS) preschool version and the Mullen Scales of Early Learning (MSEL) at 36 months. Least squares regression was used to assess the association between maternal oxidative stress biomarkers and child outcomes, including adjustment for potential confounders.

Results: In crude models, we observed a positive association (β=0.492, p=0.024, 95% CI 0.06-0.92), between the ln-transformed ratio of GSH:GSSG and ln-transformed SRS, meaning that for a 10% increase in the ratio of GSH:GSSG (and thereby a decrease in oxidative stress), the SRS total score is estimated to increase by 4.8% (increase in ASD-related traits). In adjusted models accounting for child sex, maternal age, maternal race and ethnicity, maternal education, and pre-pregnancy BMI, the association persisted and strengthened (β=0.529, p=0.012, 95% CI 0.12-0.94). GSH and GSSG examined individually yielded positive and negative associations with SRS, respectively, consistent with the direction found for GSH:GSSG ratio, although individual marker associations were not statistically significant. Parallel analyses examining associations with the Early Learning Composite score of the MSEL demonstrated no significant associations, though estimates were in a plausible direction. No significant associations were observed with 3-nitrotyrosine.

Conclusions: We observed an inverse association between oxidative stress measured in the 3rd trimester of pregnancy via the GSH:GSSG ratio and offspring SRS at age three. The paradoxical association between increased ASD traits and decreased oxidative stress emphasizes the need for further investigation into the role oxidative stress plays in ASD and neurodevelopment. Future analyses will examine potential modifiers and non-linear associations, which may help to explain these findings, as well as investigate other oxidative stress biomarkers involved in lipid peroxidation and DNA damage.

421.006 *(Poster)* Association of Placental Morphology with Autism-Related Traits in the EARLI Study

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Background: Placental morphologic features may yield important insights into factors influencing prenatal fetal development. Previous work has suggested differences in placental morphology between families enriched for autism spectrum disorder (ASD) and those from the general population, but how such features associate with ASD-related outcomes in enriched-risk families is not yet well characterized.

Objectives: To examine whether placental morphologic features are associated with ASD-related outcomes in families with enriched-risk for ASD.

Methods: Participants were drawn from the Early Autism Risk Longitudinal Investigation (EARLI) study, a multisite prospective autism enriched-risk cohort study, which enrolled pregnant mothers who had already had a child with ASD, and followed the subsequent child through the age of three. Analyses here include mother-child pairs with data on placentas and offspring outcome data (n=129, including 21 children with a diagnosis of ASD at age 3). Outcomes examined include ASD clinical diagnosis, Social Responsiveness Scale (SRS) scores (preschool version), and Mullen Scales of Early Learning (MSEL) Early Learning Composite scores. Placental morphologic features, including placental weight, thickness, eccentricity, perimeter, area, radius, and umbilical cord parameters were examined in association with these outcomes using multivariable linear regression models adjusting for maternal demographic factors, body mass index, and the child's sex. We also explored use of principal components analysis (PCA) to create groupings of a wider set of placental morphology features, and examined these components in association with our outcomes as well.

Results: Although unadjusted analyses showed some associations of placental morphologic features with SRS and MSEL scores, these did not persist after adjusting for factors noted above. Results from PCA identified 3 main components, summarizing 83.4% of the variance in these data; these were related to placental shape/cord location, placental surface size, and variance in disc thickness. The z-score of the component summarizing placental shape and cord location (capturing placental radius, umbilical distance from center, and umbilical cord eccentricity, with higher values on the component indicative of a larger placenta and more eccentric cord features) was significantly positively associated with SRS scores in analyses (Beta=6.76, 95% CI 0.08 – 13.45) adjusting for maternal demographic factors and placental weight, but not following adjustment for maternal BMI and child sex (Beta= 6.18, 95% CI -1.10 – 13.47). Other parallel analyses examining associations with the Early Learning Composite score of the MSEL and ASD diagnosis demonstrated no consistent or significant associations.

Conclusions: Our preliminary analyses did not reveal strong associations between placental morphologic features and child ASD-related outcomes, though our sample size was small. Further analyses will examine placental vascular measures and explore other variable reduction and grouping techniques. Given the placenta is the key interface between the mother and the developing fetus, a better understanding of how placental features may relate to ASD is needed.

421.007 *(Poster)* Association of Prenatal Phthalate Exposure with Autistic Traits: Exposure Measurement in Maternal Urine & Meconium

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Background: Phthalates are endocrine disrupting chemicals suspected to adversely affect fetal neurodevelopment. Several epidemiologic studies have linked prenatal phthalate exposure to fetal neurodevelopment in a sexually dimorphic manner. In these studies, phthalate metabolites were measured in maternal urine from pregnancy, reflecting maternal exposure given temporal variability. Meconium, the first stool of the neonate, may be a better biosample to measure fetal exposure as it is more proximal to the fetus than maternal urine.

Objectives: To evaluate the association between phthalate metabolites measured in 3rd trimester maternal urine or in baby's meconium with a quantitative measure of autism-related traits assessed at 36 months in a cohort of children at high risk for Autism Spectrum Disorder (ASD).

Methods: We quantified 14 phthalate metabolites in third trimester maternal urine samples and 13 metabolites in meconium samples collected from children born to mothers in the Early Autism Risk Longitudinal Investigation (EARLI) study, a pregnancy cohort of mothers with an older child already diagnosed with ASD. Phthalate metabolites were measured using liquid chromatography-mass spectrometry. Molar sum of di-2ethylhexl phthalate (DEHP) metabolites, and an anti-androgenic (AA) score using mono-isobutyl phthalate (MiBP), mono-n-butyl phthalate (MnBP), mono benzyl phthalate (MBzP), and DEHP metabolites were computed. Autism-related phenotype was measured at 36-months using the Social Responsiveness Scale (SRS). Among children with available SRS and maternal urine samples, and among those with SRS and meconium samples, we evaluated the association of log-transformed phthalate metabolites with log-transformed SRS total raw score, using linear regression models adjusted for *a priori* selected covariates. Quadratic terms were used to explore non-linear associations and interaction terms between child sex and phthalate metabolites were used to explore effect modification.

Results: Eleven metabolites were detected in over 90% of maternal urine samples and only six were detected in over 90% of meconium samples. Two maternal urine metabolites were positively associated with increasing SRS, MnBP, β= 0.19 (95% CI 0.01, 0.38), and mono-3-hydroxy-n-butyl phthalate (MHBP), β= 0.18 (0.02, 0.36), as was the AA score, β= 0.19 (0.02, 0.36). Interpreting the results as a percent change, a 10% increase in MnBP and the AA score would result in a 1.8% increase, and for MHBP- a 1.7% increase in the SRS total raw score. Further, maternal urine mono-carboxy-isononyl-phthalate (MCNP), mono-2-ethyl-5-oxohexyl phthalate (MEOHP), and mono-ethyl-phthalate (MEP) showed inverted U-shaped log-log relationships with child SRS score. Interactions with sex were suggested ($p<0.2$) for mono-3-carboxypropyl phthalate (MCPP), MEOHP, Mono-2-methyl-2hydroxypropyl phthalate (MHiBP), and the molar sum of DEHP metabolites. Meconium phthalate metabolites MnBP, MBzP, and the AA score had similar effect estimates as maternal urine in unadjusted models but were not statistically significant in covariate adjusted models. A statistically significant U-shaped association was observed for meconium MiBP.

Conclusions: Higher levels of a subset of phthalates measured in third trimester maternal urine were associated with higher degree of autism traits, some in a sex-specific manner, in this high-familial autism risk cohort. Phthalates were detected in meconium, but findings were not fully consistent with urine. Further exploration of prenatal phthalate exposure and autism-related phenotype is warranted.

421.008 *(Poster)* Autism Spectrum Disorder Prevalence in Children Aged 12-13 Years from the Longitudinal Study of Australian Children

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Background: There has been an increase in autism spectrum disorder (ASD) prevalence worldwide including Australia.

Objectives: Provide an ASD prevalence update from parent and teacher report using the Longitudinal Study of Australian Children (LSAC).

Methods: The LSAC is a prospective cohort study of Australian children representative of the population with two cohorts: Kinder (birth year 1999/2000) and Birth cohort (birth year 2003/2004). Children in the Birth and Kinder cohort with parent- and teacher-reported ASD prevalence were compared to children without ASD. There were N=3,381 (66%) responding in the Birth cohort at age 12 and N=3089 (62%) for the Kinder cohort at age 16. Main outcome measures were the proportion of parent and teacher reported ASD in the cohorts from age 10-16 years; quality of life measured by the Paediatric Quality of Life Inventory, and emotional/behaviour problems as measured using the Strengths and Difficulties Questionnaire.

Results: Parent-reported ASD prevalence increased to 4.36% [95% CI 3.56 -5.19] at age 12-13 years in the Birth cohort and 2.60% [95% CI 2.07-3.31] in the Kinder cohort. Kinder cohort ASD-children had more parent- and teacher-reported social problems, and lower parent-reported social and psychosocial quality of life.

Conclusions: As expected, parent-reported ASD prevalence continued to rise. Higher prevalence in the Birth cohort may relate to milder cases of ASD being diagnosed.

421.009 *(Poster)* Autism Spectrum Disorder Prevalence in Immigrant Communities in Minnesota: Data from the MN-ADDM Study

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Background: Children of immigrants may have higher rates of autism spectrum disorder (ASD) (Crafa & Warfa, 2015), particularly those from countries with a low human resource index (Barnevik-Olsson et al., 2008; Keen et al., 2010; Magnusson et al., 2012). Through previous surveillance projects, we have been tracking prevalence of autism in Somali and Hmong children in Minnesota. Minnesota has the largest population of Somali immigrants, an estimated 57,000 people, and the second largest population of Hmong, close to 60,000 people (American Community Survey, 2017). In a previous study focused on Minneapolis, Somali children with ASD were far more likely to have co-occurring ID than children with ASD in other racial/ethnic groups (Hewitt et al., 2016; Esler, Hall-Lande, & Hewitt, 2017). However, in a subsequent study with an expanded geographic area, rates of ID did not differ for any racial/ethnic group.

Objectives: We will compare ASD prevalence in 8-year-olds across racial/ethnic groups from the Minnesota site of the CDC Autism and Developmental Disabilities Monitoring Network (MNADDM), surveillance years 2014 and 2016, with a focus on two large racial/ethnic groups in MN: Somali and Hmong. We will also compare the co-occurrence of ID in children with ASD across racial/ethnic groups.

Methods: We will combine data from 2014 and 2016 surveillance years to obtain adequate sample sizes to compare prevalence across our populations of interest. Prevalence calculations utilize standardized ADDM methods (Christensen et al., 2016) involving systematic review of health and special education records of 8-year-old children within our defined surveillance area. The area includes nine school districts in two large urban counties. Population denominators are obtained from the National Center for Health Statistics Vintage 2018 Bridged-Race Postcensal Population Estimates for 2016 and adjusted to include only children living in the surveillance area. A child is classified as Somali or Hmong based on reported home language in education and health records.

Results: Sample sizes from surveillance year 2014 lacked power to detect differences, but estimates revealed nonsignificant trends of higher ASD prevalence for Somali children (1 in 26) and lower ASD prevalence for Hmong children (1 in 54) compared to the overall MN prevalence of 1 in 42 children. To increase power, prevalence estimates from combined surveillance years 2014 and 2016 will be compared across racial/ethnic groups assuming a Poisson distribution. Chi squared and Fisher's exact tests will be used to identify differences between populations. We will also compare rates of ASD for children in MN with overall U.S. prevalence reported by the CDC. Finally, we will compare prevalence of co-occurring ID in children with ASD across racial/ethnic groups.

Conclusions: Because ASD early identification can improve outcomes, identifying subgroups of children with a higher prevalence or more severe forms of ASD can inform public health policy and improve outcomes for individuals with ASD and their families. Differences in prevalence by racial/ethnic group may suggest barriers to service utilization. Culturally sensitive methods for outreach and diagnosis may be warranted to decrease disparities in evaluation and diagnosis of ASD.

421.010 *(Poster)* Comorbidities of Children with Autism Spectrum Disorder at the Time of Evaluation Among a Sample of Puerto Rican Children

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Background: The Autism Spectrum Disorder is a neurobiological condition where deficiencies are presented in various areas such as social communication, and stereotyped behavior patterns, and a conglomeration of various activities and limited interests, among others. This disorder begins from childhood and is prevalent throughout life. Notably, when the DSM-V was released, he introduced the novelty of accepting the possibility of a concurrent diagnosis (or comorbid) autism (ASD) and Attention Deficit Disorder (ADHD). Other studies consider that autism can occur in conjunction with conditions such as intellectual disabilities, speech and language disorders, anxiety, dyspraxia, bipolar disorder, depression and obsessive-compulsive disorder, among others. In the research field, Autism remains an innovative topic. This condition is considered a medical epidemic worldwide. Current statistics in the United States report that 1 in 59 children has autism diagnosis. In Puerto Rico, the prevalence of autism is 1 in every 62 children by 2012. It is noteworthy that Latin American statistics are not updated and research with this population are scarce.

Objectives: This research aims to establish which are concurrent conditions (comorbidities) of children diagnosed with Autism Spectrum Disorder in a Satellite Center at South Puerto Rico. This study will estimate the prevalence of comorbidities presented in children with ASD in a group of Puerto Rican children.

Methods: This study used a database created with interviews from mothers of children with neurodevelopmental conditions that visited the Satellite Center for evaluation purposes and information collected from evaluation reports. For this analyzes only confirmed cases of ASD using DSM-V criteria were included. After quality control, the analyzes were performed with 160 confirmed ASD cases [mean age 5.2 ±2.8]. Statistical analyzes such as univariate and bivariate analyzes were performed, due to sample size nonparametric test were used to assess differences by sex. Prevalence of comorbidities were estimated among the study population in general and by sex.

Results: 82.8% (n=130) of cases were male and 17.2% (n=30) were females. The most frequent reported comorbid disorders were significant Speech and Language delay with 72%(n=103) of cases. Followed by sensory deficits with 26.6% (n=38), and Attention Deficit Disorder and Hyperactivity 25.2% (n=36). When compared reported comorbidities by sex. Male children with ASD were two times more likely to report motor problems than female with ASD (OR=2.0,95%CI 0.9, 7.5). In terms of sensory problems female with ASD were 80% more likely to report sensory problems than male with ASD (OR= 0.2, 95%CI 0.8, 0.5).

Conclusions: This study confirms what's exposed in the literature, that Autism Spectrum Disorder is most often diagnosed in males than females. Also provides a list of signs and symptoms that could lead to a possible diagnosis, being speech delay the principal symptom reported. It is important to continue doing research with the goal to decrease the age of diagnosis and promote early interventions in Puerto Rican children.

421.011 *(Poster)* Comparison of Two Surveillance Case Definitions for Monitoring Prevalence of Autism Spectrum Disorder Among 8-Year-Old Children

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Background: Since 2000, the Autism and Developmental Disabilities Monitoring (ADDM) Network conducts population-based surveillance of autism spectrum disorder (ASD) in multiple US communities among 8-year-old children. To classify ASD, ADDM sites collected verbatim (text) descriptions of behaviors from medical and educational evaluations which were then reviewed and coded by ADDM clinicians. This process was labor-intensive and took at least four years to publish the data from a given surveillance year. The need to produce more timely public health data—combined with increased community recognition of ASD over the intervening time period—led to a re-evaluation of the ADDM methods. We identified a potential new surveillance case definition requiring less time and less data collection and undertook a comprehensive assessment comparing the new case definition to the previous one.

Objectives: To compare and evaluate a new ASD surveillance case definition to the previous ASD case definition in the ADDM Network.

Methods: The new case definition is based on community identification of ASD and includes children with a diagnostic statement of ASD in an evaluation, ASD classification in special education, or an ASD ICD-9 billing code in hospital or other health system records. Using the previous and new case definitions on data from eight ADDM sites for surveillance year 2014, we compared prevalence (overall and within subgroups), as well as other important surveillance indicators including median age at earliest developmental evaluation, median age at first ASD diagnosis, and proportion with co-occurring intellectual disability. Additionally, we examined the percent of children included as ASD cases in all ADDM sites from 2000-2012 that met the new case definition. We estimated the amount of data collection and time required by the new and previous case definitions.

Results: Overall, 4045 children met the previous ASD case definition for surveillance year 2014 compared to 4025 children who met the new case definition, producing ASD prevalence estimates of 1.73% and 1.72%, respectively. Using the previous case definition as the "gold standard", sensitivity of the new case definition was 87.3% and positive predictive value was 87.7%. ASD prevalence by race/ethnicity or sex did not differ between the two case definitions. Median age of earliest evaluation, median age of first ASD diagnosis, or proportion with intellectual disability did not significantly change under either case definition. From 2000-2014, the percent of children classified by ADDM as having ASD that met the new case definition increased from 64.0% to 87.1%, suggesting community diagnoses of ASD have increased over time. The new case definition does not require clinical review and is expected to require about half as much data collection as the previous case definition and yield more timely reporting.

Conclusions: The new ASD case definition is a more direct barometer of community identification of ASD and should considerably reduce resource and time requirements for conducting autism surveillance while retaining very similar measurement properties to the previous case definition. Timely data will be useful in monitoring changes in prevalence and planning for needed services in the community.

421.012 *(Poster)* Cumulative Parental Occupational Exposures and Severity of Autism Spectrum Disorder

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Background: Previously, we found that parental solvent exposure was associated with autism spectrum disorder (ASD) but did not evaluate if parental occupational exposures were associated with the severity of ASD symptoms.

Objectives: To investigate if cumulative parental occupational exposures are associated with the severity of ASD symptoms.

Methods: Between 2003-2012, demographic, health, and parental occupational history information were collected as part of the CHildhood Autism Risks from Genetics and Environment (CHARGE), a population based case-control study that enrolls both children with autism and from the general population who are between the ages of 2 - 5 years old, born in California, living with at least one biologic parent, and residing in the catchment areas of a specified list of California Regional Centers that coordinate services for persons with developmental disabilities. All the children underwent cognitive, social, and medical evaluations at either the University of California, Davis, Medical Investigation of Neurodevelopmental Disorders Institute (UC Davis MIND) in Sacramento, CA or the University of California, Los Angeles (UCLA) Neuropsychiatric Institute and are defined as either ASD or typically developing (TD). After excluding TD children, their parents, and individuals who did not have complete data, 532 children with ASD and their parents were included in this study. Parental occupational exposures were assessed by two industrial hygienists, who reached consensus in categorical exposure scores. For each job that the parent held, the industrial hygienists estimated the frequency and intensity of 12 exposures. Cumulative exposure was then derived by multiplying the [frequency of exposure (0-3)] x [intensity of exposure (0-3)] x [work hours/week] for each job held three months prior to pregnancy until birth of the study child and summing across jobs to create a summary score. The summary score was then log transformed for analysis. The 10-point scale of the Calibrated Severity Score, based on Autism Diagnostic Observation Schedule-2, was used (1 = mild ASD symptoms, 10 = high ASD symptoms) as the outcome. Multiple regression was used to evaluate associations between each of the cumulative occupational exposure scores and ASD severity adjusting for maternal age, smoking, length of breastfeeding, birthplace, regional center, total years of education, and alcohol consumption.

Results: The mean ASD severity score was 7.41 ± 1.55. Maternal occupational exposure to phenol was positively associated with ASD severity (β=1.18, p =0.014) as were pharmaceuticals (β=0.45; p =0.038). There were no occupational exposures in fathers alone that were associated with ASD severity. However, when mothers and fathers were combined, higher ASD severity was associated with occupational exposures to phenols (β=0.91, p < 0.001), pharmaceuticals (β=0.33; p =0.036), and disinfectants/cleaners (β=0.23; p = 0.032).

Conclusions: Data from this observational autism study suggests a linear dose-response relationship of occupational exposures during the pregnancy to phenol, pharmaceuticals, and disinfectants with ASD severity. Higher cumulative exposure levels were associated with higher ASD severity.

421.013 *(Poster)* Distributional Properties and Criterion Validity of a Shortened Version of the Social Responsiveness Scale: Implications for Quantitative Trait Research

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Background: The Social Responsiveness Scale (SRS) is a widely-used and well-established quantitative measure of social communication and autism-related traits with strong psychometric properties. Recently, a 16-item shortened version of the scale was developed, but its performance has not been tested as a stand-alone questionnaire, nor have its properties been examined in a general-population sample.

Objectives: We sought to 1) compare the distributional properties and performance of the 16-item "short version" of the SRS to the original 65-item "full version" and 2) conduct a validation study of these versions (goal n=400).

Methods: 1) Data was drawn from the Environmental Influences on Child Health Outcomes (ECHO) Program. 10 ECHO Cohorts contributed data to these analyses, comprising 2,354 individuals from both general population and ASD-focused studies (aged 3-18 (mean 6.7 years), n=136 with ASD). 16-item scores were derived from existing 65-item data (majority school-aged SRS-2). Distributional properties were compared by density plots of standardized short and full total raw scores. Criterion validity was examined using ROC curves, estimating associations with established ASD risk factors, and assessing correlation in parent-child scores. 2) Participants in our validation study, conducted at the Drexel Autism Clinic seeing patients referred for ASD diagnosis, and through a Kaiser Permanente general population-based sample, were given either the short or full SRS. Analyses comparing distributional properties and basic statistics were conducted based on these administrations.

Results: Within the ECHO data, standardized distributions of short and full SRS scores were highly overlapping; though short scores had a higher peak and slightly narrower distribution, means and overall distributions were comparable, particularly within the higher score range (indicative of greater ASD traits). Furthermore, discriminative ability of the two scores with ASD diagnosis was nearly identical, with area-under-the-curve values of 0.8548 and 0.864 for the full and short forms, respectively. Preliminary analyses of risk factors in ECHO data suggest similar associations between maternal age and both the full and short scores. Correlation in parent-child scores in these data was somewhat stronger based on full scores (r=0.25 for father-child and 0.11 for mother-child) than short (r=0.21 and 0.08), though the number with parental SRS scores (n=124) limited our ability to assess familiality. Within our field validation study, approximately 175 individuals have been enrolled to date, with data available from 80 from the Drexel Autism Clinic. Within this sample, standardized distributions of the two scores differed, with mean scores approximately 2 standardized points higher using the short form than the full scale.

Conclusions: Distributional properties and ASD discriminative ability of the shortened and full SRS appear similar based on existing data deriving short scores from full scale administrations. However, preliminary data from field validation work suggests potential differences in short scores when derived from 16-item stand-alone administrations. These results, together with the need to compare key SRS properties not adequately addressed here (e.g., familiality/heritability), suggest further consideration of the impacts of relying on shortened quantitative trait measures for etiologic research is warranted.

421.014 *(Poster)* Ethnicity, Providers, and Recognizing Autism in Arizona

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Background: ASD (Autism Spectrum Disorder) prevalence estimates vary by race/ethnicity. While the disparity in prevalence of ASD between Hispanics and non-Hispanic Whites (NHW) has narrowed since 2000, Hispanic ASD prevalence is most recently estimated as just 62% the prevalence of ASD among NHW. Differences by race/ethnicity in the types of providers who evaluate children may contribute to differences in treatment for ASD and subsequent detection of cases by surveillance systems.

Objectives: Evaluate the effects of ethnicity on patterns of practice and community recognition of ASD cases.

Methods: Cases from the Arizona Developmental Disabilities Surveillance Program (ADDSP) from surveillance years 2000 to 2010 were included; these cases were ascertained according to the CDC's Autism and Developmental Disabilities Monitoring Network protocol. Cases were defined as having community recognition of their condition if they had a clinical diagnosis and/or they received special educational services for autism. We used chi-square tests to evaluate differences by ethnicity in which types of providers had evaluated each case and differences in the likelihood of community recognition for cases who had been examined by each type of professional. Finally, we used logistic regression to look for differences by race/ethnicity in community recognition among all cases ever evaluated by each type of provider.

Results: ADDSP identified 2,303 children who met case criteria for ASD. Among these cases, 1,437 were NHW and 555 were Hispanic. Psychologists without doctoral level training evaluated the largest proportion of cases (72.5%), followed by speech and language specialists (54.7%). Compared to NHW, Hispanic cases were less likely to have been evaluated by a physician ($p<0.01$) and more likely to have been evaluated by a speech and language specialist ($p<0.05$). NHW were more likely to have community recognition; 67.9% of NHW had community recognition compared to 59.3% of Hispanics ($p<0.001$). Compared to NHW, the odds ratio for recognition Hispanics was 0.69 (0.56-0.84). Cases were more likely to have community recognition if they had been evaluated by physicians (OR=3.34; 2.75-4.05 CI). Other provider types had half the odds of recognizing ASD with significant odds ratios ranging from 0.42 – 0.54.

The odds of community recognition for Hispanics was lower than for NHW among all cases who had ever been seen by specific types of professionals: education specialist OR=0.56 (0.38-0.84), an occupational therapist OR=0.61 (0.44-0.85), a physical therapist OR=0.33 (0.17-0.62), a psychologist without doctoral training OR=0.70 (0.55-0.89), or a speech & language specialists OR=0.60 (0.46-0.78).

Conclusions: Differences in access to providers combined with differences in how evaluation by specific provider types translates into community recognition of ASD may contribute to disparities in service access and broader community recognition of ASD in Arizona.

421.015 *(Poster)* Examining the Variability and Resource Burden of Determining ASD Prevalence Estimates within Electronic Health Record Systems

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Background: The research and public health communities are currently debating the value of varying methodologies for ascertaining autism spectrum disorder (ASD) prevalence.

Survey, record review, screening/assessment, and hybrid methods yield varying estimates over time. Additionally, many of these methodologies are time and labor intensive resulting in reporting delays. For example, there is currently a 2-year time delay in CDC's Autism and Developmental Disabilities Monitoring (ADDM) network methodology. To this end, epidemiologists are exploring the potential value of administrative and computational methods of estimating prevalence of ASD with efficiency and accuracy (e.g. moving toward real-time estimates of ASD).

Objectives: In order to examine the initial variability of electronic health record (EHR) based prevalence estimates, we targeted cohorts of children within a contiguous geography for a series of consecutive birth years (2010-2014). This is the same geography utilized by the Tennessee ADDM Network. These birth years and geography will be represented in pending CDC ADDM 4 and 8-year old surveillance cycles affording for direct comparison of results. We hypothesize that this EHR based method will result in higher prevalence estimates, and that the costs/resources of these estimates will represent a fraction of other review methods.

Methods: Data request was made to the Mid-South Clinical Data Research Network (CDRN), the largest medical network in this area, to extract individuals with current addresses in the specified geography and ICD-9/10 ASD codes present in their EHR. This was completed for consecutive birth years from 2010 to 2014. In addition to diagnostic codes, data regarding basic demographics; race/ethnicity, sex, and geo-codable data were obtained.

Results: We were able to ascertain ICD-9/10 prevalence estimates for ASD across a large geography (entire TN ADDM geography within primary medical source reported in recent surveillance cycles) for 5 birth years within a single week and with estimated costs less than $1000. ASD prevalence ranged from 1:51 (birth year 2013) to 1:55 (birth year 2014 and 2010).

Conclusions: Administrative prevalence estimates obtained from coherent EHR systems may provide quick and resource efficient methods for enhancing understanding of ASD prevalence across large geographies. This method appears to be a currently viable strategy within some large networks. It has the potential to help move toward real-time population estimates across larger age ranges and to yield strategies for understanding prevalence of groups of individuals over time. Although promising, the limited nature of administrative data and errors in estimation will be further investigated and discussed.

421.016 *(Poster)* Frequency of Autism Spectrum Disorder in a Spanish Cohort of Children with Premature Birth

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that has a higher risk of appearing in children with premature birth, with a recent meta-analysis reporting a general prevalence of 7% (one in every 14) (Agrawal, Rao, Bulsara & Patole, 2018), compared to 1.7% (one in 59) prevalence in the general population (CDC, 2018). With the improvements in neonatal care that have occurred in recent decades, the chances of survival of children born prematurely are greater (Anderson et al. 2011). Although there have been many advances to reduce the incidence of problems associated with premature birth, there is still a high risk of co-occurrence, such as physical and neurodevelopmental disorders for this population, which may even persist in adolescence as behavioral or academic problems or deficits in executive function (Twilhaar, de Kieviet, Aarnoudse-Moens, van Elburg & Oosterlaan, 2018). This makes the population of premature children with ASD a particularly vulnerable group throughout their childhood. Hence the importance to study the expression of ASD in a population with premature birth.

Objectives: The objective of this research is to study the frequency and neuropsychological characteristics of ASD in a cohort of children (7 to 9 years old) with premature birth (below 37 weeks) and/or low birth weight (under 1500 kg).

Methods: A cohort of participants with premature birth, who were between 7-9 years old at the time of the assessment, was selected. Families from the selected cohort were contacted from the hospital by post and/or telephone to explain the research objectives, asking for collaboration in the study and providing informed consent in case of acceptance. Once the signed informed consent forms were received by the research team, families were contacted, and they were offered an appointment to conduct a neuropsychological assessment. When children showed signs of ASD, a referral to the diagnostic unit was made for differential diagnosis.

Results: Of the 133 children who met the inclusion criteria, 120 letters were sent to their families, as 12 of the premature newborns did not survive and one did not have a postal address. 58 families responded by agreeing to collaborate with the study. So far, 46 evaluations have been made, of which four of the children evaluated have ASD (9%). These results are preliminary, and the study is still ongoing, so current results should be interpreted with caution and additional data on participants' neuropsychological characteristics are expected.

Conclusions: In our country there is no study of the frequency of ASD in children born prematurely. The results of this study would be of great importance on a national level, but they would also provide evidence at an international level to better understand the frequency of ASD and associated neuropsychological characteristics in children with premature birth. Results could improve detection procedures and support systems for this at-risk population. In this way, the services could offer a better intervention in the shortest possible time to improve their adaptive functioning and generate a future with a better quality of life for the child and their families.

421.017 *(Poster)* Gears: Gene-Environment Autism Research Study through Collaboration with SPARK Research Match

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Background: Despite evidence for a role of pre- and peri-natal risk factors for autism spectrum disorder (ASD), few studies have examined interactions between genetic variation and perinatal environment in a well-powered setting. The Genes and Environment Autism Research Study (GEARS) leverages data from Simons Powering Autism Research for Knowledge (SPARK; SPARKforAutism.org), an online research platform for individuals with ASD and their families, to enable the study of gene-environment interactions on a large scale.

Objectives: GEARS contacted participating SPARK families with the goal of successfully administering a perinatal environmental questionnaire and obtaining permission to link their genetic and phenotypic data. In this abstract, we aim to demonstrate the feasibility of online recruitment via SPARK, to show the frequency of perinatal risk factors among a subset of SPARK mothers, and to explore crude associations with ASD-associated traits as an initial indication of the utility of this GEARS integrated data.

Methods: SPARK sent email invitations to mothers of children with ASD ages 2 to 12 years who had already provided saliva samples and completed SPARK phenotypic questionnaires. Mothers were first asked if they were interested in participating in GEARS and then asked to complete the GEARS questionnaire, which included questions about the presence of medical risks and other environmental exposures during pregnancy. Fathers were provided the option to decline use of their genetic data in later GEARS analyses. Means and frequencies of self-reported responses were estimated as well as crude associations to ASD severity and traits measured by three questionnaires: Social Communication Questionnaire (SCQ), Developmental Coordination Disorder Questionnaire (DCDQ), and Repetitive Behavior Scale-Revised (RBS-R).

Results: Of the 2,089 mothers invited, 1,346 (64.4%) indicated interest in participating and 1,255 (93.2%) completed the questionnaire. One father opted out. The total time for recruitment and data collection was 6 weeks. Over 90% of mothers rated their GEARS participation experience as "Good" (5 /5) and >80% reported that the research topic is of "High" importance to them (5/5). Forty-eight percent of mothers reported drinking alcohol during pregnancy, 16% smoked, 15.7% of births were premature, the mean BMI of mothers was 27.3 (SD= 8.1), and mean paternal age was 32.7 years (SD= 6.16). Increasing SCQ score was significantly associated with multiple perinatal factors including premature birth ($p<0.001$), paternal age ($p< 0.001$;), maternal BMI ($p<0.05$), alcohol use ($p<0.001$) and smoking ($p<0.05$) during pregnancy. Coordination and repetitive behavior ratings were also significantly associated with premature birth (DCDQ $p<0.001$; RBS-R $p<0.01$), smoking (DCDQ and RBS-R $p<0.05$) and alcohol consumption during pregnancy (DCDQ $p<0.001$).

Conclusions: This study demonstrates the feasibility of fast, online-based data collection to integrate perinatal environmental information into a well-characterized genetic research cohort for ASD and will enable well-powered gene-environment interaction studies. Our preliminary results indicate face validity of the self-reported perinatal based on previously reported means and frequencies and given detected associations with measures of ASD severity and traits. Currently in-progress integration of genetic data for these participants may provide insight to the combined role of environmental exposures and genome-wide genetic risk factors in for ASD.

421.018 *(Poster)* Genetic Liability to Autism and Educational Attainment: Investigating Causal Associations and the Possible Role of IQ through Two-Sample Mendelian Randomization.

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Background: The association patterns of Autism Spectrum Disorder (ASD) with educational attainment seem to be complex. Observational evidence suggests that ASD is associated with poor academic outcomes, while high parental educational attainment seems to be associated with risk of ASD in the offspring. Despite recent evidence on strong positive genetic correlations between ASD and educational attainment, little is known on the causal nature of the associations and the possible role of IQ.

Objectives: A. Assess the bidirectional causal associations between genetic liability to ASD and educational attainment within a Mendelian randomization (MR) framework.

B. Assess whether the identified causal effects were independent of IQ by using an extension of MR, Multivariable MR.

Methods: MR is a form of instrumental variables analysis, using common genetic variants as proxies for exposures of interest and allowing the assessment of their causal effects on health-related outcomes. The method under certain assumptions, has the potential to unpick the direction of the causal effect and investigate the presence of pleiotropy. However, in cases that multiple exposures are suspected to have causal effects on an outcome, and the exposures seem to be genetically and phenotypically related, it can be difficult to disentangle the direct causal effects of each exposure on the outcome through univariable MR. For this reason, we used Multivariable MR, in which multiple exposures are entered within the same model and their direct effects on the outcome can be estimated. The latest GWAS summary statistics for ASD, IQ and educational attainment were used. In order to increase the power of the study, instruments were extracted from the overlapping set of SNPs between ASD, IQ and educational attainment. This ensured that we retained in the analyses as many instruments as possible. Causal effect estimates were generated using Inverse variance weighted models. Sensitivity analyses were performed to assess the robustness of the estimates and the presence of pleiotropy.

Results: There was limited evidence to suggest a causal effect of genetic liability to ASD on educational attainment (MRIVWb= 0.02; 95%CI: -0.04 to 0.08; pval= 0.52). On the contrary, there was evidence consistent with a positive causal effect of genetic liability to higher educational attainment on risk of ASD (MRIVWOR: 1.51; 95%CI: 1.28 to 1.77; pval= 5.5x10-07), which was found to be largely attributed to the effects of IQ (EA: MVMRIVWOR: 1.26; 95%CI: 0.95 to 1.65; pval= 0.10; IQ: MVMRIVWOR: 1.29; 95%CI: 1.02 to 1.64; pval= 0.04).

Conclusions: The present finding of a positive causal effect of genetic liability to higher educational attainment on risk of ASD is likely to reflect parentally transmitted effects. IQ plays a central role in these effects, and this can have important implications for future research in the field of ASD aetiopathogenesis.

421.019 *(Poster)* Global Epidemiology of Autism Spectrum Disorders

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Background: According to the WHO most recent estimates, 1 in 160 children worldwide has an ASD. However, this is an average estimate and the last survey on global prevalence of autism and pervasive developmental disorders dates back from 2012. Since then, diagnostic criteria have changed, and many more epidemiological surveys have been conducted. Therefore, it is necessary to have up-to-date estimates from various world regions to inform policy, services, and further research.

Objectives: We conducted an update to the 2012 systematic review of epidemiological surveys of autism worldwide (Elsabbagh et al. 2012).

Methods: We adopted a systematic review methodology in the identification of epidemiological reports of autism published from 2012 to present. We systematically searched online databases including Medline/PubMed for studies that reported prevalence or cumulative incidence of autism disorders. A complementary hand search was performed based on the references. Data was extracted on main characteristics including year and country/region of data collection, age of participants, the presence of intellectual disability, sample sizes, prevalence rates and confidence intervals, diagnostic criteria as well as study design. Analysis was performed by subregions of countries defined according to the WHO classification.

Results: From a total of 1105 records retrieved, 49 studies met the eligibility criteria, with the majority being conducted in Europe and the US. However, relative to the 2012 review, more prevalence estimates are now available from previously under-represented regions including Africa, Eastern Europe, and the Eastern Mediterranean.

The review included studies with various designs including epidemiological surveys, cohort studies, registry and administrative data, with a greater contribution from school-based surveys. Based on the evidence reviewed, the prevalence estimates of autism ranged from 11-390/10 000. The male-to-female ratio ranged between 1 and 5.2.

Consistent with the 2012 systematic review, there was substantial variability in estimates within and across geographic regions. Despite this variability, the evidence reviewed does not support differences in autism prevalence by geographic region. Similar to the last review, a consistent increase in the prevalence estimates over time was found but very few studies since then have addressed controversies related to this time trend.

Conclusions: The results are in line with reports indicating a global increase of ASD prevalence and highlight the recent availability for estimates from some previously under-represented regions. This represents a step towards filling an important knowledge gap. However, there is still a need for more robust data in order to address questions of high public relevance and value worldwide.

421.020 *(Poster)* Grandparental Alcohol and Tobacco Use and Risk of Autism Spectrum Disorder in Grandchildren

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Background: Evidence of multigenerational effects of environmental and nutritional exposures is supported by a growing body of experimental and epidemiologic research. Behavioral changes have been induced in grand-offspring of nicotine-exposed male and female mice. In a recent cohort study in England, smoking during pregnancy by the maternal grandmother was associated with increased risk of diagnosed autism and two autistic traits (Social Communication and Repetitive Behavior) in grandchildren, independent of maternal smoking. No studies have considered the impact of grandpaternal smoking or grandparental alcohol intake on future risk of autism in grandchildren.

Objectives: We sought to evaluate grandmaternal and grandpaternal prenatal smoking and alcohol consumption in relation to risk of autism spectrum disorder (ASD) in their grandchildren.

Methods: The California Health and Development Study cohort includes over 15,000 women (F0) pregnant in Northern California between 1959 and 1967. Women were interviewed in early pregnancy about themselves and their partners. Their offspring (F1) were linked to the next generation's (F2) birth records in California to identify grandchildren, and those were linked to the Department of Developmental Services records to identify ASD cases. Smoking at the time of pregnancy and average weekly number of drinks of wine, beer and hard alcohol were reported by the grandmother. Log-binomial regression models estimated relative risk of ASD with any smoking, any drinking, and weekly number of alcoholic beverages (continuous) for grandmothers and grandfathers, with generalized estimating equations to account for clustering of grandchildren to the same grandparents. Confounders from the F0 generation included grandmaternal age, race, and parity, and grandpaternal education and household income; models of smoking and alcohol were mutually adjusted for each other. In a sensitivity analysis, F1 maternal age and parity were also included as confounders.

Results: The final F2 sample size was 18,149 grandchildren, with 110 ASD cases. Prevalence of smoking and alcohol use around the time of the grandmother's pregnancy was 34.6% and 52.7% among grandmothers, and 42.3% and 74% among grandfathers, respectively. Grandpaternal smoking was related to ASD (adjusted RR=2.03, 95% confidence interval [1.25, 3.3]), but grandmaternal smoking was not (aRR=0.9 [0.6, 1.5]). Increasing total alcohol consumption was suggestive of increased ASD risk (aRR=1.04 [0.96, 1.13] per grandmaternal drink consumed; aRR=1.04 [0.99, 1.10] per grandpaternal drink consumed), with stronger associations for hard alcohol (aRR=1.11 [1.00, 1.24] per grandpaternal drink consumed; aRR=1.15 [0.97, 1.36] per grandmaternal drink consumed). There was no association of ASD with increasing wine or beer consumption, or with any vs. no alcohol consumption, for either grandparent. Adjusting for F1 covariates did not alter results.

Conclusions: The results support a role of perinatal grandparental behavioral factors in risk of ASD in grandchildren, particularly grandpaternal smoking and grandparental alcohol consumption. Larger epidemiologic studies with information on smoking and alcohol in the F0 and F1 generations and animal studies are needed to confirm these findings and investigate biological mechanisms, including epigenetic alterations to the germ line.

421.021 *(Poster)* Health Disparities in Middle and High School Youth with Autism Spectrum Disorder: Participation in Extracurricular Activities, Community Involvement, and School Engagement

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Background: Autism Spectrum Disorder (ASD) can put individuals at risk for social isolation, disconnection from work, and diminished community participation in young adulthood. Participation in extracurricular activities, community involvement, and school engagement during secondary school may help buffer against these outcomes by providing individuals with ASD the opportunity to learn prosocial skills, develop initiative, and establish peer relationships. Though prior research indicates that individuals with ASD have lower levels of participation (Ratcliff et al., 2018), sociodemographic differences have not yet been explored.

Objectives: This study examines sociodemographic disparities in participation and engagement among youth with ASD.

Methods: Using data from the 2011/12 and 2016/17 National Survey of Children's Health (NSCH), we examined the rate of parent-reported engagement in sports, clubs, community service, work for pay, homework completion, and school interest. Sociodemographic factors examined included child's race (white vs. not white), parent report of child's sex (male vs. female), parent earning wages below the federal poverty level (yes vs. no), and parental education (high school or less vs. more than high school). We used chi-square tests to identify significant differences in rates of engagement based on each sociodemographic factor.

Results: There were $N = 676$ youth with ASD (mean age = 14.43 +/- 1.71, 82% male, 80% White) in 2011/12 and $N = 586$ youth with ASD (mean age = 14.56 +/- 1.70, 81% male, 81% White) in 2016/17. There were no significant differences in the rate of homework completion or school interest based on any sociodemographic factor examined. In 2011/12 only, youth with ASD were less likely be involved in work if they were female (8% vs. 19%, $p = .003$) or if they had a parent with an education level of high school or less (13% vs. 21%, $p = .01$). Across both years, youth with ASD whose parent reported lower educational attainment were less likely to be involved in clubs (43% vs. 56%, $p < .001$, 21% vs. 43%, $p < .001$, respectively) and sports (26% vs. 40%, $p < .001$, 16% vs. 31%, $p = .01$). In 2011/12 only, youth with ASD had lower levels of engagement in clubs if they came from a family of low SES (35% vs. 50%, $p = .04$). In 2016/17 only, male youth with ASD were less likely to be engaged in clubs (37% vs. 48%, p=.03). Youth with ASD had lower rates of participation in community service if they were not white (51% vs. 66%, $p = .001$ in 2011/12) or if they had a parent with lower educational attainment (58% vs. 69%, $p = .003$ in 2011/2012 and 28% vs. 42%, $p = .01$ in 2016/17).

Conclusions: Across both years, data demonstrate clear demographic disparities among youth with ASD. This was more evident for parents with less education, students of color, and students whose families were low SES. Though some associations were no longer significant in 2016/17, these results suggest a continued need for targeted interventions to promote engagement among youth with ASD to further narrow this disparity gap.

421.022 *(Poster)* Interaction of Blood Manganese Concentrations with GSTT1 in Relation to Autism Spectrum Disorder in Jamaican Children

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Background: Autism Spectrum Disorder (ASD) is a complex lifelong neurodevelopmental and behavioral disorder, characterized by impairments in social interaction and communication, and by repetitive, rigid behavior. Although the causes of ASD remain largely unknown, the evidence suggests that it is likely the result of interactions between various factors including genetic and environmental exposures occurring in utero or very early in infancy.

Since 2009, our research team has investigated the role of glutathione-S-transferase (GST) genes (*GSTM1*, *GSTP1* and *GSTT1*) that are activated under conditions of oxidative stress, and six heavy metals/metalloids (lead (Pb), mercury (Hg), arsenic (As), cadmium (Cd), manganese (Mn), aluminum (Al)) in relation to ASD in Jamaican children. These genes encode enzymes that play a major role in detoxification by mediating the transfer of reduced glutathione to electrophilic xenobiotic substrates. We have previously observed that blood Mn concentrations (BMC) and *GSTP1* have a significant interaction in relation to ASD.

Objectives: The objective in this study is to investigate the additive or interactive associations of *GSTT1* polymorphisms of GST genes, in relation to ASD in Jamaica.

Methods: We used data from 266 case-control pairs of children 2-8 years old from our autism project in Jamaica. For the *GSTT1* gene, since the assay does not distinguish between a normal homozygote (I/I) and a heterozygote (I/D), we considered only a recessive model using a binary variable to represent their genotype: I* and DD. We used conditional logistic regression (CLR) to compare demographic characteristics and socioeconomic status (SES) including parental education between case and control groups. We categorized BMC into four quartiles and then used CLRs to assess their associations with ASD status and various exposure variables including genotypes for *GSTT1*. Using univariable and multivariable CLR models, we assessed the possible association between the categorized BMC and ASD status and the interaction effects between BMC and *GSTT1* in relation to ASD.

Results: The mean age of ASD cases and typically developing (TD) controls was 63.5 and 64.0 months, respectively. About 81% of the ASD cases and TD controls were male. Nearly all of the ASD cases (95.5%) and TD controls (97%) were Afro-Caribbean. In models using CLR with ASD status as a dependent variable with the categorized BMC and *GSTT1* as independent variables, the interaction between *GSTT1* and BMC was significant ($P = 0.02$). Specifically, considering the lowest quartile blood concentrations of Mn as the referent category, we found that among children with DD genotype, the odds of being in the fourth quartile of BMC was higher for ASD cases than for TD controls (MOR=3.32, 95% CI:1.08 -10.17, $P = 0.04$). Association of BMCs with ASD status among children with different *GSTT1* genotypes based on interactive (metal *GST gene) recessive genetic models using CLR models, adjusted by potential confounders, overall was significant ($P = 0.04$).

Conclusions: Although we found a potential role of *GSTT1* as an effect modifier when assessing the role of BMC in ASD based on interactive models, we believe this finding requires replication in other populations.

421.023 *(Poster)* Investigating the Associations between Genetic Liability for Rheumatoid Arthritis and Autism and Autistic Traits

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Background: Autism spectrum disorders, hereafter autism, are neurodevelopmental disorders characterised by social interaction and social communication issues in addition to restricted or repetitive patterns of behaviour and interests. Abnormal inflammatory activity is thought to occur in autism.

Higher prevalence of autism in offspring born to mothers with autoimmune disorders such as rheumatoid arthritis has been reported. It is possible that in utero exposure to elevated levels of maternal autoantibodies and inflammation is an underlying mechanism in autism development. Thus far, the relationships between genetic liability for rheumatoid arthritis and autism and autistic traits have yet to be investigated.

Objectives:

1. To investigate the association between maternal and offspring's own genetic liability for rheumatoid arthritis and autism-related phenotypes in the offspring
2. To investigate the possible causal effect of maternal rheumatoid arthritis on development of autism in the offspring

Methods: To capture maternal and own genetic liability for rheumatoid arthritis, standardised polygenic risk scores (PRSs) were constructed using genetic data from participants of the Avon Longitudinal Study of Parents and Children (ALSPAC) and summary statistics from a rheumatoid arthritis genome-wide association study (GWAS) on individuals of European ancestry. Single nucleotide polymorphisms (SNPs) from autosomal chromosomes that passed a 0.05 GWAS p-value threshold were included.

To test genetic association, modified Poisson regression was performed with i) rheumatoid arthritis PRS for ALSPAC mothers and ii) rheumatoid arthritis PRS for their offspring as exposures, and validated cases of autism and severe presentation of four autistic traits in the offspring (social and communication difficulties [SCDC], coherence, repetitive behaviours and sociability) as outcomes. Ten genetic principal components were adjusted for.

To test for causality, bi-directional two-sample Mendelian randomisation (MR) was also performed to assess the possible causal effect of rheumatoid arthritis on autism (instrument selection p-value threshold: 1e-06) and visa versa (instrument selection p-value threshold: 1e-08). Techniques such as inverse-variance-weighting (IVW) and MR-Egger regression were used. Heterogeneity and horizontal pleiotropy were assessed.

Results: As illustrated in Table 1, we found little evidence of associations between i) rheumatoid arthritis PRS for mothers and ii) rheumatoid arthritis PRS for offspring and autism-related phenotypes.

As illustrated in Table 2, our MR results provide little evidence for a causal effect in either direction. There was also little evidence for heterogeneity and horizontal pleiotropy.

Conclusions: There was little evidence for associations between i) rheumatoid arthritis PRS for mothers and ii) rheumatoid arthritis PRS for offspring and autism and autistic traits in the offspring. Our results looking at lifetime risk for rheumatoid arthritis suggest no causal risk of maternal rheumatoid arthritis on autism-related phenotypes.

421.024 *(Poster)* Maternal Dietary Patterns during Pregnancy in Association with Child Autism-Related Traits

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Background: Maternal diet during pregnancy is critical to fetal neurodevelopment. Emerging research has linked prenatal and periconceptional intake of certain nutrients with autism spectrum disorder (ASD) and ASD-related traits, but research considering combined effects through use of dietary patterns capturing usual intake of a range of nutrients is lacking. Further, while existing research has provided evidence for immune disruption in ASD, studies have not examined dietary patterns related to inflammation.

Objectives: To examine maternal prenatal diet based on the Empirical Dietary Inflammatory Pattern (EDIP), which captures inflammatory potential of the diet, and the Alternative Healthy Eating Index for Pregnancy (AHEI-P), which captures adherence to healthy eating guidelines (and is linked with lower inflammation), in association with child autistic traits and cognitive development.

Methods: Participants were drawn from the Early Autism Risk Longitudinal Investigation (EARLI), an autism-enriched risk cohort that followed mothers who already had a child with ASD through a subsequent pregnancy until that child was age 3. Dietary patterns were derived from intake of foods reported on a validated Food Frequency Questionnaire (FFQ), collected in the first half of pregnancy, according to published guidelines (modified for pregnancy, excluded alcohol, coffee and tea). 189 mother-child pairs with reported prenatal diet and child outcome measures at 36 months, including the Social Responsiveness Scale (SRS) and Mullen Scales of Early Learning (MSEL), were included here. Multivariable linear regression accounting for maternal demographic factors, body mass index, and child sex was used to examine the association between EDIP and AHEI-P scores (in quartiles with the first as reference(Q1)) and SRS (total raw) and MSEL scores (early learning composite). We also examined adjustment for folate.

Results: Crude analyses suggested positive associations between SRS scores and the EDIP (indicating more autistic traits with a more pro-inflammatory diet), and inverse and positive associations with SRS and MSEL scores, respectively, in association with the AHEI-P (indicating fewer autism-related traits and higher cognition related to a healthier diet). In adjusted analyses, AHEI-P associations with SRS scores were not observed (Q3 vQ1 ß =-4.66, 95% CI -17.83, 8.51; Q4vQ1 ß =-7.47, 95%CI -20.17, 5.23), while associations between SRS scores and EDIP were suggestive, though not significant, for the third quartile of the EDIP (ß=11.65, 95%CI-.44, 23.75; Q4 was no longer elevated). Associations were suggested with the third quartile of the AHEI-P (Q3vQ1, ß=11.51, 95%CI 2.53, 20.48; Q4 was no longer elevated) and higher EDIP scores (Q3vQ1, ß=-8.26 , 95% CI -17.38, .87; Q4vQ1 ß=-5.19, 95%CI -14.47, 4.07) in adjusted analyses of MSEL scores. Estimates additionally adjusted for folate were similar.

Conclusions: Results are consistent with the hypothesis that pro-inflammatory maternal dietary patterns may increase ASD-related traits in children, and that healthier/anti-inflammatory maternal dietary patterns may reduce such traits. However, further work is needed to investigate these and other dietary patterns. Because nutrients do not act in isolation in biological pathways relevant to ASD, and maternal dietary patterns capture combined effects of foods and nutrients, targeting dietary patterns may be a key strategy for identifying modifiable risks of ASD-related outcomes.

421.025 *(Poster)* Maternal Fish Intake during Pregnancy in Association with Child Autism-Related Traits

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Background: Fish is the primary source of omega-3 polyunsaturated fatty acids (PUFAs) critical for neurodevelopment, but also of potential contaminants such as mercury. Guidelines for pregnant women recommend at least weekly intake of fish like salmon, rich in omega-3 PUFAs, and avoidance of larger fatty fish (e.g, swordfish, mackerel, tuna, etc.) that may bioaccumulate certain toxicants. While previous work has suggested positive associations between maternal fish intake during pregnancy and child neurodevelopment, prospective studies focused on ASD-related traits are lacking.

Objectives: To examine the association between prenatal fish intake and child autistic traits and cognitive development.

Methods: Participants were drawn from two US prospective pregnancy cohorts: the Early Autism Risk Longitudinal Investigation (EARLI), an autism-enriched risk cohort, and the Health Outcomes and Measures of the Environment (HOME) Study, a population-based cohort. A total of 426 subjects reported fish intake during pregnancy and child outcome measures collected at age 3 (EARLI) or 3-8years (HOME). Multivariable linear regression accounting for potential demographic confounders, prenatal vitamin and supplement use, and maternal body mass index, was used to examine the association between maternal fish intake and child raw total SRS scores in both cohorts, and cognitive scores in each cohort: Mullen Scales of Early Learning (MSEL) early learning composite scores in EARLI and Bayley Mental Development Index in HOME. Maternal fish intake was categorized by timing in pregnancy, type of fish, and frequency of intake: none, low (monthly), and high (≥once/week). We also examined total intake across pregnancy and consistency of intake across the first half and second half of pregnancy. Secondary analyses examined associations by child sex and cohort-stratified analyses of SRS scores.

Results: Most participants had no or low fish intake across pregnancy (69.7%). In adjusted analyses, relative to no intake, higher fish intake in the second half of pregnancy was associated with increased SRS scores (e.g, greater ASD-related traits; ß=5.60, 95% CI 1.76, 12.97). We also observed a stronger association for women who switched from lower to higher intake (ß=9.44, 95% CI 1.03,17.86). When examining fish type, particularly in the second half of pregnancy, intake of shellfish and fatty fish (including tuna, shark, mackerel, and swordfish) were both associated with increased SRS scores, while intake of salmon was associated with decreased SRS scores (ß=-4.66, 95% CI 10.3, 0.97). Higher fish intake was associated with increased cognitive scores (indicating improved performance) across pregnancy in EARLI (MSEL ß=6.55, 95% CI -1.94, 15.04) but not HOME (Bayley scores ß=-0.78, 95% CI -5.86, 4.31); no clear patterns with fish type emerged. In secondary analyses, cohort-stratified SRS results were similar, and associations with both SRS and MSEL scores for frequency of intake in late pregnancy were stronger in male than in female children.

Conclusions: Findings suggest late pregnancy may be a potential critical window for fish intake in association with ASD-related traits. Continued investigation of these associations with ASD-related traits is needed, particularly examining the relative contribution of beneficial fats vs. potential contaminants in different fish types.

421.026 *(Poster)* Meconium Androgens Are Correlated with ASD-Related Phenotypic Traits in Early Childhood.

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Background: It is known that steroid hormones are crucial for sex-differentiation of the human fetus and brain development. Several studies have suggested a potential link between steroid hormone levels and autism spectrum disorder (ASD). Previous studies utilizing umbilical cord blood or amniotic fluid have produced inconsistent results which may be due to specimen availability and timing of collection. Notably, access to amniotic fluid is prone to selection bias and androgen concentrations in cord blood represent levels later in pregnancy and do not capture cumulative exposure. To overcome these limitations this study used meconium – the first stool of a newborn – to estimate prenatal androgen exposure.

Objectives: This study investigated the association between levels of the major androgens: testosterone (T), dehydroepiandrosterone (DHEA) and androstenedione (A4), measured in meconium, and ASD-phenotype at 12 and 36 months of age. Analysis was performed on both unconjugated (U-) and conjugated (T-) forms of androgens.

Methods: The sample was drawn from the Early Autism Risk Longitudinal Investigation (EARLI), an enriched risk pregnancy cohort where enrolled families had a child with an ASD diagnosis and an infant sibling was followed prospectively. Meconium androgens were measured by liquid chromatography-mass spectrometry as either the unconjugated or total amount for each androgen. Autistic traits were measured at 12 months with the Autism Observation Scale for Infants (AOSI) and at 36 months with the Social Responsiveness Scale (SRS). Separate robust linear regressions were fit to assess the association between each of the log-transformed androgens and log-transformed total AOSI and SRS scores. A three-way interaction term between sex of the child, sex of the proband, and androgen concentration was introduced into every model. Stratified analyses were conducted for each of the groups defined by the proband's sex and child's sex.

Results: The study enrolled 244 children, of whom 137 (61 males, 76 females) provided data on both outcomes and had meconium androgen measurements. Evidence for the three-way interaction was observed in models predicting AOSI with T-A4 (P=0.047), SRS with U-T (P=0.053), and SRS with U-DHEA (P=0.05). In the adjusted model; T-T, U-A4, and U-DHEA were positively associated with AOSI among females with female probands, predicting 11%, 57%, and 28% increases in the expected AOSI with every 25% increase in the respective androgen concentration. In the same group, U-T and U-DHEA were positively associated with SRS, predicting a 6%, and 21% increase in the expected SRS with every 25% increase in the respective androgen levels. Additionally, higher concentrations (25% increase) of U-T and T-T predicted higher SRS (3% and 4% increase, respectively) in males with male probands.

Conclusions: We observed that the effect of fetal androgen levels on ASD phenotype is different by sex of both the younger sibling and the older affected proband. A positive link between some androgens and quantitative ASD phenotypes have been most frequently found among female children with female probands, which supports the theory postulating greater etiologic liability among relatives of ASD-affected females. However, the findings must be considered within the constraints of the enriched cohort design.

421.027 *(Poster)* Predicting Age of Diagnosis in Children with Autism Spectrum Disorder Using Deep Learning Approaches

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Background: Revised estimates of Autism Spectrum Disorder (ASD) suggest that 1 in 59 children are diagnosed with the disorder. While these new numbers represent a heighten awareness on the importance of early identification, the average age of diagnosis in the United States remains after 4 years of age. This is despite the fact that an ASD diagnosis can be made reliably as early as 2 years of age. Given ample research which supports early intervention results in the most optimal outcomes, more information is needed to determine factors contributing to the age of ASD diagnosis. This information may shed light on potential factors placing families at a greater risk to obtain a diagnosis considered late in childhood development.

Objectives: Given the importance of early identification of ASD, the main objective of this study was to analyze a large and representative sample of individuals with ASD to determine any factors that predicted the age of diagnosis. Two big data analysis were applied to predict year of diagnosis. The fully connected neural network (NN) is one of the fundamental architectures building blocks for deep learning, in where one hidden layer with 20 units is applied. The Random Forest (RF) is an ensemble learning method, which constructs a multitude of trees and drives the final classification result by a majority vote policy.Outcomes from this study have the potential to uncover new insight and factors that could facilitate an earlier ASD diagnosis.

Methods: The Simons Foundation Autism Research Initiative (SFARI) is a nationally representative clinical and genetic database that includes data on individuals with Autism as well as their families. Information about participants diagnosed with ASD were extracted from the data set, comprising a sample of 36,174 participants. To investigate participants, 125 different features were extracted and transferred to six categories based on age range such as developmental language level and sleep behavior.

Results: Based on preliminary results from the trained models, the testing accuracy for the RF prediction model is able to predict the age of ASD diagnosis at the accuracy of 85.1%. In the fully connected NN, the model is able to predict the age of ASD diagnosis at the accuracy of 84.3%.

Conclusions: Collectively, this information may lend support for factors that should be considered by clinicians and service providers in the early evaluation and identification of ASD. The current research represents a promising method to uncover factors that could help to facilitate an earlier diagnosis. Finally, given the growing volume of big data initiatives in ASD, future research should continue to explore disparities in age of diagnosis, health and family quality of life.

421.028 *(Poster)* Prenatal Perceived Stress As a Risk Factor for ASD

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Background: The prenatal period is a sensitive time when a mother's behaviors can affect her child's life indefinitely. Specifically, maternal activities during pregnancy and their relation to autism spectrum disorder (ASD) is an area of research that requires more inquiry. In addition to genetic factors, many environmental factors such as what she ingests, inhales, or experiences, has lasting effects on the neurodevelopment of her child[1-4]. Only two retrospective studies[5,6] have shown prenatal stress to be associated with a higher risk of ASD, but there has been no prospective data to show this association. Moreover, a mother's stress during pregnancy may be even more of a concern for high-risk younger siblings of children with ASD[7], which has not yet been studied.

Objectives: The objective of this study is to examine the effects of prenatal perceived stress on high-risk moms as a risk factor for ASD in their child.

Methods: This prospective cohort study includes 265 high-risk pregnant women that already have at least one child with ASD and are at an increased risk of having another child with ASD. The exposure of interest was maternal perceived stress during pregnancy and the outcome of interest was child diagnosis of ASD. Logistic regression models were used to determine the relationship between prenatal perceived stress and ASD, controlling for maternal race and ethnicity, exposure to natural or man-made disasters, diabetes (Type 1, Type 2, and Gestational), hypertension, and preeclampsia. Perceived stress was measured using Sheldon Pearson's Perceived Stress Scale, which is the most widely used psychological instrument to measure perceived stress[8]. Child neurodevelopment was assessed longitudinally from birth through three years of age by trained psychologists and an ASD diagnosis was given if the child met criteria based on an algorithm including Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) comparison score and Mullen Scales of Early Learning (MSEL) score.

Results: In the second trimester, a one point increase in perceived stress score resulted in 8% higher odds of having a child diagnosed ASD (OR 1.08, 95% CI (1.02, 1.14)). In the third trimester, a one point increase in perceived stress score resulted in 11% higher odds of having a child diagnosed with ASD (OR 1.11, 95% CI (1.05, 1.17)). Findings in the first trimester were not significant.

Conclusions: This is the first study to find associations between perceived stress and ASD in high-risk mothers that already have at least one child with ASD. Significant findings in line with previous literature of prenatal stress as a risk factor for ASD. Increased risk of ASD due to increased perceived stress in the second and third trimesters of pregnancy are important findings that could lead to target intervention programs to alleviate or even mitigate stress for women, especially during this window of pregnancy. It is critical to improve our current understanding of stress during fetal development so we can better design and recommend interventions for pregnant women.

421.029 *(Poster)* Prenatal and Perinatal Risk Factors for Autism Spectrum Disorder

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Background: Identifying modifiable risk factors for autism spectrum disorder (ASD) has important clinical implications, especially in view of the rapid increase in reported prevalence of ASD. It is assumed that environmental factors play a causal role in the development of ASD. However, there was not sufficient evidence to implicate any prenatal or perinatal factor in ASD etiology. Previous studies regarding prenatal and perinatal factors in ASD revealed controversial results.

Objectives: The purpose of this study is to evaluate the prenatal and perinatal history of ASD, as compared to their unaffected siblings, and to identify a number of environmental risk factors that may be associated with the ASD in Korean population.

Methods: Subjects with ASD (ASD) and their unaffected siblings (SIB) were recruited. The clinical best estimate diagnosis of ASD was made for both groups by child psychiatrists according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). All subjects with ASD and SIB were assessed using Korean versions of Social communication questionnaire, Autism Diagnostic Interview-Revised and Autism Diagnostic Observation Schedule. Prenatal and perinatal history was obtained from the interview and questionnaire with primary caregivers and each facet was compared in those with ASD and SIB. Differences in parental and child characteristics between children with and without ASDs involving continuous and categorical data were compared using independent t-tests and chi-square tests, respectively. The effect of each prenatal and perinatal factors were compared between probands with ASD and SIB using multiple logistic regression. A multivariable logistic regression was conducted for significant variables ($p < .05$) and borderline significant variables and adjusted ORs with their 95% CIs were generated.

Results: There were 662 probands with ASD (mean[SD] age=87.4[56.3] month; male, 86.7%; IQ=79.12[25.8]). A total of 380 SIB (mean[SD] age=91.0[55.8] month; male, 47.9%; IQ=104.9[19.7]) were included in the analysis. The ASD group showed significantly higher rates of oligohydramnios (OR 8.5, 95% CI [1.1, 66.1]) compared to SIB group. The ASD group also showed higher frequency of neonatal jaundice (OR 1.5, 95% CI [1.1, 2.2]). The frequency of admitting to the neonatal intensive care unit in any reasons (OR 2.4, 95% CI [1.1, 6.5]) and neonatal oxygen supply due to hypoxia (OR 1.7, 95% CI [1.2, 5.2]) were significantly higher in subjects with ASD compared to unaffected individuals.

Conclusions: Findings from our study suggests that prenatal and perinatal conditions, especially oligohydramnios, neonatal jaundice, admitting to the neonatal intensive care unit and neonatal hypoxia, are associated with increased risk of ASD. This might be consistent with the current hypothesis that exposure to ischemic-hypoxic conditions might be related to ASD.

421.030 *(Poster)* Prevalence of Autism Spectrum Disorders in Arizona American Indian/Alaska Native Children

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Background: Autism spectrum disorders (ASD) are developmental disabilities (DD) tracked by the Autism and Developmental Disabilities Monitoring (ADDM) Network, a group of programs funded by The Centers for Disease Control (CDC) since 2000. In 2002, the ADDM network began reporting prevalence estimates by Race and Ethnicity for non-Hispanic White, non-Hispanic Black, non-Hispanic Asian/Pacific Islander and Hispanic of any race. American Indian/Alaska Native (AIAN) prevalence has not been previously reported by ADDM. There are no established prevalence estimates for individuals of AIAN descent.

Objectives: The goal of this project was to provide an initial prevalence estimate for ASD in AIAN children aged 8 years.

Methods: ADDM collects data on children who received clinical or educational services related to ASD or other DDs during the identified study year and were demonstrated to be living in the surveillance area. This project used data for children aged 8 years in 2000 – 2014. Population denominators for calculating ASD prevalence estimates were obtained from the national Center for Health Statistics Vintage Bridged-Race Postcensal Population estimates for children aged 8 years and older by county, race, ethnic origin and sex. The number of children living in the surveillance area was calculated by comparing school enrollment in the included districts to the total enrollment for Maricopa County for 3rd grade in each study year and using that proportion to adjust the postcensal population denominators. The standard coding for ADDM includes classifying all individuals reporting Hispanic ethnicity as Hispanic. Given the numerous tribes in Arizona who are also of Hispanic ethnicity we revised the coding structure to prioritize AIAN race above all data. Population denominators and ASD case counts previously report were used for the non-Hispanic white group and the original ethnicity grouping for Hispanic, any race. Statistics comparing groups included chi-square, prevalence estimates and confidence intervals, and t-tests.

Results: Prevalence estimates for each race and ethnicity grouping differed significantly, with Hispanic children at 6.3 per 1000, AIAN children at 12.6 per 1000 and non-Hispanic White children at 19.5 per 1000. In addition, a comparison of the new Hispanic category excluding individuals who are AIAN demonstrated a significantly lower prevalence than the estimate with Hispanic of any race previously calculated at 10.4 per 1000. Over time, the risk indices for the AIAN group were higher than Hispanics but the gap began closing in approximately 2010. The mean risk index for AIAN is 1.02% and for Hispanics excluding AIAN is 0.63%.

Conclusions: The national ADDM process identifies cases as Hispanic above any race and these individuals have been counted as Hispanic. Reclassifying these individuals as AIAN increases the counts available for estimating prevalence and changes the makeup of the Hispanic group for Arizona. There is a high proportion of individuals of AIAN descent in Arizona relative to other locations in the country. It is important to provide baseline prevalence estimates for ASD in this population to assist tribes in understanding the potential service needs of this growing population.

421.031 *(Poster)* Prevalence of Autism in South Texas Region Reveals Lower Rate in 8 Counties

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Background: Prevalence of Autism Spectrum Disorder (ASD) is found to be much lower in the Hispanic population. Detailed prevalence and incidence data in the South Texas region, which has a large Hispanic population, are unknown.

Objectives: This study estimated the prevalence of ASD in the greater San Antonio, Texas region, and assessed the supply of medical providers in the same region to understand gaps in services needed in this community.

Methods: The study outlined 8 counties in South Texas that comprise the greater San Antonio area (Bexar, Bandera, Comal, Kendall, Atascosa, Guadalupe, Medina, and Wilson Counties), which made up our CBSA (core based statistical area). ASD prevalence was estimated by using data from multiple sources including commercial payors, Medicaid, Medicare, Tri-Care, as well as school district data from those with an educational (rather than medical) diagnosis of ASD. To evaluate the CBSA's supply of local providers, over 330 providers/community workers were contacted across the CBSA and underwent a strategic interview to capture information on important questions regarding autism services in the community.

Results: ASD prevalence in the San Antonio CBSA was found to be 1 in 79, which is slightly lower than the national average of 1 in 59. Prevalence varied slightly by the source: for those ages around 6-11 years, the Medicaid group is 1 in 139, commercial insurance group is 1 in 169, Tri-Care group is 1 in 42. The school districts list the prevalence of an educational diagnosis of ASD at 1 in 70. Gender differences were noted at 4:1 boys to girls - similar to national data. All groups showed a significantly lower prevalence rate among Hispanics (approximately 5:1). It remains uncertain if this is a disparity due to lack of access or socioeconomic status or if there is a genetic predisposition causing a decrease in the autism prevalence in Hispanics. Given the approximately 30,000 births in the CBSA per year, the incidence was estimated at 391 cases per year. In regard to the provider capacity for ASD medical diagnoses and medical treatment, the number of doctors was found to be significantly lacking. In the CBSA, only 3.5% of the market doctors in ASD related specialties actually work with ASD patients. The mix of providers varies significantly at the county level. Given the incidence, the CBSA would need 5.7 multidisciplinary diagnostic teams to meet the need in this area. There are not enough providers to meet the need.

Conclusions: The prevalence of ASD in the Greater San Antonio area is lower than the national average. Gender ratio of ASD was similar to the national average. Prevalence rate among Hispanics was markedly lower than in non-Hispanic whites. In addition, the number of medical providers who diagnose and treat ASD is markedly less than needed to serve the need in this area.

421.032 *(Poster)* Psychotropic Medication Prescriptions in Children with ASD

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Background: Children with an autism spectrum disorder (ASD) may benefit from medication to treat symptoms of ASD and co-occurring conditions such as attention-deficit/hyperactivity disorder (ADHD), anxiety, and aggression. Prescribing guidelines based on impairment profile are lacking, and clinical practice often takes a trial-and-error approach to prescription use. Only two prescription are approved for use in ASD (risperidone and aripiprazole, both for the treatment of irritability). A national profile of medication use in children on the autism spectrum is lacking and this exploratory study will address that gap.

Objectives: This study will present recent, nationally representative findings of the prevalence of psychotropic medication use in children age 18 and younger with ASD.

Methods: This study used data from the Medical Expenditure Panel Survey (MEPS) to describe psychotropic medication use in children with ASD. The MEPS is a nationally representative panel survey of health, health service use, medical events, health insurance coverage, and pharmacy use in non-institutionalized children and adults in the US conducted by the Agency for Healthcare Research and Quality (AHRQ) in the US Department of Health and Human Services (HHS). We combined MEPS years 2010-2016, resulting in a sample size 561 children with ASD ages 18 and under.

To identify psychotropic drug use, we used the Cerner Multum therapeutic class code to identify psychotherapeutic agents (code 242) from the prescribed drugs file and estimated prevalence of use in children with ASD. We calculated the cost spent on all psychotropic medications in a year for each person and reported the average for out-of-pocket expenditures and total cost. We then examined the frequency of individual medications within this therapeutic class.

Results: Thirty two percent of children with ASD had at least one prescription for a psychotropic medication in the year they were surveyed, and one quarter had six or more. Among children 12-18 years, 51% had at least one prescription for a psychotropic medication, and 42% had six or more. Average yearly expense for medication was $77 out of pocket, with a mean total expense of $2069 per person. Costs were similar in children age 11-18. The most common medication was fluoxetine, with 7% of children having a prescription for that in a year (11% of children ages 12-18), followed by sertraline (5% of all children, 9% of children ages 12-18), risperidone (4% - 6%), aripiprazole (3%), trazadone (3% - 5%), and escitalopram (2% - 4%).

Conclusions: One third of all children with ASD, and half of children ages 12-18, were prescribed at least one psychotropic medication in a year. Most were prescribed more than one. Future research should consider the presence of other co-occurring conditions that are common indications for medication use in children with ASD, including ADHD. Understanding prescribing patterns and how these connect to successful outcomes is an important step to building clinical guidelines for medication use in this population.

421.033 *(Poster)* Quantitative Trait Score Anomalies in ASD-Enriched Risk Families: Discrepancies between Social Responsiveness Scale T-Score and ASD Case Status in Younger Siblings of ASD Probands

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Background: The Social Responsiveness Scale (SRS) is a quantitative measure that enables examination of ASD-related traits across the population and has strong agreement with ASD diagnosis. Few studies have detailed SRS scores or thresholds with case status in high familial risk studies, which enroll younger siblings (or their pregnant mothers) of a child already diagnosed with ASD.

Objectives: To examine the distribution of SRS scores and correspondence with ASD diagnosis in younger siblings from ASD-enriched risk studies.

Methods: Participants included 275 children (ages 2.9-9.3, mean 3.4 years) drawn from 4 high familial risk cohorts: the Early Autism Risk Longitudinal Investigation (EARLI), Markers of Autism Risk in Babies-Learning Early Signs (MARBLES), the Infant Brain Imaging Study (IBIS), and four sites from the Baby Siblings Research Consortium (BSRC). We examined SRS score distributions and agreement between published SRS thresholds and ASD diagnosis. Cases with consistent SRS scores (T>=60, the established cut-off consistent with ASD) and cases with inconsistent SRS scores (T <60) were compared on basic characteristics and available neurodevelopmental testing.

Results: 71 of the younger siblings received an ASD diagnosis. Of these, 60% had “inconsistent” T scores (<60, n=43; T score mean=49.3, range=38-59; raw score mean=38.44); the remainder had “consistent” T scores (n=28; T score mean= 72.9, range=61-101; raw score mean=96.39). Parental SRS scores did not significantly differ between the groups, though father scores were slightly higher in the consistent than inconsistent group (T=51 vs 45, respectively; p= 0.21). Proband (the older sibling diagnosed with ASD) scores and ages did not significantly differ between these groups (T~80 in both), though probands were slightly younger in the consistent case group (proband mean age=5.7 years and 6.4 years in the consistent and inconsistent groups, respectively; p= 0.49). The majority of children in both case groups had been administered the preschool version of the SRS (86% and 79% in the inconsistent and consistent, respectively), and 70% of both groups were male. There were not significant differences in demographic characteristics between the groups. In the subset of cases with data available on other neurodevelopmental testing (n=39), Vineland Adaptive Behavior Scales scores were higher in the inconsistent than consistent case group (composite score 88.68 vs 77.76, respectively, p=0.01), but there was no difference in Autism Diagnostic Observation Scale severity score (p=0.51). In comparison to ASD cases, over 90% of children receiving no diagnosis of ASD had T scores in the consistent range (mean T score=45, range 34-84).

Conclusions: We observed lower than expected agreement between SRS T scores and ASD diagnosis in participants from these studies enriched for high familial risk of ASD. This discrepancy did not appear to be fully explained by version differences or potential biases in reporting of traits in the younger sibling (given similarities in proband scores). Further research in larger samples will be needed to address other potential explanations, such as potential diagnostic differences in studies with close follow-up of infant siblings, and/or the presence of greater phenotypic variation (a wider spectrum of symptomatology) of ASD in multiplex families.

421.034 *(Poster)* Reported and Substantiated Child Maltreatment Among Children Identified By the Missouri Autism and Developmental Disabilities Monitoring Network

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Background: Studies have shown that although children with autism spectrum disorder (ASD) are more likely to be reported for child maltreatment than children without ASD from the general population, reports of maltreatment among children with ASD are less likely to be substantiated, and there are no significant differences between children with and without ASD in the prevalence of having a substantiated report. It is unknown, however, whether this pattern holds when children with ASD are compared with children who have substantial aggregations of ASD symptomatology but do not meet full diagnostic criteria for an ASD.

Objectives: The objectives of this study were to estimate the prevalence of past three year reported and substantiated child maltreatment in the past three years among children identified by the Missouri Autism and Developmental Disabilities Monitoring Network (MOADDM) as having clinical or near-clinical level symptomatology, and to investigate whether the nature and conclusions of these reports differ between the two groups.

Methods: State records of reports of child maltreatment from July 1, 2016 to June 30, 2019 were matched with records of children aged 9-17 years who had been identified through MOADDM in 2010, 2012, and 2014 as potential ASD cases (n=1920). Children confirmed as meeting criteria for ASD (n=1242) by ADDM methodology were compared to children whose cases were reviewed on the basis of symptom aggregation but were determined not to meet ASD criteria (n=678) on prevalence of report of child maltreatment, as well as type of maltreatment reported and report conclusion using chi-square and Fisher's exact test.

Results: A similar percentage of children with and without confirmed ASD had a child maltreatment report in the past three years (13.20% vs. 12.24%; p=.55). Among the 247 children with reports, there were no significant differences between groups for type or number of types of maltreatment reported: 57.09% had reports of neglect, 53.04% had reports of physical abuse, 20.24% had reports of emotional abuse, and 10.93% had reports sexual abuse. Two or more types of maltreatment had been reported for 30.7% of children with reports. A higher percentage of reported children with confirmed ASD had a substantiated report than reported children with non-confirmed ASD (7.93% vs. 3.61%); however, this difference fell short of statistical significance (p=.19).

Conclusions: These data critically build upon knowledge of the rates of child maltreatment from population-ascertained cohorts of children with ASD symptomatology and clarify the burden of child maltreatment suffered by this fragile population. Children identified through the MOADDM surveillance system who did not meet criteria for ASD after clinician review did not differ significantly from those who did meet ASD criteria in terms of likelihood of being reported for child maltreatment or having a report substantiated. These findings suggest that previously observed elevations in the prevalence of reports of child maltreatment for children with ASD may not be restricted to children whose burden of ASD symptoms fall above the threshold for clinical diagnosis.

421.035 *(Poster)* School Attainment and Employment of Individuals with Autism Spectrum Disorder: A Prevalence Study Using European Data from Denmark

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Background: Information on education and employment prospects in adulthood among individuals with autism spectrum disorder (ASD) diagnosed in childhood is limited. The largest study to date among 680 individuals receiving special education services in the United States, reported that 35% of the participants attended college and 55% held paid employment during the first 6 years after high school; however, that study lacked a general-population comparison group.

Objectives: This population-based European study evaluated education and employment among individuals with and without ASD in Denmark.

Methods: A prevalence study was conducted using data from several registries in Denmark. We identified 810 individuals with a diagnosis of ASD recorded before the age of 12 years and 8,100
age-, sex-, and region-matched individuals without ASD. Individuals were born in Denmark between 1989 and 1991 and survived until age 25 years. Log-binomial regression, adjusted for demographics, socioeconomic factors, and comorbidities, was used to estimate prevalence ratios (PRs) with 95% confidence intervals (CIs) for completing primary, secondary, and post-secondary education, and obtained employment by age 25 years.

Results: Most individuals with ASD, and the matched population, were men (86.7%). Compared with the matched members of the general population, individuals with ASD had a higher prevalence of depression (28.6% vs. 12.4%), bipolar disorder (29.9% vs. 5.8%), and attention deficit hyperactivity disorder (26.7% vs. 4.8%). Prevalence of primary school completion was similar between those with and without ASD (96.9% vs. 98.5%; adjusted PR 0.99 [95% CI 0.98–1.00]). Compared with the matched population, those with ASD had a markedly lower prevalence of secondary school completion by age 25 (35.3% vs. 78.2%; adjusted PR 0.64 [95% CI 0.58−0.70]) and post-secondary education completion (8.6% vs. 27.0%; adjusted PR 0.56 [95% CI 0.45–0.70]). Around half (51.4%) of the individuals with ASD did not have a complete set of primary school test results, likely due to attending a special needs or private school without requirement for final test results. Among individuals with a final primary school test score, those with ASD had, on average, higher marks than those without ASD. At 25 years of age, 27.2% of individuals with ASD had employment lasting ≥6 months, compared with 77.7% of individuals in the general population (adjusted PR 0.51 [95% CI 0.45–0.58]). Furthermore, compared with those without ASD, a higher proportion of those with ASD were receiving public benefit (21.4% vs. 10.7%) or pension (35.6% vs. 2.8%).

Conclusions: In a population-based European cohort, individuals with ASD in Denmark had similar prevalence of primary school completion as members of the general population of the same age, sex, and region but had a lower prevalence of completing education beyond primary school and retaining employment. Among those with school test results, individuals with ASD achieved higher marks on average than the general population. Many individuals with ASD were financially dependent on public support. The study was limited to Danish children born 1989–1991 and information on disease severity and IQ was unavailable.

421.036 *(Poster)* School Function and Comorbid Psychiatric Conditions As Mediators to Predict Cyberbullying Involvement in Youth with Autistic Traits in a Nationally Representative Sample

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Background: Cyberbullying has become an international concern among youths with autistic traits in the digital age. It requires the attention of professionals in the fields of mental health and education due to its potentially severe consequences such as adjustment disorder, and suicidal behaviors among these victims. However, there is limited knowledge about the mediators for these associations.

Objectives: This study aimed to investigate whether school dysfunction, comorbid psychopathologies, such as anxiety/depression, inattention, hyperactivity/impulsivity, and oppositional behaviors, mediated the link between autistic traits and cyberbullying involvement.

Methods: The data is derived from a nationally representative sample of 9486 students (aged 9-14 years) from 69 schools in Taiwan. Autistic traits were measured by the Social Responsiveness Scale. Cyberbullying involvement was assessed by the Cyberbullying Experiences Questionnaire. Clinical questionnaires for school function and anxiety/depression were examined using the Chinese version of the Social Adjustment Inventory for Children and Adolescents and Child Behavior Checklist, respectively. ADHD-related symptoms including inattention, hyperactivity-impulsivity, and oppositional defiance were assessed by the SNAP-IV. The sample was divided into two groups, respectively, according to the status of cyberbullying victimization and perpetration. We compared demographic data and information from above questionnaires by independent T-test and Chi-squared test. Multiple mediation model was used to examine the mediating effects of comorbid psychopathologies on cyberbullying victimization and perpetration.

Results: The prevalence rates of cyberbullying victimization and perpetration were 14.3% and 8.8% respectively. Cyberbullying victimization and perpetration were positively associated with autistic traits, parent-reported school dysfunction, and comorbid psychiatric conditions. We also found specific mediating effects of hyperactivity/impulsivity and parent-reported school dysfunction on both cyberbullying victimization and perpetration, independent of age and sex.

Conclusions: Our results support a strong association between autistic traits and cyberbullying victimization and perpetration, as well as provide evidence showing some psychopathology such as hyperactivity/impulsivity and school dysfunction mediating such associations. Early identification and intervention of these difficulties may offset the risks of cyberbullying. Our findings need to be replicated in a longitudinal study.

421.037 *(Poster)* Sensory Features and Associated Eating and Sleeping Problems in a Population-Based Sample of Eight-Year-Old Children with ASD

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Background: Sensory features are believed to be highly prevalent among children with autism spectrum disorder (ASD), and can include under- or over-responsivity and unusual sensory interests. Existing literature suggests sensory features may be present in 54-94% of ASD cases (Baranek et al., 2006; Tomchek & Dunn, 2007) and are related to health behaviors including sleeping and eating (Mazurek & Petroski, 2015; Mazurek et al., 2013), yet most studies use clinical or convenience samples, which introduce bias. There is a strong need for population-based studies to understand sensory features in a broader context of children with ASD.

Objectives: The objectives of the proposed analyses are to use a population-based sample of children with ASD to determine the prevalence of sensory-related features among 8-year olds, evaluate differences in sensory-related features by sex, and explore relationships between sensory-related features and abnormalities in eating and sleeping.

Methods: To accomplish the objectives, we used population-based data from the Utah Autism and Developmental Disabilities Monitoring Network (ADDM) project in study years 2010 and 2012 (N=873 eight-year-old children with ASD, 81% male). The sample is 75% White, non-Hispanic, consistent with state demographics. Sensory variables were abstracted from medical and educational records using the Centers for Disease Control and Prevention's ADDM methodology (see Table 1). We examined differences in the occurrence of sensory features by sex and presence of eating/drinking and sleeping problems using chi-square analysis. We used multivariable logistic regression, adjusted for sex, to determine if sensory features are associated with sleeping and eating problems.

Results: Sensory variable frequencies are displayed in Table 1. Collectively, 80.5% of the children had a positive indication for ≥ 1 sensory variable. Presence of sensory features did not differ by sex (X^2=0.15, p=0.70). Significantly more children with ASD who had abnormalities in eating or drinking also had the presence of sensory features (86% vs. 69%; X^2=35.15, p<0.001). Differences were also noted in sleeping difficulties, with 85% of children with sleeping problems also presenting with sensory features (vs. 76%; X^2=9.52, p<0.01). When entered into a multivariable logistic regression models, we identified that children with sensory features were significantly more likely to have eating/drinking problems (Odds ratio: 2.75 [95% confidence interval: 1.95-3.87]) and sleeping problems (Odds ratio: 1.70 [95% confidence interval: 1.21-2.39]).

Conclusions: Our results from a large, population-derived sample support existing literature suggesting high prevalence of sensory features in children with ASD, and relationships between sensory features and eating/drinking and sleeping problems. The frequency of 80.5% identified in this study is on the higher end of previously reported ranges derived from samples of convenience (reports range from 54-94%), which further justifies the inclusion of sensory features in the DSM-5 diagnostic criteria and reinforces their clinical relevance. Although the dataset we used did not allow for more nuanced understanding of the types of sensory features, as would be captured using a standardized sensory measure, our study adds new information about the prevalence of these features among children with ASD.

421.038 *(Poster)* Sex Differences in the Association of Neonatal Thyroid Stimulating Hormone and Autism Spectrum Disorder

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Background: Maternal and neonatal thyroid function is essential to neurodevelopment. Exposure to maternal hypothyroid conditions in utero has been linked to autism spectrum disorder (ASD), with one study noting a stronger impact on female offspring. To-date, evidence examining sex differences in the association of neonatal thyroid levels and ASD risk is limited. However, growing research indicates sexual dimorphism in the development and sensitivity of the fetal thyroid gland, with possible implications for long-term health.

Objectives: To determine if relationships between neonatal thyroid hormone levels and subsequent diagnosis of ASD or intellectual disability (ID) differ by sex.

Methods: The Early Markers for Autism (EMA) Study is a population-based, case-control study of children born during 2000-2003 in Southern California. We obtained neonatal thyroid stimulating hormone (TSH) levels measured during routine newborn screening among children later diagnosed with ASD (n=524), ID (n=124), and general population controls (n=402). Controls were randomly sampled from birth certificate files and frequency matched to ASD cases by sex, birth month, and birth year. Using odds ratios (ORs) obtained from multivariate unconditional logistic regression, we examined sex differences in TSH between ASD or ID status vs. controls in models stratified by sex and through inclusion of an interaction term. Sex-differences in TSH relationships were further analyzed with respect to ASD subgroups defined by co-occurring ID (composite scores on standardized cognitive tests less than or equal to 70) and onset type (early onset ASD vs. ASD with regression) ascertained by expert review of records from the California Department of Developmental Services. We examined neonatal TSH both as a continuous (ln-transformed) variable and as quartiles. We adjusted models for matching factors (birth month and year), birthweight, gestational age, maternal education, parity, maternal Hispanic ethnicity, and age at newborn bloodspot collection.

Results: Among controls, males had higher geometric mean TSH levels than females (4.7 vs. 4.0 µIU/ml, p=0.04) whereas TSH levels did not vary by sex among children with ASD (4.4 vs. 4.5 µIU/ml, p=0.78). We observed a positive association between continuous neonatal TSH levels and ASD among female children (adj-OR: 1.99, 95%CI: 1.03-3.75) and no association among male children (adj-OR: 0.91, 95%CI: 0.70-1.19) (p-interaction=0.16). These TSH relationships remained elevated in females for subphenotypes of ASD+ID (adj-OR: 2.39, 95%CI: 0.85-6.77; p-interaction=0.44) and early onset ASD (adj-OR: 3.36, 95%CI: 1.42-7.98; p-interaction=0.10). Sample sizes within female strata of other ASD subphenotypes were insufficient for analysis. Among males, TSH relationships were generally null for all ASD subphenotypes examined. Though the sex interaction was not significant, TSH was also associated with higher odds of ID among females (adj-OR: 3.83, 95%CI: 1.53-9.63) but not among males (adj-OR: 0.92, 95%CI: 0.58-1.46) (p-interaction=0.70). Patterns of association were similar in models using TSH quartiles.

Conclusions: Our findings suggest that neonatal TSH may impact neurodevelopment in a sex-specific manner, with female children demonstrating greater thyroid-related susceptibility to ASD and ID than male children. Given that high neonatal TSH, indicative of thyroid insufficiency, is modifiable, continued study of these sex-differences are needed and could inform future development of sex-specific thyroid therapies.

421.039 *(Poster)* Temporal Trends in Domain-Specific Adaptive Behavior (AB) Scores in Cohorts of 8-Year-Old Children with Autism Spectrum Disorder (ASD)

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Background: With increased interest in characterizing level of functioning in individuals with ASD, AB test scores may measure variation in functioning otherwise unaccounted for by measures used to assess severity of ASD symptomatology or cognitive impairment, such as Autism Diagnostic Observation Schedule-2 calibrated severity scores and intelligence quotient (IQ). A previous population-based analysis found that the proportion of children with ASD and significant AB limitations decreased over time between 2000-2010, suggesting that as ASD prevalence has increased so has the proportion with no AB limitations. Whether this trend occurred across all AB domains or was limited to specific domains, however, is unknown.

Objectives: The aim of this study was to expand on this earlier finding regarding trends in AB limitations based on composite AB scores by assessing whether temporal increases in mean AB scores in successive cohorts of children with ASD occurred across specific AB domains: socialization, communication, daily living skills (DLS), motor skills.

Methods: Cross-sectional data from all contributing Autism and Developmental Disabilities Monitoring Network (ADDM) surveillance sites from 2002-2010 and 2014 were pooled. The ADDM Network is a multisite surveillance system incorporating health and school records and clinician reviews to estimate the number of 8-year-olds in the population meeting DSM criteria for ASD. Of the 26,885 ASD cases identified between 2000-2014, a subsample of 8,695 children had domain-specific Vineland Adaptive Behavior Scales (VABS) scores. The association of surveillance year with domain scores from the most recently administered VABS test was estimated through multiple linear regression, controlling for characteristics which differed between those with and without domain scores, including IQ, age at administration of the test, race, age at earliest known ASD diagnosis, and socioeconomic status (SES), as well as test edition, sex, and study site, overall and stratified by IQ, race, sex, and SES.

Results: Overall, the proportion of cases with domain scores indicating mild or more AB limitations (score≤70) decreased over the study period. The average AB domain score change associated with one surveillance year progression ranged from +0.63 (95% CI 0.24-1.01, p<0.01) for motor to +1.68 (95% CI 1.33-2.03, p<0.0001) for DLS. The temporal trend of increasing AB domain scores with successive cohorts generally held when analyses were stratified by IQ and sociodemographic characteristics with the largest increases in every stratum in DLS. In general, associations were stronger in those with IQ>70 relative to those with IQ≤70, girls relative to boys, white relative to non-white children, and high relative to lower SES. Analyses limited to sites contributing data from at least four surveillance years and with AB domain scores available for 20%+ of cases resulted in the same overall trends, with the strongest association in DLS, followed by communication, socialization, and finally motor.

Conclusions: This analysis suggests that with each successive cohort of 8-year-old children with ASD between 2002-2014, AB scores increased within each domain. Further research is needed to understand the reasons for this trend, including potential effects of early intervention or disparities in access to care.

421.040 *(Poster)* The Association between Atopic Diseases and Neurodevelopmental Disabilities in a Longitudinal Cohort

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Background: With increasing prevalence of atopic diseases and neurodevelopmental disabilities among children in the US, research has been exploring the connection between the two. For example, some reported the link between various atopic diseases with autism spectrum disorders (ASD) and attention deficit hyperactivity disorders (ADHD); however, results have been inconsistent.

Objectives: To investigate whether asthma, atopic dermatitis (AD) and allergic rhinitis (AR) are more prevalent in children with ASD, ADHD, and other neurodevelopmental disabilities (NDDs), compared to those without any NDDs.

Methods: 3153 children enrolled at birth and followed prospectively in the Boston Birth Cohort:160 with ASD, 422 with ADHD (without ASD diagnosis), 1133 with other NDDs, and 1438 without any NDDs. Children with ASD and ADHD were classified in the ASD group. Other NDDs included mental, behavioral and neurodevelopment disorder excluding ASD and ADHD. NDDs, asthma, AD and AR were defined based on ICD codes of physician diagnoses documented in the electronic medical records. Multivariable logistic regressions were carried out to estimate the association (odds ratio (OR) and 95% confidence interval (CI)) between asthma, AD and AR and NDDs (i.e. ASD, ADHD, and other NDDs), respectively. All multivariable regression models adjusted for the following confounders: child sex, birth year, child birth weight, child age at last visit, maternal highest education level, maternal race/ethnicity, maternal age at delivery, maternal pre-pregnancy Body Mass Index (BMI) and maternal smoking during pregnancy. Small proportion of missing values of maternal pre-pregnancy BMI, maternal smoking status during pregnancy, and maternal education level were imputed using the value with highest frequency.

Results: The prevalence of asthma among children with ASD, ADHD, other NDDs and without any NDDs were 31.9%, 40.5%, 30.1% and 21.4%; with the adjusted ORs 1.22 (0.84-1.77), 1.60 (1.24-2.06) and 1.29 (1.07-1.56), respectively. The prevalence of AD among children with ASD, ADHD, other NDDs and without any NDDs were 36.3%, 38.9%, 33.3% and 26.5% respectively; with the adjusted ORs 1.42 (0.99-2.03), 1.68 (1.31-2.15), 1.33 (1.12-1.59), respectively. The prevalence of AR among children with ASD, ADHD, other NDDs and without any NDDS were 24.4%, 33.7%, 25.2% and 15.7%; with the adjusted ORs 1.17 (0.78-1.76), 1.55 (1.19-2.04) and 1.44 (1.17-1.77), respectively.

Conclusions: Overall, there were positive associations between atopic diseases and neurodevelopmental disabilities; however, after child and maternal factors are taken into account, the associations diminished in ASD group. This could be, in part, due to ASD group has the smallest sample size among all NDDs groups. Our findings provide evidence of higher prevalence of atopic diseases among children with NDDs (as compared to those without NDDs) in this US urban population. It is possible that the atopic diseases included in the study share common etiology and that the NDDs are so as well to some extent. It raises the hypothesis that certain pathogenic pathway maybe shared by atopic diseases and NDDs. Findings from this study may inform health care providers and parents to pay more attention on detecting, preventing, and treating atopic diseases among children with NDDs.

421.041 *(Poster)* The Etiological Relationships between Maternal Health and Autism Spectrum Disorder

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Background: We have shown that mothers of children with autism spectrum disorder (ASD) have considerably higher burden of disease around pregnancy than mothers of unaffected children. Nevertheless, the full spectrum of maternal medical diagnoses has never been comprehensively assessed for their association with offspring ASD.

Objectives: The goals of our study were (i) to identify all maternal medical diagnoses around pregnancy associated with ASD risk in offspring, and (ii) to distinguish the effects of maternal health before, during and after pregnancy on the risk of ASD.

Methods: We used medical information on Israeli children (N=89,483) born 1998-2007 and their parents, to identify diagnoses more common around the pregnancies (pregnancy + preceding 1 year) of mothers of children with ASD, than of mothers of control children. In all analyses, we used logistic regression analysis and controlled for child's year of birth, maternal age and family's socioeconomic status. In order to eliminate the associations arising due to a correlation between diagnoses, we tested the effects of all diagnoses significantly associated with ASD after false discovery rate adjustment for multiple testing ($q < 0.05$) in a joint, penalized regression model. In order to resolve whether these associations are underlain by shared genetic factors, or by disruption of fetal development, we compared the ASD risk associated with maternal number of diagnoses during pregnancy, with the risk associated with diagnoses that are unlikely to directly affect the fetus, i.e. those recorded before or after pregnancy.

Results: Twenty eight ICD-9 codes recorded in mothers 21 months prior to child's birth were associated with ASD in offspring in the initial, single-diagnosis models. Entering these items into a single penalized regression model eliminated all but 13 of these associations, suggesting the issue of phenotype correlation in epidemiological studies. Maternal diagnoses most strongly associated with ASD included psychiatric, metabolic and genitourinary diagnoses (e.g. depression: OR=1.25 (1.04-1.48); non-inflammatory disorders of cervix: OR=1.22 (1.06-1.41); disorders of adrenal glands: OR=1.71 (1.03-2.86)). Comparison of the effects of maternal disease burden before, during and after pregnancy revealed that only the number of diagnoses recorded during and after, but not before, were significantly associated with ASD risk in children (during: OR=1.11 (1.07-1.14), after OR=1.05 (1.01-1.08)).

Conclusions: Our analyses suggest pervasive effects of maternal health on the risk of ASD in offspring. We have identified both known and potentially novel early-life risk factors for ASD, highlight the utility of unbiased, data-driven approaches in epidemiology of ASD.

421.042 *(Poster)* Utilization of the Maternal and Child Health Handbook in Early Identification of Autism Spectrum Disorder and Other Neurodevelopmental Disorders

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Background: Despite the importance of incorporating caregivers' concerns about their child's development into the early identification and detection of autism spectrum disorder (ASD) and other neurodevelopmental disorders (NDDs), findings from existing research studies may not reflect concerns that caregivers raise at home while observing their child's behavior and development continuously and prospectively.

Objectives: 1) To examine how prospectively recorded information about the child's early development corresponded with diagnoses of ASD at 5 years of age and 2) to investigate what milestone items can discriminate NDD from non-NDD as well as ASD from non-ASD NDD (intellectual disability, attention-deficit hyperactivity disorder, and developmental coordination disorder).

Methods: Samples are children who participated in developmental checkups, conducted in all 5- year-old children residing in Hirosaki city, Japan. Each NDD case was ascertained following the developmental screening and the subsequent in-person assessment. Developmental milestone data were extracted from the Maternal and Child Health Handbook (MCHH), which is a booklet distributed by municipalities to all pregnant women residing in Japan as universal health care. Binomial logistic regression analysis was conducted to examine the associations between each milestone item of the MCHH and NDD.

Results: Among 720 children who underwent the assessment, 455 children received one or more NDD diagnosis (ASD: n = 124, non-ASD NDD: n = 331). There were 18 milestone items/early signs discriminating NDD from non-NDD; parental concerns about motor milestones emerged first, followed by concerns about social play and speech development. Sixteen items were identified to be early predictors for children who were later diagnosed with ASD compared to non-ASD NDD. These concerns encompassed multiple areas of development, including play, speech, motor, and social interaction. More concerns became noticeable as the child's development progressed. While the motor milestone items became pronounced and started differentiating NDD and non-NDD by 12 months of age, very few milestone items discriminated ASD from non-ASD NDD prior to 24 months.

Conclusions: The present study demonstrated the utility of the MCHH as a tool to educates parents to understand what they need to look for in charting their child's developmental milestones. Additionally, findings from the present study provided us with further understandings of important milestone items that could be early predictors for ASD and other NDDs if not attained by certain developmental periods.

421.043 *(Poster)* Validation of Electronic Health Record Autism Diagnoses in a Pediatric Healthcare Network for Screening and Study Recruitment

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Background: Learning health systems (LHS) merge healthcare delivery with research, data science, and quality improvement processes, in order to facilitate both research and clinical innovations. This work is made possible by the use of electronic health records (EHR) in clinical care, but relies upon methods to identify patients with a specific condition. Within autism spectrum disorder (ASD) research, algorithms that identify ASD patients from clinical notes have been proposed, but they are complex, difficult to implement, and sensitive to the data source, thus limiting generalizability across healthcare systems. Other studies propose simpler International Classification of Disease (ICD) code-based models, but these lack validation against an external data source, relying instead on manual chart review of the EHR itself.

Objectives: Measure the performance of ASD ICD code-based models in identifying patients with ASD as determined by a gold-standard research ASD diagnostic assessment.

Methods: We studied 566 children with parental concerns about or community diagnosis of ASD, who also had EHR data from at least one clinic visit at the Children's Hospital of Philadelphia. Independent gold-standard research diagnostic evaluations confirmed an ASD diagnosis in 79% of this cohort. Performance of the ASD ICD based models was measured by positive predictive value (PPV) and sensitivity. Sensitivity was measured relative to the full cohort, as well as a model specific subcohort with enough visits to make a model positive possible.

Results: Of the 411(73%) patients who had one or more (1+) ASD ICD code in their EHR, 362(88%) received an ASD diagnosis during the research evaluation, yielding a PPV of 88% and sensitivity of 81%. The more restrictive 2+ ASD ICD model yielded a PPV of 89% and sensitivity of 69%. The 1+ Expert ASD ICD model yielded a PPV and sensitivity of 88% and 56%. However, in the subcohort of patients seen by a psychologist, psychiatrist, or neurologist (vs other provider), sensitivity was 91%. The PPV of 1+ ASD ICD before age 5 was 93% with a sensitivity of 21%, increasing to 49% in the model specific cohort. With regards to identifying patients without ASD, the model of 0 ASD ICD yielded a PPV of 44% and sensitivity of 58%. When restricted to patients with 8+ clinical visits, PPV improved to 68% but sensitivity reduced to 32%.

Conclusions: The model of one or more ASD ICD code in a patient EHR performed well, but not perfectly for identifying ASD. Alternative algorithms can increase PPV at the expense of sensitivity. Requiring an ASD ICD code before age 5 improves PPV substantially. This may be helpful when recruiting research subjects from clinical settings, potentially obviating the need for time-consuming research evaluations to confirm diagnosis. In contrast, 2+ ASD ICD codes or expert ASD ICD codes did not significantly improve PPV. Results also indicated that lack of an ASD ICD code is informative, especially for patients who had 8+ visits. Overall, our results demonstrate that EHR diagnoses are remarkably consistent with independent, gold-standard research evaluations, which should facilitate future learning health system research.

421.044 *(Poster)* What Are People Googling about Autism? Trends in Internet Google Queries about Causes and Treatments of Autism over the Past 15 Years: An Exploratory Infodemiology Study

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Background: Over 70% of people search for health information online (Fox, 2013). While the internet has widespread information about autism spectrum disorder (ASD), it has also led to misinformation and perpetuated misperceptions related to the causes and treatment of ASD (Cruchet et al., 2016). Infodemiology is an area of public health informatics research using big data analytics to understand online search behavior. *Google Trends* is the most common infodemiology tool used to analyze online search data (Mavragani et al., 2019).

Objectives: The objectives were to: 1) use infodemiological data to analyze trends in internet searches over time about causes and treatments of ASD; and 2) inform clinicians and ASD/health organizations about public online queries regarding ASD.

Methods: The infodemiology methodology framework for *Google Trends* analyses as outlined by Mavragani et al. (2019) was used. *Google Trends* applies algorithms to assess frequency of online searches comparing different terms. These analyses focused on Google searches in the United States from 2004 (earliest data available) until present (2019). The terms analyzed were comprised of key words from common questions in clinical practice about *causes* of ASD including: vaccines, genetics, environmental factors, and microbiome; and separate analyses for queries about *therapies* including: ABA (applied behavior analysis), gluten free diet, chelation therapy, marijuana, probiotics, and stem cell therapy.

Results: Google Trends results are normalized on a scale ranging from 0 to 100 to represent the frequency and relative interest of search topics. For online searches about *causes* of ASD (Figure 1), vaccines had the greatest search volumes compared to other terms, with an initial peak observed in 2008, reaching the highest frequency in 2015, with a current upward trend. In comparison, searches about the role of genetics, environmental factors and microbiome occurred less frequently.

For online searches about ASD therapies (Figure 2), ABA consistently had a high frequency of online interest since 2004 with a slight decrease between 2010-2013, followed by steadily rising interest. The analyses of chelation therapy and gluten free diet showed high trending interest in 2005 and 2007, respectively, followed by a steady decline since. Searches for ASD and marijuana had an initial rise in 2009 and continue to trend upward, coinciding with increased legalization of marijuana. Searches about probiotics and stem cell therapies have both been relatively low yet are gaining interest, with more overall queries about probiotics than stem cell therapy.

Conclusions: Infodemiology using *Google Trends* is an effective strategy to analyze large-scale data trends in web-searches about ASD. High interest continues surrounding vaccinations and ASD with less searches about the role of genetics. ABA exhibited a consistently high frequency of online interest, while other therapies trended and then lost interest over time (i.e., gluten free diets and chelation therapy). Marijuana, less so probiotics and stem cell therapy, appear to be gaining interest online. This information can be used to inform clinicians, guide clinical conversations and help ASD advocacy/health organizations develop targeted education and online communication strategies to provide up-to-date, accurate and evidence-based information in areas of public online interest.

Epigenetics

POSTER SESSION — **EPIGENETICS**
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422.001 *(Poster)* Altered DNA Methylation in a Severe Subtype of Idiopathic Autism: Sex Differences and Potential for Identifying Epigenetic Signatures for ASD

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Background: Although differences in DNA methylation have been associated with both syndromic and idiopathic autism, differential methylation has not been previously examined with respect to sex differences and utility as an epigenetic screen for idiopathic autism spectrum disorder (ASD). Moreover, the clinical heterogeneity of individuals with idiopathic ASD has posed a challenge with regards to identifying significantly differentially methylated genes.

Objectives: The goals of this study were to: 1) investigate differences in the DNA methylation profiles of lymphoblastoid cell lines (LCL) derived from a subgroup of severely affected individuals with idiopathic autism and their respective sex-matched siblings; 2) describe ASD-relevant pathways and functions that may be impacted by the differentially methylated genes; 3) identify sex-dependent differences in methylation patterns; and 4) examine the potential for identifying epigenetic biomarkers in peripheral tissues.

Methods: Individuals with idiopathic autism associated with severe language impairment were identified by cluster analyses of ADI-R scores to reduce clinical heterogeneity among cases. Differentially methylated genes (DMGs) in the DNA of cases and controls, either combined or divided into discovery and validation sets, were investigated using Affymetrix Human Promoter GeneChips and identified using Partek Genomics Suite software. Multi-experiment Viewer microarray analysis software was used for additional statistical and classification analyses to explore the potential of identifying DMGs that can distinguish cases from controls. Pathway and functional analyses of the DMGs were performed using Ingenuity Pathway Analysis software.

Results: This study reveals statistically significant differences in DNA methylation in LCL derived from individuals sampled from a severely affected subgroup of individuals with idiopathic ASD and from their unaffected sex-matched siblings and shows, for the first time, genome-wide, sex-dependent differences in methylation profiles and pathways pertinent to autism. Synaptogenesis, semaphorin, and mTOR signaling pathways are consistently over-represented among DMGs identified from independent paired analyses of cases and controls divided either by sex or by separation into discovery and validation groups. Moreover, the DMGs are statistically enriched in genetically defined autism risk genes. In contrast to DMGs in males, DMGs in females are associated with metabolic pathways that implicate mitochondrial and metabolic dysfunction, especially in fatty acid and branched chain amino acid pathways. Classification analyses using machine learning approaches further demonstrate that a limited number of DMGs exhibit potential to serve as class predictors with moderately high sensitivity and specificity.

Conclusions: DMGs in LCL derived from a severe subtype of idiopathic autism consistently implicate common pathways known to be impacted in ASD. Class prediction analyses suggest the potential for developing an epigenetic screen for ASD.

422.002 *(Poster)* Multi-Omics Approach to Study the Effects of Air Pollution on Neural Cell Development.

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Background: Epidemiologic studies have established that air pollution exposure contributes to an increased risk of autism spectrum disorder (ASD) diagnosis. We investigated the effect of a component of air pollution, diesel particulate matter, on neuron development. To understand the whole effect of this toxicant we integrated omics data at the DNA accessibility, RNA expression, and protein abundance levels.

Objectives: 1) Find differential gene expression between control and 4 increasing doses of air pollution. 2) Determine changes in gene promoter accessibility following exposure. 3) Impact of air pollution on protein abundance. 4) Integration of multi-omics approaches to understand exposure effect on biological pathways.

Methods: ReNcell CX cortical neural progenitor cells were exposed to 0, 10, 20, 50 and 100 ug/mL of air pollution for 24 hours. Cells were harvested for RNA-seq to determine gene expression (n=4), ATAC-seq (Assay for Transposase Accessible Chromatin) to determine DNA accessibility (n=2) and mass spectrometry to determine protein abundance (n=3).

Results: RNA-seq revealed a total of 10,098 genes were differentially expressed (q <0.05) following diesel particulate matter (DPM) exposure. At 10 ug/ml, there were 59 genes differentially expressed; at 20 ug/ml DPM, there were 500 genes differentially expressed; at 50 ug/ml DPM, there were 3,806 genes differentially expression; and at 100 ug/ml DPM, there were 5,733 genes differentially expressed. More than 200 of these differentially expressed genes are present on the SFARI database of ASD candidate genes, suggesting a convergence of genetic and environmental influences on ASD risk. Analyses of the downregulated DE genes indicated enrichment of genes involved in gene expression, nervous system process and chromosome organization. Analyses of upregulated genes indicated enrichment of genes involved in neuron apoptotic process, negative regulation of cell projection organization, and negative regulation of neuron differentiation and neurogenesis. ATAC-seq indicated decreased chromatin availability of genes involved in neuron differentiation, neuron projection development, nervous system development and axon development following DPM treatment. DNA promoters that were more accessible following DPM treatment were enriched for detection of chemical stimulus and metabolic processes. Integration of downregulated RNA differentially expressed genes and downregulated proteins resulted in pathway overrepresentation of neuron migration and axon guidance.

Conclusions: The multi-omics data analysis offers a more complete understanding of how neural progenitor cell development is affected following air pollution exposure. We observe an abundance of ASD associated genes significantly differentially expressed at all doses. Further, biological pathways impacted by genetic variants are also impacted by air pollution exposure, suggesting convergent molecular mechanisms.

422.003 *(Poster)* Placental Epigenome-Wide Association Reveals Co-Methylated Loci within 22q13.33 Integrating Genetics and Maternal Environment in the Marbles Prospective Autism Study

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Background:

Most autism spectrum disorder (ASD) cases appear to be multifactorial, involving common genetic variation and environmental factors. DNA methylation shows dynamic changes during fetal development and contains the molecular memory of *in utero* experiences such as maternal nutrition and exposures. Placenta, normally discarded at birth, is a potentially rich source of epigenetic biomarkers that can provide mechanistic insight into heterogeneous etiologies of ASD. Unlike most other human tissues, placenta contains partially methylated domains that reflect methylation landscapes in oocytes and pre-implantation stages of development.

Objectives:

This study sought to identify specific regions of differential methylation reflecting ASD risk in placenta for early ASD prediction and biological insight. At each genetic region showing differential methylation, we also are investigating the influence of both common genetic variation and *in utero* maternal environment on DNA methylation levels.

Methods:

We performed whole genome bisulfite sequencing (WGBS) analyses on a total of 179 placenta samples from newborns later clinically classified as having ASD, non-typical development (Non-TD) or typical development (TD). Both male and female samples were included from the MARBLES (Markers of Autism Risk in Babies-Learning Early Signs) prospective high-risk cohort study. This study recruited pregnant women who had a prior child with ASD. In the discovery group (46 ASD and 46 TD), differentially methylated region (DMR) analysis was performed to assess DNA methylation differences between ASD and TD. Analysis of replication with another cohort and prediction with other 87 samples are ongoing. In order to incorporate genetics, whole genome sequencing (WGS) was also performed on a subset of matched cord blood DNA samples (41 ASD and 37 TD).

Results:

In the discovery group, a total of 139 DMRs discriminating ASD from TD placental samples were identified, averaging 2kb in length (methylation difference > 5%, permutation-based $p < 0.05$) (**Figure 1**). These ASD DMRs mapped to 170 genes significantly enriched for functions in development and neural differentiation (adjusted $p < 0.05$). Fourteen ASD hypomethylated DMRs, including two with genome-wide significance, mapped to a single 118 kb block at 22q13.33 (**Figure 1**). Those 14 DMRs had methylation levels highly associated with each other, forming a 22q13.33 methylation block (**Figure 2**). Five out of 14 DMRs in the 22q13.33 block were significantly associated with SNPs located inside the DMRs. Furthermore, methylation levels within five out of 14 DMRs in the 22q13.33 methylation block were significantly associated with measured placenta folate level and 5,10-methylenetetrahydrofolate concentrations (adjusted p-value < 0.05).

Conclusions:

Together, these results suggest that placental methylation levels within the 22q13.33 methylation block were sensitive to both genetic and environmental factors. Further replication analysis is ongoing. These results provide evidence that placental methylation levels reflect the intersection of genetic and environmental etiologic factors in combination with prior results on brain tissue from persons with autism.

Family Issues and Stakeholder Experiences

ORAL SESSION — FAMILY ISSUES AND STAKEHOLDER EXPERIENCES
314 - Family and Community Training, Awareness and Diversity

314.001 *(Oral)* Can Autism Trainings Reduce Implicit and Explicit Stigma? Comparing a Participatory Training to a Training Developed without Autistic Input

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Background: As increasing numbers of autistic students enter college, they often exhibit academic strengths (Bakker et al., 2019). However, they also face stigma, which contributes to mental health problems (Botha et al., 2018). Autism stigma is associated with more acceptance of inequality (Gillespie-Lynch et al., 2019), suggesting that social dominance orientation (SDO) contributes to stigma, as it does to generalized prejudice (Bäckström & Björklund, 2007). Online trainings have been used to improve explicit autism stigma among college students in Japan, Lebanon and the US (Gillespie-Lynch et al., 2015; Obeid et al., 2015; Someki et al., 2018). Although implicit stigma has been highlighted as an important target for anti-stigma research (Stier & Hinshaw, 2007), prior research has not attempted to reduce implicit autism stigma. Nor has prior research included autistic students in the process of developing trainings to improve understanding.

Objectives: 1) Examine predictors of explicit autism stigma, including SDO and implicit stigma.

2) Evaluate if a participatory autism training (developed in collaboration with autistic students) or a non-participatory training (developed without autistic input) is more effective at reducing implicit and explicit stigma.

Methods: Four autistic college students and four high school students helped adapt an autism training by making concepts/assessments more accessible/engaging. After pilot assessments of the participatory training with high school (n = 53) and college students (n = 431) in NYC and an initial evaluation of the non-participatory training with college students in Quebec (n = 179) and Georgia (n = 84), we revised the trainings. College students in NYC were randomly assigned to either the participatory (n = 103) or the non-participatory training (n = 102). Pre- and post-tests consisted of an IAT (implicit stigma), social distance scale (explicit stigmal = .87), and a participatory autism knowledge measure (=.84).

Results: A regression revealed that heightened implicit stigma (B = -.18, p = .006), SDO (B = .30, p < .001) and reduced autism knowledge (B = -.21, p = .004) and quality of prior contact with autism (B = -.22, p = .001) predicted explicit stigma ($R2$= .35). Improvements with training in implicit stigma, $F(1, 161) = 36.28$, p < .001, $\eta^2 = .18$, explicit stigma, $F(1, 203) = 4.74$, p = .03, $\eta^2 = .02$, and knowledge were observed, $F(1, 203) = 20.90$, $p < .001$, $\eta^2 = .09$. A trend toward improved explicit stigma following the participatory relative to the non-participatory training was observed (p = .08).

Conclusions: Implicit stigma and SDO contribute to explicit stigma towards autism, suggesting that interventions that have been effective at reducing implicit biases (e.g., receiving feedback about implicit biases and education about strategies to reduce biases; Devine et al., 2012), may also reduce autism stigma. Carefully designed trainings can ameliorate implicit and explicit stigma. Although our participatory training was not significantly more effective than our non-participatory training, our participatory knowledge measure exhibited better internal consistency than published non-participatory measures. Autism trainings can provide insights about factors that shape attitudes toward autism while promoting understanding and acceptance.

314.002 *(Oral)* Feasibility and Impact of the Implementation of Caregiver-Oriented and Non-Specialist Facilitated TEM - Transforming Everyday Moments - Workshops in Argentina

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Background: In many low and middle-income countries such as Argentina, parent-implemented interventions are sometimes the only available treatment for children with ASD. One of such parent-implemented interventions existing in Argentina is called TEM - Transforming Everyday Moments - workshop, a caregiver-oriented workshop intended for caregivers of children diagnosed with ASD under the age of 6 and low verbal abilities. This workshop offers tools to caregivers to promote play, engagement, shared enjoyment and communication skills. Since 2013 more than 100 TEM workshops have been done, reaching more than 1300 caregivers. In 2018, 100 caregivers from the 24 provinces were trained as facilitators via a 2-month online TEM training course, so that they could implement TEM workshops in their cities. This study aims to show the results related to feasibility and impact of this online training course for 100 facilitators.

Objectives: 1) To assess the feasibility of training 100 caregivers as TEM workshop facilitators in the 24 provinces of Argentina via a 2-month online training course. 2) To assess the impact of the implementation of TEM workshops for caregivers participating in the workshops.

Methods: In 2018 100 caregivers of individuals with ASD were selected to participate in the TEM online training course. They were asked to complete multiple-choice assessments after each lesson and submit videos which were evaluated by a tutor. At the end of the online course, facilitators provided a TEM workshop to local caregivers. All participants in the local TEM workshops were invited to complete a feedback survey about the workshop.

Results: 1) Feasibility: 42% of facilitators reached criteria to be certified as facilitators. TEM workshops were implemented in 16 of 24 Argentine provinces. 2) Impact: to date, 794 caregivers have participated in TEM workshops implemented by the online-trained facilitators. In the anonymous feedback survey, caregivers referred the following: a) How useful was the TEM workshop overall? (possible scoring 1-10, 1 being not useful and 10 being extremely useful): 672 scored 10 (84,6%), 75 scored 9 (9,4%), 37 scored 8 (4,7%), 7 scored 7 (0,9%); b) How much do you believe your playing skills have changed after the workshop? (1 being no change and 10 being maximum change): 501 scored 10 (63,1%), 114 scored 9 (14,4%), 137 scored 8 (17,3%), 24 scored 7 (3%), 8 scored 6 (1%), 4 scored 5 (0,5%), 1 scored 2 (0,1%) and 5 scored 1 (0,6%); and c) Would you recommend this workshop to other caregivers?: 790 answered Yes (99,5%), 4 answered Maybe (0,5%), and none answered No.

Conclusions: In countries like Argentina there are many barriers for families to access services for their young children with ASD. In this context, parent mediated interventions can sometimes be the only source of tools and strategies to improve the socio-communicative and play abilities of children with ASD. Training non-specialists via an online course to become facilitators of a free parent-training workshop is a feasible alternative to expand access to services and has a positive impact in caregivers, empowering them and improving joint engagement with their children.

314.003 *(Oral)* Gender Variance in Neurodivergent Children and Youth: A Pond Network Pilot Report

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Background: Gender variance refers to an individual's variation in gender role behaviors and identity, deviating from culturally specific gender norms associated with assigned sex at birth. Previous studies reported increased wishes to become other gender in children diagnosed with ASD or ADHD, mostly measured by a parent-reported single item. Clinical and registry studies also showed increased gender identity variance in autistic compared to neurotypical adults. In our previous community-based study of school-age children that also included those with ASD (N=80) or ADHD (N=247), we used a well-validated parent-report instrument (Gender Identity Questionnaire for Children, GIQC) and found ASD (but not ADHD) children displayed heightened gender variance; moreover, in neurotypical children, gender variance was higher in assigned females than males, and was associated with autistic traits. These findings need to be replicated with better-powered sample. Furthermore, it remains unclear whether gender variance is associated with neurodevelopmental categorical diagnoses or dimensional traits and if this relationship varies with age across childhood and adolescence.

Objectives: In this pilot report from the Endocrine and Sex/Gender Platform of the Province of Ontario Neurodevelopmental Disorders (POND) Network, we investigated a sample of children and youth enriched with clinical diagnoses of ASD or ADHD, including birth-assigned males and females, regarding: (1) how gender variance varies by categorical diagnoses and assigned sex; (2) whether gender variance is associated with dimensional ASD and ADHD traits; and (3) how gender variance varies by age.

Methods: Sample included 371 participants aged 2-21 years enrolled in POND Network: N=165 ASD (mean age 9.4 years; 130 biological male, 35 biological female), N=111 ADHD (mean age 9.9 years; 78 male, 33 female), and N=95 typically developing (mean age 12.6 years; 53 male, 42 female). Gender variance was estimated by the GIQC total score, dimensional autistic traits by the Social Communication Questionnaire (SCQ) total score and the Repetitive Behaviors Scale–Revised (RBS-R) total score, and dimensional ADHD traits (attention- and activity/impulsivity-regulation) by the Strengths and Weaknesses of Attention-Deficit/Hyperactivity-symptoms and Normal-behaviors (SWAN). ANOVA was used to investigate categorial group differences on gender variance. A multiple regression model examined the most significant predictors of gender variance among age, assigned sex, dimensional traits, and categorical diagnoses.

Results: Two-way ANOVA showed significant main effects of diagnosis ($F_{(2, 365)}$=9.6, p<0.001, η_p^2=0.050) and sex ($F_{(1, 365)}$=16.7, p<0.001, η_p^2=0.044) on GIQC score, without significant diagnosis-by-sex interaction ($F_{(2, 365)}$=0.46, p=0.63). Overall, ASD group had higher gender variance than ADHD (p_{Tukey}<0.001) and typically developing groups (p_{Tukey}=0.001), whereas the latter two did not differ from each other (p_{Tukey}=0.94); assigned females, irrespective of diagnosis, had higher gender variance than assigned males. Multiple regression identified significant predictors of gender variance being: sex (standardized coefficient Beta=-0.23), age (Beta=0.14), SCQ score (Beta=0.28) and SWAN activity/impulsivity-regulation score (Beta=-0.33).

Conclusions: Autistic children and youth are more likely to display heightened gender variance than typically developing or ADHD children and youth. Gender variance is higher in assigned females and older children and youth, and those with higher autistic traits and lower activity-impulsivity regulation, even after accounting for categorical diagnostic status.

314.004 *(Oral)* Helping Double Rainbows Shine: How Teachers Support Gender Diverse Youth on the Autism Spectrum.

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with social communication impairments that impact peer relationships and school experiences. Research has shown that youth with disabilities and youth who identify as LGBTQ+ face significant risk factors (Murray, 2003; Robinson & Espelage, 2012; Sadowski, 2008), but little qualitative research has been conducted with youth with ASD who identify as transgender or gender diverse (Strang et al., 2018). Kosciw et al. (2016) found that LGBTQ+ youth who could identify at least one supportive adult ally at their school reported having a more positive view of their school's climate. By interviewing adolescents with ASD who identify as transgender or gender diverse, greater understanding of their personal school experiences can be gained, aiding in the development of more supportive teacher practices that meet their needs.

Objectives: To 1) understand how teachers influence the perception of safety and support of gender diverse youth with ASD regarding their gender identity, 2) how teachers influence these students to feel unsupported in their gender identities, and 3) how these students perceive that their gender identities could be better supported in schools.

Methods: This basic qualitative study included 10 participants diagnosed with ASD and identified as transgender or gender diverse (M_{age} = 16.7 years, range = 14-19). Data was collected via one-to-one semi-structured interviews conducted in an outpatient hospital setting. Interviews were transcribed and a coding scheme was developed. Using the coding scheme, thematic analysis was utilized to detect commonalities and themes across interviews.

Results: Participants reported teachers as being a significant source of potential support or invalidation of their gender identities. Teachers who gave space for and respected students' personal agency regarding disclosing gender status, preferred pronouns and names were perceived as more supportive than those who did not honor student agency. Participants also reported that teachers who actively upheld and enforced formal and informal school policies around bullying and homophobic/transphobic rhetoric were more supportive than teachers who passively reacted or ignored such behaviors. Teachers who were open, genuine, and warm were considered more supportive than teachers who were not or appeared to be saying things for personal gain or district requirements. These themes were connected with positive perceptions of support and safety around gender identity for these participants.

Conclusions: Our results support and build on previous findings indicating that teachers influence school climate for LGBTQ+ youth. Youth with ASD who identify as transgender or gender diverse reported that teachers who were warm, genuine, and actively responded to homophobic/transphobic remarks helped build a more positive, supportive school climate regarding gender identity than teachers who reacted passively. Overall, findings provide direction for the development of teacher trainings on discussing LGBTQ+ topics with students, promoting personal student agency around gender identity, and how to actively respond to potential homophobic/transphobic comments and behaviors.

ORAL SESSION — FAMILY ISSUES AND STAKEHOLDER EXPERIENCES
315 - Family Dynamics and Demographic Effects

315.001 *(Oral)* Trajectory of Change in the Observed Couple Relationship Quality of Parents of Children with Autism

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Background: In cross-sectional studies, parents of children with autism spectrum disorder (ASD) have been found to differ, in both adaptive and maladaptive ways, in their romantic couple relationship experiences relative to other parents (Hartley et al., 2017; Sim et al., 2016). Little is known, however, about the trajectory of change in the quality of the couple relationship across time in parents of children with ASD. The *Vulnerability-Stress-Adaptation* model (Karney & Bradbury, 1995) posits that changes in couple relationship quality are shaped by the stressors that partners and the couple experience, existing vulnerabilities that each partner brings into the relationship, and ability to use adaptive couple processes to navigate stressors.

Objectives: This study's goal was to explore change in the observed quality of couple interactions across a three-year time span. Additionally, we explored the role of parenting stressors (child's ASD symptoms and co-occurring emotional and behavioral problems) and parent vulnerabilities (Broad Autism Phenotype [BAP] and depressive symptoms) on the initial level and trajectory of change in quality of observed couple interactions.

Methods: This longitudinal study included 378 parents (N=189 couples) of a child with ASD. Data was collected across four time-points, each approximately one year apart. Parents were predominantly White and non-Hispanic, and children had an average of 7.9 years old. ASD diagnosis was documented by an educational or medical professional using the ADOS. The Social Responsiveness Scale -2 (SRS-2; Constantino & Gruber 2012) and the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) were used to measure ASD symptoms and co-occurring emotional and behavioral problems. The Broader Autism Phenotype Questionnaire (BAPQ: Hurley et al., 2007) and Center for Epidemiologic Studies Depression Scale (CESD; Radloff, 1977) were used to measure parent BAP and depressive symptoms. A 7-minute videotaped couple problem-solving interaction in which couples discussed a topic of disagreement was coded using the Marital Interactions Coding Scales (Frosch et al. 1998).

Results: Structural equation modeling using the lavaan package (Rosseel, 2012) in R revealed that on average, global relationship quality demonstrated a significant linear decline across time (β=-0.70, p <0.001). There was a significant negative effect of mother's depressive symptoms on the intercept (level of relationship quality), and a significant negative effect of father's initial level of depressive on the slope of observed relationship quality (β=-0.32, p=0.04). Likewise, there was a significant negative effect of father's BAP on the slope of decline in relationships quality (β=-0.32, p=0.03). Greater levels of depressive symptoms or BAP in fathers were related to more negative decline in relationship quality across time. The effect of child SRS-2 and CBCL on intercept and slope were not significant.

Conclusions: Findings suggest that on average, there is a linear decline in observed global relationship quality of couples with a child with ASD across a span of three years. Rate of decline in couple relationship quality was predicted by father initial level of depressive symptoms and BAP. Child variables did not predict change in relationship quality across time. These findings have implications for programs aimed at enhancing romantic couple relationships.

315.002 *(Oral)* Responsive Parenting Interacts with Child Genetics to Predict Heterogeneous Patterns of Social Development in ASD

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Background: Autism spectrum disorder (ASD) is characterized by substantial heterogeneity in social phenotypes (Masi et al. 2017). Emerging research suggests that social environments such as parenting and individual genetic variants both play key roles in the social development of children with or without ASD. However, a more nuanced understanding of how these factors interact is needed to: (1) parse apart diverse sources of social heterogeneity in ASD, (2) resolve inconsistencies in the literature, and (3) develop and select optimal treatments based on individual differences.

Objectives: Given the need to characterize novel sources of heterogeneity in ASD, the present study sought to: (1) evaluate the interactive or additive effects of responsive parenting and biologically plausible candidate genes (5-HTTLPR, DRD4, OXTR) in predicting trajectories of social functioning over time, (2) test competing models of GxE (i.e., diathesis stress vs. differential susceptibility), and (3) assess child emotion regulation as a mechanism of GxE.

Methods: Participants were 104 children with ASD ages 4 to 7 years (M = 5.6 years) and their primary parent (89% mothers) sampled from a multi-site longitudinal study of developmental processes in ASD. Eligible participants met criteria for ASD using gold-standard methods (ADOS-2) and exhibited IQ ≥ 50 (on WPPSI-III). Children were assessed at three additional time points across 1.5 years. Parents and children participated in a free play parent-child interaction at Time 1, which was coded for responsive parenting using an established coding system (PDI-R; Caplan et al., 2019). Teachers provided assessments of child social functioning (SSiS) at all three time points, and parents reported child emotion regulation abilities (Emotion Regulation Checklist) at Times 2 and 3. Children and parents were invited to provide DNA saliva samples (Oragene; OG-500) as part of a follow-up procedure. Covariates (parent genotype, race/ethnicity) controlled for gene-environment correlation artifacts.

Results: Structural equation models revealed that the association between responsive parenting and social skills growth over time was significantly moderated by child genotype. Results for 5-HTTLPR suggest a *differential susceptibility* model of GxE (β = 0.20, p <.01; see Figure 1), such that children with the SS genotype demonstrated more positive growth in teacher-rated social skills with higher levels of responsive parenting, and less growth with low responsive parenting. DRD4 interacted with responsive parenting in a *diathesis stress* manner (β = 0.26, p =.03; see Figure 2), such that children with the 7-repeat allele (7+) fared worse in the context of low levels of responsive parenting only. OXTR did not moderate the relationship between responsive parenting and social skills growth, nor did parent-reported emotion regulation mediate the GxEs found.

Conclusions: Findings of the present study are preliminary and require replication in larger samples, yet highlight the importance of taking a biopsychosocial approach to understanding phenotypic heterogeneity in ASD. That 5-HTTLPR and DRD4 moderated parenting effects suggest a potential role for serotonin and dopamine systems in environmental sensitivity in ASD. Elucidation of GxEs in ASD will help to inform targeted treatment efforts based on individual differences.

315.003 *(Oral)* Exploring the Experiences of Families of Latino Children Newly Diagnosed with ASD

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Background: Latino children experience disparities in age of diagnosis of ASD and linkage to Early Intervention Services and subspecialty care, despite the evidence that early identification and intervention improves outcomes. To gain insight into the factors that impact these processes, this study investigated the experiences of Latino families with young children during the critical first year following ASD diagnosis.

Objectives: The goal of this study was to understand the impact of ASD diagnosis on Latino families and the pathway(s) from initial identification of concerns to receipt of diagnosis and linkage to services across the first year post-diagnosis.

Methods: We conducted semi-structured interviews with Latino parents whose children were diagnosed with ASD during the previous 3-6 months. Parents were invited to participate in two interviews: 1 at time of first follow up appointment, and another 6 months later. Interviews were recorded and transcribed verbatim in the language in which they were conducted. Spanish interviews were then translated to English by a professional translation service and reviewed by bilingual study team members for accuracy. Qualitative data was analyzed iteratively as it was collected using the constant comparative method. We met regularly to develop and revise the coding tree. Divergent views among team members were resolved by consensus. Themes were identified through a process of immersion/crystallization. An advisory committee composed primarily of Latino stakeholders contributed to the development of interview questions and provided cultural context throughout the research process, including review of findings, to establish trustworthiness.

Results: Twenty Latino parents of 21 children newly diagnosed with ASD were interviewed at time 1, 3-6 months post-diagnosis. Nineteen families of 20 children were also interviewed again at time 2, about 6 months later. At time 1 children averaged 39 months of age (range=22 - 61 months). Four major themes emerged from the interviews: (1) Families did not feel heard when sharing concerns about their child's development with professionals for the first time; (2) Parents were surprised that the diagnostic process relied on parental description of child development and behavior, as well as observation of the child and not on medical tests; (3) Characteristics of autism were more behavioral and less physical than parents expected; and (4) Having a child diagnosed with autism is a significant moment for families, and is impacted by the way the clinician shares the diagnosis.

Conclusions: Latino parents in our sample described barriers that affected the timeliness and experience of receiving a diagnosis of ASD for their child. These findings have important implications for clinicians, particularly around enhancing communication with families. Respecting and validating parental concerns, not assuming knowledge of ASD or the diagnostic process, and attending to all facets of both verbal and non-verbal communication with parents when sharing a diagnosis all emerged as important considerations for pediatric providers.

315.004 *(Oral)* The Effects of Family Sociodemographic Factors on the Autism Spectrum Disorder Diagnostic Process from a Clinic Intake Perspective

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Background: With growing awareness of Autism Spectrum Disorder (ASD), screening and referrals for diagnostic evaluations have increased. However, there are disparities in the diagnostic process across demographic backgrounds. Contributing factors include socioeconomic status (SES), lack of access to healthcare, and difficulty navigating the healthcare system.

Objectives: This project aimed to assess the impact of socio-demographic factors on the diagnostic process of children with suspected ASD. We hypothesized that the intake process would take longer for individuals from marginalized backgrounds.

Methods: This study used referral-tracking data collected between March 2011 and July 2018 at a reputable clinic specializing in ASD. The sample included 6,098 patients referred for diagnostic clarification. Variables included age of patient, gender of patient, distance to the clinic, and family's SES (a composite score of median income, free & reduced lunch rates, and high school graduation rates for the patient's zip code). We used multivariate regressions to investigate the relation between socio-demographic factors and whether a referral packet was returned, whether an evaluation was completed, and time lag between diagnostic processes.

Results: Patients were typically 6.45 years old (SD = 4.65) and male (76.6%). Families lived an average of 85.17 miles (SD = 66.15) from the center. The average SES was 5.20 (SD = 1.00), where 1 represented low SES and 15 represented high SES. 3,689 families (60.5%) returned their referral packet, but then only 57.9% eventually underwent a diagnostic evaluation. The average time between referral and return of packet was 98.10 days (SD = 163.20). The average time between referral and diagnostic evaluation was 334.23 days (SD = 214.56).

Controlling for covariates, only age and distance were significant predictors of returning a packet. After the clinic received a packet, younger children were more likely to undergo a diagnostic evaluation. Controlling for covariates, further distance predicted quicker packet return times and quicker time to evaluation. In addition, a child's age predicted longer delays to an evaluation.

Of the families that did return a packet, most of the patients were male (77%), not Hispanic (94.5%), had public (60%) or private (39%) insurance, and were not eventually diagnosed with ASD (61.8%). The households were typically Caucasian (89.65%), had incomes under $50,000, had High School (32.7%) or Some College (33.5%) education, and had 3.99 dependents (SD = 1.47).

Conclusions: These results describe some of the impact of the clinical intake process on current health disparities in ASD. Our study did not support previous research findings that SES is a significant obstacle to obtaining diagnostic services. However, our study did find significant differences for families who lived farther from the clinic and had older children. These results have practical significance for families navigating the diagnostic system for their child with developmental delays, for clinicians invested in improving the screening process for diverse families, and for researchers interested in describing and predicting evaluation outcomes.

POSTER SESSION — FAMILY ISSUES AND STAKEHOLDER EXPERIENCES
423 - Family Issues and Stakeholder Experiences Posters

423.001 *(Poster)* "Having All of Your Internal Resources Exhausted Beyond Measure and Being Left with No Clean-up Crew:" Defining Autistic Burnout

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Background: Autistic burnout is an urgent issue within the adult autistic community, described as a state of incapacitation, exhaustion, and distress often resulting in loss of vocation, health, and quality of life, and, at times, leading to suicidal behavior. Yet little is known empirically about autistic burnout.

Objectives: We aimed to use a community-based participatory research (CBPR) approach to gain a deeper understanding of autistic burnout, to begin to characterize it, and to explore its potential links to suicidal behavior through qualitative analysis of public writings and existing and new interviews with autistic adults.

Methods: The Academic Autism Spectrum Partnership in Research and Education (AASPIRE) used a CBPR approach to conduct this study. AASPIRE is a long-running CBPR collaborative comprised of autistic people, academic researchers, family members, disability professionals, and clinicians, many of whom identify as belonging to multiple roles. Autistic community partners directed and participated in all aspects of this study including identifying the research topic, developing the grant proposal, creating study materials, analyzing and interpreting data, and creating dissemination materials. We compiled 19 interviews and 19 public internet sources on autistic burnout. Interview participants were a U.S. national sample of autistic adults who identified as having been professionally diagnosed with an autism spectrum condition. We conducted a thematic analysis, using a hybrid inductive and deductive approach, at semantic and latent levels, through a critical paradigm. We addressed trustworthiness through multiple coders, peer debriefing, and examination of contradictions.

Results: Autistic adults described the primary characteristics of autistic burnout as chronic exhaustion, loss of skills, and reduced tolerance to stimulus. They described burnout as happening because of life stressors that added to the cumulative load they experienced, and barriers to support which created an inability to obtain relief from the load. These pressures caused expectations to outweigh abilities resulting in autistic burnout. Autistic adults described negative impacts on their health, capacity for independent living, and quality of life, including resultant suicidal behavior. They also discussed a lack of empathy from neurotypical people and described acceptance and social support, time off / reduced expectations, and doing things in an autistic way / unmasking as associated with their experiences of recovery from autistic burnout.

Conclusions: Autistic burnout appears to be a phenomenon distinct from occupational burnout or clinical depression, as it had different defining characteristics. Better understanding autistic burnout could lead to ways to recognize, relieve, or prevent it, including highlighting the potential dangers of teaching autistic people to mask or camouflage their autistic traits, and including burnout education in suicide prevention programs. These findings highlight the need to reduce discrimination and stigma related to autism and disability. We are currently using the findings to develop and test a new measure of autistic burnout.

423.002 *(Poster)* "I Think It's the Way of the Future": Stakeholders' Perspectives on Participatory Research within the Autism CRC

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Background: Participatory approaches to research are gaining increased popularity as efficacious methods for conducting health research and research with minority populations. Such approaches engage community stakeholders not only as research participants, but as active and equal partners in the research process. A growing evidence base indicates that these approaches result in research that is more relevant, appropriate, and beneficial to the target community. In autism research, though, participatory research remains rare. In Australia, the Cooperative Research Centre for Living with Autism (Autism CRC) has been at the forefront of a movement to increase community engagement in autism research. Despite these organisational efforts, it is unclear whether individual stakeholders are similarly dedicated to participatory research.

Objectives: This study sought to understand Autism CRC stakeholders' experiences of, and attitudes towards, participatory research. We investigated participants' understandings of participatory research, and their own experiences of participatory research to date. We also examined participants' perceptions of the benefits and challenges of participatory research, and gathered their suggestions for ways to facilitate future community engagement. Finally, we gained their views on the potential systemic and contextual factors that impact upon community engagement in autism research.

Methods: Participants were a subsample from a larger participant group (n = 65) who completed an online survey investigating participatory research within the Autism CRC. Within the online survey, 25 (38%) participants indicated a willingness to engage in a follow-up interview. All participants were academic partners (research professionals and research students) or community partners (autistic people, family members, service providers etc.) involved in Autism CRC-funded research projects. Interviews were semi-structured, and conducted via web-conferencing or face-to-face.

Results: Data collection is ongoing, with 16 interviews completed to date. Participants include 11 academic partners and 5 community partners, including 4 autistic adults. Interviews range from 40 - 64 minutes, with an average of 52 minutes.

Based on preliminary analyses, participants demonstrated consistent but somewhat superficial understanding of participatory research. Most participants described participatory research in terms of community engagement "at every stage of the research process", but few mentioned key participatory concepts such as power-sharing. Participants also described experiences of community engagement largely at a consultative level, although many stated that they would prefer their research to be more participatory. Importantly, participants commented on a perceived shift in the broader autism research context, describing autism research as becoming more respectful towards and inclusive of autistic people.

Conclusions: Initial analysis indicates that autism stakeholders have a fundamental understanding of participatory research and are supportive of increased community engagement in autism research – consistent with the Autism CRC's focus on participatory research. Participatory practices, however, appear to lag behind stakeholder attitudes, suggesting that there is considerable room for improvement to ensure the genuine engagement of community partners in Autism CRC research.

423.003 *(Poster)* A Case Study Exploring How the Special Interests of a Group of Female/Gender Non-Binary Autistic Adults Promote or Hinder Their Ability to Thrive

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Background: Adults with autism are among our most vulnerable and poorly-served citizens as many have few close friends, are dependent on families, and struggle with employment. In other words, many are “failing to thrive.” One theoretical framework for ‘thriving’ in neurotypicals suggests that it occurs over time through the complex interplay between (1) the person’s sparks and (2) the support from sources that nurture those sparks (Benson & Scales, 2011). Researchers define ‘sparks’ as “a passion for a self-identified interest, skill, or capacity that metaphorically lights a fire in [a person’s] life, providing energy, joy, purpose, and direction”(Scales et al., 2011, p264). Thus, the special interests (SIs) of autistics should theoretically hold great promise for fostering their ability to thrive given that as many as 95% of autistics hold SIs, and their time spent pursuing SIs can amount to that of a part-time job.

Objectives: To understand how autistic adults feel their SIs promote or hinder their ability to thrive.

Methods: An autism service provider and researchers created a series of support sessions for women/gender non-binary autistics around employment experiences. We used a participatory approach such that autistic researchers (students and professor) were part of the research team. Participants created a graffiti wall using the spark questions (Table 1b), forming a visual display of the cumulative thought process of the group (Figure 1). Data sources included the graffiti wall and transcripts of participant dialogue during and after its creation. Participants also completed the Workplace PERMA Profiler, a survey of “flourishing” (similar to thriving), which examines well-being across five domains. (Scores range from 1 to 10; Table 1a). Using a mixed methods approach to integrate the qualitatively generate data (analyzed using a purely inductive, grounded method) with the PERMA measure allowed us to examine the convergence between the two data sources.

Results: Graffiti wall: Participants reported a large number of sparks (n=28), and all reported more than one. They also reported that many people in their lives nourished or had knowledge of their sparks. And, there was a high level of agreement that having a safe space was critical for the expression of their sparks and that neurotypical expectations and societal norms interfered with their sparks. Survey: Mean Workplace PERMA Profiler scores tended to be similar to previously published scores (Butler & Kern, 2016) across all domains except for Engagement, which was higher in our sample (Table 1a). Engagement, which refers to “being absorbed, interested and involved in one’s work”, shares similarities with the concept of sparks. Thus, these autistic participants had high thriving scores on the domain most closely related to the expression of their sparks.

Conclusions: As predicted by theoretical models, the findings of this small, exploratory study suggest that our participants feel their well-being is enhanced by engaging in their sparks and SIs. Given that young people with sparks often have richer, more meaning-filled lives, it may be important to nurture the autistic tendency to develop intense SIs in order to promote their ability to thrive.

423.004 *(Poster)* A Collective Case Study of Inclusion in Mainstream Community Programs for Children with Autism

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Background: Inclusion is often understood as a mindset where children feel a sense of belonging regardless of ability or disability. Inclusive communities are linked with improved emotional, social and academic outcomes, development of friendships, skill development, and tolerance of diversity for all children, including those with autism. Inclusive communities are also linked with broad societal benefits, such as decreased stigma associated with disability and difference. Children with ASD participate in significantly fewer community-based programs than their peers, often attributed to child and/or family factors such as a lack of financial resources, perceived competence, and emotional and social functioning. The focus has largely been on such individual features, and the broader social-ecological factors influencing inclusion are often ignored.

Objectives: (1) To compare how parents of children with autism versus program staff define inclusion in community programs, and (2) to identify and understand social-ecological facilitators and barriers to inclusion in community programs for children with autism.

Methods: This study used a collective case study approach, with cases anchored around mainstream community programs identified as inclusive. Data collection for each case included: semi-structured interviews with parents whose child participated in the community program and corresponding community program leaders; a textual analysis of policies and practices extracted from program documents (program guides, websites, medical forms, registration forms, mission, vision and value statements, and inclusion policies accessed online or provided by program staff); and observation field notes.Cases were analyzed individually, followed by a cross-case analysis, through an iterative process of coding, categorizing, and constant comparative analysis, informed by grounded theory techniques.

Results: Four cases were anchored around programs (dance, swimming, cycling, day camps) that all identified as inclusive. A total of eight parents (seven mothers and onefather) with a child with autism (mean age = 7 years; range 3-10 years), and 10 program staff have been interviewed to date across cases. One program was perceived as an exemplary example of inclusion by parents and program staff, whereas three programs were perceived as exemplary by program staff, but not by parents. Addressing objective one, preliminary analysis suggests that parents primarily view inclusion as an overarching philosophy that supports social belonging, whereas staff primarily discussed practices related to accommodations and aide support, more in line with current conceptualizations of integration. Addressing objective two, preliminary analysis supports one overarching theme, “It’s a philosophy, not a practice or policy”, and three sub-themes, “Experience with autism decreases stigma”, “Open communication is key”, and “Resources can help, but also hinder inclusion”.

Conclusions: Our data suggest that programs that identify as inclusive are not always experienced as such by parents of children with autism, particularly when they are not perceived to demonstrate a philosophy that embraces diversity and ability. This research may increase reflection of one’s own and organizational assumptions of autism and of current inclusive practices and policies, to facilitate understanding and inclusion of children with autism in community programs.

423.005 *(Poster)* A Comparison of Parenting Daily Hassles in Parents of Children with Autism and Typically Developing Children

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Background: Parenting a child with ASD is highly stressful and reported to be more difficult than parenting children with different types of disability, or with no disability; however, the daily hassles that contribute to the increased stress for this specific group have not been studied systematically. Hassles are “experiences and conditions of daily living that have been appraised as salient and harmful or threatening to the endorser’s well-being” (Lazarus, 1984).

Objectives: The goal of this research was to determine what areas of daily strain are most prevalent in the lives of parents with young children with autism.

Methods: Parents (n=16, 100% mothers) of children with ASD (14 males, 2 females) were recruited through a large rehabilitation hospital in Toronto, Canada. Data from the typically developing comparison group were obtained from a database at an affiliated university. A fixed variable matching procedure was used to select the comparison group (n=16, 100% mothers). Parenting daily hassles were assessed using an adapted version of the *Parenting Daily Hassles* scale (Crnic & Greenberg, 1990; Arimura, 2008). Demographic features were assessed using a questionnaire. We investigated which specific daily hassles uniquely characterize the lives of parents of children with ASD in comparison to parents of typically developing children. Independent- and paired-samples *t*-tests were used to explore differences between groups and within the ASD group on continuous variables. The majority of variables met the broad assumption of normality (skew < |2.5|; kurtosis < |3.5|). The Bonferroni correction was used when several statistical tests were performed simultaneously.

Results: Parents of children with ASD experienced overall higher levels (Cohen’s $d = .58$), higher frequency, and higher intensity of daily hassles than parents of typically developing children. Further, some daily hassles items relating to restricted, repetitive patterns of behaviour, interest or activities were associated with greater intensity ($p = .005$) and frequency ($p = .004$) of daily hassles in parents of children with ASD. Further, mean parent ratings on the items associated with characteristics of ASD (e.g., impairments in social communication) were significantly higher than parent ratings on the set of items categorized as unrelated to characteristics of ASD (Cohen’s $d = 1.16$). Demographic factors such as marital status also influenced parenting daily hassles, with parents of children with ASD experiencing greater levels of daily hassles when raising a child as a single parent ($p = .012$).

Conclusions: Overall, this study provided an initial exploration of the daily hassles associated with parenting a young child with ASD. While previous research has looked at global life stress in parents of children with ASD, this study is unique in its examination of specific daily tasks and experiences that contribute to parent stress. In addition, these findings serve as a starting point for future research exploring the experiences, frustrations, and needs of parents raising children with ASD. This line of research is important for policymakers to consider when developing programs and services for this population, as combating parental stress and fostering parental well-being are critical for positive family functioning and child development.

423.006 *(Poster)* A Comparison of Parenting Stress in Mothers of Children with Autism between Japan and the U.S.: A Qualitative Analysis of Interviews with Mothers

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Background:

Factors influencing stress in mothers of children with ASD are complex and reflect the socio-cultural context of parenting. Findings reported here are part of our on-going cross-cultural research project on mothers of children with ASD.

Objectives:

To compare factors associated with parenting stress in mothers of preschool children with ASD between Japan and the U.S. to improve understanding of how cultural factors related to parenting stress may lead to improved methods for culturally adapted interventions.

Methods:

- Forty-seven mothers of preschool children diagnosed with ASD participated (24 from US, 23 from Japan). The mothers and their parents were native born in the US or Japan.
- Mothers were recruited from clinics, schools, treatment centers, and parent organizations.

1. Instruments/Measures

- Questionnaires completed by mothers
    - Parenting Stress Index (English and Japanese versions). We examined the percentages of the mothers with a clinically significant level of parenting stress (>85 %ile) for each country.
    - Developmental history and demographics (English and Japanese), including time of the first formal diagnosis, time between when differences first were noticed and formal diagnosis, and the number of treatment programs child was in.
- Interview with mothers
    - We asked mothers to describe their stress related to parenting children with autism. and to rate their physical and emotional health on a scale of 1 (low) to 10 (high).

1. Analysis

- Used deductive coding of parenting stress using the names of subscales in the original PSI as categories.
- Used Fisher’s t-test to compare frequencies of categories between the US and Japan.
- Used t-test to compare the differences in demographic characteristics, formal diagnosis and treatment programs.

Results:

1. Quantitative analyses

- About 60% of mothers in both countries reported a clinically significant level of parenting stress (PSI). The parenting stress was particularly high related to Child Characteristics in both countries.
- Maternal self-report of physical and emotional health was low (average between 5-6) in both countries.

- US children received formal diagnosis slightly earlier than Japanese children, but the difference was not statistically significant.
- US children received a significantly higher number of treatments than Japanese children.

2. Qualitative Analyses

- Mothers in both countries had high stress related to child problem behavior and to child's behavioral or developmental characteristics.
- U.S. mothers reported high stress related to parental role restrictions influenced by the cultural orientation of independence and human agency, whereas for Japanese mothers, stress was influenced by a group-oriented culture that values conformity, and the expectation that mothers must be selflessly devoted to their children and emotionally close.

Conclusions:

- Because mothers in both countries had high stress related to child problem behaviors, supports for mothers of children with autism will enhance well-being of both children and their parents.
- US mothers of children with autism will benefit from support such as respite care to reduce stress related to time-management.
- For Japanese mothers, support providers should understand that parents may feel discouraged by children's inappropriate behavior in school settings with group activities. Support providers should also understand that Japanese mothers may minimize their struggles because of cultural norms and expectations about motherhood.

423.007 *(Poster)* A Cross Sectional Study of Environmental Influences on Participation in Children on the Autism Spectrum

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Background: Children on the autism spectrum are reported to participate less in home and community activities compared to their peers (Askari et al., 2014). They also show a decline in participation as they age (Simpson et al., 2019). This has implications on the child's long-term health and well-being. Research has focused on attendance and levels of participation; however, little is known about environmental factors which may impact on the participation of children who have autism and if these factors change over time.

Objectives: The aim of this study is to investigate environmental factors that parents identify as impacting on children's participation in home and community activities.

Methods: A cross sectional study was used to explore parent perceptions of environmental facilitators and barriers to participation in children on the autism spectrum across home and community settings. Parents of children age 5-6 years (n = 72) and children aged 9-10 years (n = 94) completed the Participation and Environment Measure for Children and Youth.

Results: Parent-identified barriers varied across the sample and differed between the age groups. The most commonly identified barrier for home participation was the cognitive demands of the task, with over 25% of parents endorsing this item in both age groups. Supportive factors in the home environment included the physical layout, sensory environment and attitudes of therapists and professionals with over 50% of parents identifying these as aiding or not an issue for their child's participation. In contrast, group differences were identified on the physical and social demands of the activity. Parents of the older children more frequently reported these items as a barrier to participation while parents of the younger children endorsed these items as usually helping participation. Further group differences were reported with the child's relationship with family members identified as a barrier by parents of older children, but not for younger children. In the community, approximately 50% of parents commonly endorsed two main barriers, social demands and sensory qualities of the setting, and over 40% of parents in both groups identified the availability and adequacy of programs as a barrier to their child's participation. Further analysis of differences based on gender and level of ability will be discussed.

Conclusions: The findings from this research highlight the importance of considering barriers based on the child profile (e.g. age) when developing supportive programs. The importance of further longitudinal studies to explore cohort differences in this study will be discussed. Parents identified more factors in the home environment that facilitate participation than in the community suggesting that parents are successfully adapting the home environment to support their child. Factors which may create more supportive and accessible community programs to facilitate participation will be discussed.

423.008 *(Poster)* A New Measure of Family Adjustments and Accommodations in Intellectual and Developmental Disorders

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Background: Parents of children with intellectual and developmental disabilities (DD) often adjust their lives around their child's symptoms and need for extra care, as a way to maximize success and prevent or reduce stress. Adjustments might include reducing demands placed on a child, acquiescing to the child's requests, or avoiding exposure to situations that could lead to disruptive behavior (Storch et al., 2007), but can also include major alterations in career plans, living arrangements, family goals, etc. Unfortunately, current measures of family impact focus on parent stress (Abidin, 2012), which would not acknowledge the adjustments a family may have made to reduce or prevent stress. Additionally, a measure of stress would not capture the positive family changes some parents attribute to having a child with special needs.

Objectives: Develop a measure of family adjustments and accommodations to having a child (or adult member) with a DD in order to broadly capture the impact of having a family member with special needs.

Methods: 133 Items were developed based on previously collected qualitative parent interview data measuring developmental concerns, challenging behaviors, and parent priorities for a rare genetic disorder associated with intellectual disability (creatine transporter deficiency; CTD). We framed items around several themes that emerged from the previous data, including specific behavioral concerns (safety, attention difficulties, mood/irritability, property destruction, negative attention-seeking behaviors), the daily impact of having a child with a DD, and shifts in long-term plans. We also created items specifically for families of adults with DD. Feedback about item organization, inclusion, and phrasing was sought from three clinical experts, a parent, and a biostatistician, with consensus that the measure could be broadly applicable to other DDs. The questionnaire has been distributed to 26 (and counting) families of children with CTD, Fragile X Syndrome (FXS), autism spectrum disorder (ASD), Williams Syndrome, and Angelman Syndrome (AS) across three different sites. Families also completed a feedback form that evaluated their impressions of the scale.

Results: To date, 26 participants (18 FXS, 1 FXS+ASD, 6 CTD, and 1 AS; M_{age} = 16.4, *SD* = 8.4, range: 2-31) have completed this scale. Twenty-one parents also rated their overall impression of the scale and its usefulness in informing researchers about their child. Nineteen of 21 parents rated the questionnaire as "good" or "excellent," and 20 of 21 rated it as "moderately useful" or "very useful." Comments from parents include, "I think this questionnaire covered the vast majority of what it's like to parent a child with a developmental disability". Data collection is ongoing, and we anticipate having data from 50 participants that will be available for presentation.

Conclusions: This study serves as a preliminary step in understanding the experience of raising a child with special needs, from a more holistic perspective than just level of functioning or current stress. With ongoing data collection, future directions will include conducting item-level analyses to refine the measure, and then determining its utility to inform clinical decision-making and potential response to services and/or intervention.

423.009 *(Poster)* A Qualitative Examination of a Community-Based Advocacy Mentorship Program for Latinx Families

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Background: Latinx children with autism are more likely to experience inequities in the healthcare and education systems in the United States. For example, in California Latinx children receive about only 50% of State-sponsored resources and services when compared to White children. Research suggest that Latinx parents are in need of advocacy training in order to address factors that might be behind the disparity in diagnosis and services. This study is a qualitative data analysis of an intervention study designed to rigorously test, using randomization, a parent-to-parent advocacy program for parents of children with ASD within a mostly Latinx population in Southern California. This study focuses on exploring the strengths and challenges that Latinx parents who participated in an advocacy intervention study encountered.

Objectives: RQ- What are the strengths and challenges of implementing a parent-to-parent advocacy mentorship program within an urban Mostly Latinx context?

Methods: Seven one-on-one interviews were conducted with the intervention participants of a community-based advocacy mentorship program in Spanish (n=3) and English (n=4). Guided by the study's research questions (i.e., feasibility of a parent-to-parent advocacy intervention), the researchers conducted *apriori* coding of the transcripts and identified a preliminary list of categories based on the interview questions (e.g., How helpful would you describe the mentorship program you participated in?). Then, the researchers used line-by-line coding to assign categories to phrases, sentences or paragraphs within the different responses; multiple categories could be assigned simultaneously to accurately capture the overall message of the passage. Information from the category applications and identification of the subcategories guided the development of the final themes.

Results: Three themes emerged from the data analysis. 1) Usefulness and Strengths of the Advocacy Mentorship: Overall, all participants responded very optimistically to the intervention. 2) The trustworthiness of having a parent mentor from the community as the interventionist: All participants expressed gratitude and a trustworthy relationship with the parent mentor. Specifically, participants expressed that parent mentors were passionate and the fact that they had themselves a child with a disability helped them connect with them. 3) Challenges and Recommendations for Future Mentorship Interventions: Most participants expressed that the program was effective. One suggestion that came across was to let more people know about programs for Latinx parents. Participants expressed that other members of their community do not have this information nor are aware of advocacy programs.

Conclusions: Some challenges were particularly salient in recruiting and working with a low-income mostly Latinx population. For example, while most of the participants showed great interest in engaging in the intervention, participants found scheduling for the sessions difficult. A second challenge, was addressing a general unfamiliarity from the participants about research studies. Finally, there were difficulties in recruiting participants for an advocacy intervention in a hostile socio-political environment towards the Latinx population, particularly those from immigrant backgrounds. Hence, while a majority of participants engaged in the study, and had overwhelmingly positive feedback about the intervention, others probably required other engagement strategies to get them to participate.

423.010 *(Poster)* An Exploration of Parents' Perceptions Participating in an Intervention for Their Toddlers with Autism Spectrum Disorder

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Background: Implementation science plays a key role in understanding and interpreting the successful use of early interventions for toddlers with autism spectrum disorder (ASD; e.g, Odom, 2009). In order for providers *and* parents to successfully use and implement interventions, it is necessary to study, evaluate, and ensure high quality implementation processes as perceived by stakeholders, or families in early intervention. Specifically, applying the National Implementation Research Network's *Formula for Success*, there is a need to determine underlying (a) effective intervention components such as descriptions and understanding of target goals, strategies, and outcomes; (b) effective implementation processes, such as the coaching process and the extent to which parents and others are able to deliver the intervention strategies; and (c) enabling contexts, such as where and during which routines and activities the intervention is effective; that parents perceive as leading to successes and challenges for achieving improved outcomes (Blasé & Fixsen, 2013).

Objectives: Relative to an intervention for toddlers with ASD, the study aimed to identify what: (a) intervention components; (b) implementation (coaching) processes; (c) contextual factors of the intervention parents perceived as helpful or not helpful in leading to optimal outcomes?

Methods: After obtaining IRB approval, we used qualitative methodology to explore parents' perceptions of an early intervention for toddlers with ASD. Data were collected through 12 face-to-face interviews with parents from a variety of demographic backgrounds who participated in an early intervention for toddlers with ASD. Each interview was transcribed and systematically coded using Atlas.ti qualitative coding software. Transcripts were analyzed individually through iterative coding cycles. First, data were descriptively coded. Then, data were coded using a priori themes of helpful and unhelpful intervention components, implementation processes, and contexts. Two coders coded all transcripts and met regularly for consensus coding to establish credibility and reliability of the data.

Results: Major findings in the study indicate parents were satisfied with the intervention yet individual perspectives varied. Many parent participants perceived intervention components such as homework and specific strategies as helpful. Parents perceived coaching practices such as watching the interventionists' model strategies as useful and effective. Parents explained positive experiences were influenced by the interventionists' qualities and the trusting relationship that developed between themselves and the interventionists. They further perceived the context of service delivery including clinic and home sessions as enhancing their experiences.

Parents felt their children's goals were appropriate, yet did not consistently report involvement in the goal development. Parents desired additional information related to ASD, resources, and individualized directions following their completion of the intervention. They reported mixed levels of comfort practicing the intervention strategies in front of their interventionists and mixed levels of success integrating the strategies into their daily lives. Parents felt the intervention could have been longer and experienced some challenges fitting the fixed intervention session times into their schedules.

Conclusions: In sum, parents' overall perceptions indicate the need to individualize early intervention services for toddlers with ASD in order to match service style and practice with unique family characteristics, dynamics, structures, and preferences.

423.011 *(Poster)* Are Lay Theories about Developmental Disorders Related to Labeling Others As Having "Developmental Disorders"?

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Background: Recently, "developmental disorders" have received much attention in Japan. In Japan, it is a comprehensive concept including autism, Asperger's syndrome, other pervasive developmental disorders, learning disorders, and attention deficit and hyperactivity disorder. The concept of "developmental disorder" is highly recognized and will be used at medical and educational settings. However, it is expected that some adverse effects will exist. Specifically, it is assumed that misunderstanding spreads and encourages labeling of others. Based on current study, it seems that "developmental disorders" for around people is regarded as a broader more comprehensive concept compare to professional about that. To clarify the concept of "Developmental Disorders" in society, we examined lay theories about developmental disorders. Lay theories refer to simple concepts held by people about various things in daily life (Furnham, 1988). Once people internalize the lay theory, they unconsciously apply it to each problem, and express and enact a specific emotion in a manner suited to the lay theory (Averill, 1980). It is assumed that people who have lay theories about developmental disorders will lead to developmental disorders to other people encountered in daily life.

Objectives: We examined whether the lay theories about developmental disorders are related to labeling others as having developmental disorders.

Methods: Questionnaire surveys were conducted with 346 Japanese university students. In the first part of the questionnaire, the participants wrote what they thought about developmental disorders following the phrase "People with developmental disorder" and within the time limit of 2 minutes. Next, to measure the labeling of developmental disorder, we asked two questions: (1) the frequency with which they believe that their family, friends, colleagues, and strangers have developmental disorders, and (2) the extent of their confidence in such beliefs. The higher the frequency and confidence, the easier is labeling. Additionally, to examine the validity of the developmental disorders' stigma scale, we asked social desirability, other scale of stigma.

Results: To confirm the lay theory, we identified the frequent words using text mining. The case of " people with developmental disorder" is "Have", and it occurred with "Ability "and "Talent." This suggested that there is a belief that people with developmental disorders have excellent ability. Correspondence analysis revealed that the first axis was named "Dimension of Difference" and the second axis was named "Concreteness of Impressions."

To examine the effect of lay theory about developmental disorder toward labeling, we conducted multiple regression analysis with frequency scores in each scene as the dependent variables. Results revealed that the model was significant for families, friends, and people on the scale, and the main effect of the Dimension of Difference score was significant. This means that people who described the differences in characteristics between themselves and people with developmental disorders had high labeling score.

Conclusions: Possibility, lay theories lead people to label others as having developmental disorders. In the future, it is necessary to clarify the concept of "developmental disorder" in society in greater detail.

423.012 *(Poster)* Aspirations and Needs for Successful Post-Secondary Transitions: Stakeholder Voices

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Background: ASD is a lifelong disorder and many individuals require continual supports to ensure success. Despite the best efforts of special education, the outcomes for individuals with ASD after high school are less than optimal. Of particular concern is a sub-group of adolescents without intellectual disabilities (ID). Although these individuals have the potential to fully participate in mainstream community activities, outcomes for many adults without ID are surprisingly poor in the areas of secondary education, employment, independent living, and social participation (Taylor, Henninger, & Malick, 2015). These individuals are three times more likely to have no daytime activity compared to adults with ID (Taylor & Seltzer, 2011). The transition process is a time of great opportunity and risk for these adolescents and their families; however, relatively little research has addressed transition from the perspective of both adolescents and parents.

Objectives: To identify adolescents' and parents': (a) aspirations for adult life; (b) views of transition areas for which they feel most and least prepared; and (c) views of needed services to support the transition to adult life.

Methods: Parents and adolescents (ages 13-18) in general education at least 50% of the day participated in separate focus groups. Thirty-six parents and 26 adolescents (ages 13-17) from both rural and urban areas were asked about their goals after high school, and the services and supports they have used and need to facilitate a successful transition to adulthood. Using a card sort activity, participants provided information about which transition areas for which they felt most and least prepared. Focus groups were audio taped and transcribed verbatim. A constant comparative method and consensus coding process were used to validate the major themes highlighted by parents and adolescents.

Results: The parents were generally positive about their youth, highlighting strengths while acknowledging their individual challenges. Interestingly, parents and adolescents' views were often similar but differed in subtle ways. While the adolescents had aspirations for independence, they expressed concerns regarding future employment, education, ability to live independently, and develop relationships. Parents' goals focused on successful employment and independent living whereas adolescent goals related to employment focused on their specific interests such as computers or fantasy novels. Parent concerns related to social interaction (e.g., having friends to do things with), getting a job, and living independently. However, adolescents' major concerns related to being financially secure, and having a safe place to live and the social skills needed to maintain employment rather than for social community participation. Both parents and adolescents identified needs for continued supports, including social support for the adolescent and family, accessible and useable information about the adult service system, and continued professional supports according to adolescents' individualized needs.

Conclusions: The adolescent and family perspectives indicated a need for capacity building supports tailored to *what really matters* to stakeholders for achieving successful adult outcomes. Based on our study's results, those supports include social support for the adolescent and family, accessible and useable information about the adult service system, and continued professional supports according to adolescents' individualized needs.

423.013 *(Poster)* Assessing the Service Needs of Families with Children with ASD in the Inland Empire

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Background: More children with autism spectrum disorder (ASD) are in need of specialized services to support their academic, behavioral, and social wellbeing (Baio et al., 2018; Fombonne, 2018; Matson & Kozlowski, 2011). Early intervention, reliant upon early diagnosis, has been shown to significantly benefit young children with ASD and their families (Koegel et al., 2014; Rogers, 1996). While schools and in-home services have made strides towards improving access to services, large regions exist in which necessary assessment and intervention services are severely lacking, leading to geographical pockets of underserved families. One such area is the Inland Empire (IE) region of Southern California, where families have described their struggles with accessing timely diagnostic and intervention services. This pilot study aimed to examine the service needs of families with children with ASD in the IE using online methodology with families. The goal is to expand the sample over the coming months in order to gather data that will ultimately promote service delivery options for underserved families in the region.

Objectives:

1. What are the current service needs of children with ASD and their families in the IE?
2. What gaps currently exist in services for children with ASD?

Methods: An online survey was developed and distributed to a preliminary group of parents of children with ASD in the IE region (N=17), recruited through a university autism screening clinic. Recruitment is ongoing and is intended to validate the online survey as an acceptable measure of service needs. In the preliminary sample, parents reported the average age of their child to be 12 years (range 5-17; SD=4), with an average age of diagnosis at 6 years (range 2-14; SD=4). The survey asked open- and close-ended questions about the diagnosis process, accessing services, perceptions of service needs, and satisfaction with different aspects of the service delivery system (see Table 1). Likert scale survey items were analyzed quantitatively and open-ended responses will be coded qualitatively to assess the specific needs of families of children with ASD in the IE region.

Results: Preliminary analyses indicated that only 29% (n=4) of participating parents agreed that the assessment needs of individuals with ASD are currently being met, only 14% of participants (n=2) agreed that the intervention needs of individuals with ASD are currently being met, and 71% (n=10) reported that they wished their child had been receiving additional services; they also feel that there are services currently missing. Together, results highlight unmet needs in both the assessment process and ongoing services for individuals with ASD and their families. Future qualitative analyses will further assess the experiences of families of children with ASD in the IE region.

Conclusions: Results captured the need for increased services in the IE region. Parents indicated the need for increased access to comprehensive assessment as well as the ability to obtain interventions for their children with ASD. The results of the larger sample may inform service providers, medical professionals, and policymakers in the IE to support the growing number of individuals with ASD and their families.

423.014 *(Poster)* Associations between Comorbid Psychopathology in Youth with Autism Spectrum Disorder and Caregiver Coping

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Background: Comorbid mental health conditions are common in autism spectrum disorder (ASD), and they are detrimental to child well-being. Psychopathology co-occurring with ASD may also negatively impact caregiver well-being. Studies of whether having a child with ASD and a comorbid psychiatric disorder is associated with greater caregiver burden have found mixed results. One study found that a comorbid mental health problem was not associated with greater caregiver burden once other youth characteristics were taken into consideration (Kring, Greenberg, & Seltzer, 2008). Another study found that comorbid attention-deficit/hyperactivity disorder (ADHD) contributed to greater caregiver stress (Theule, Wiener, Tannock, & Jenkins, 2010). No study has investigated the potential effects of caring for a child with ASD and a comorbid diagnosis of anxiety and/or depression on caregiver coping.

Objectives: The aim of this study was to examine whether having a child with a mental health condition (i.e., anxiety, depression, and/or ADHD) comorbid with ASD was associated with poorer caregiver coping in a large nationally representative sample of families.

Methods: Data from this study were obtained from the 2016 National Survey of Children's Health, a nationally representative caregiver survey of over 50,000 young people focused on child and adolescent health and well-being. Participants included in this analysis (n = 1008) were caregivers of children 6-17 years of age (M=12.11; 81.3% male) with a current ASD diagnosis. Comorbid mental health condition was based on whether the caregiver responded that their child had ever been diagnosed by a health care provider with anxiety, depression, and/or ADHD and that they "currently have the condition." Caregiver coping was operationalized as how well the caregiver was "handling the day-to-day demands of raising children." Responses were dichotomized to "very well" and "somewhat well/not very well/not very well at all." Three binary logistic regression models were run with anxiety, depression, and ADHD as the predictors and caregiver coping as the outcome. Age and gender of the child and family household income were included as covariates in all models.

Results: Results found that child anxiety was associated with 1.39 times greater odds that the caregiver is not coping "very well" (i.e., coping "somewhat well/not very well/not very well at all") with the daily demands of raising children (p = .011). Results also found that child depression was associated with 1.74 times greater odds that the caregiver is not coping "very well" (p = .003). In addition, results indicated that child ADHD was associated with 1.35 times greater odds that the caregiver is not coping "very well" (p = .02).

Conclusions: Results indicate that having a child with ASD and a comorbid psychiatric disorder (i.e., anxiety, depression, and/or ADHD) does influence caregivers' self-reported coping. Caregivers are not coping very well with the dual diagnosis of their children. This is likely because psychiatric comorbidities include symptoms that are different from the core symptoms of ASD and result in additional functional impairment. Treatment planning should account for the added stress associated with caring for a child with ASD and a comorbid mental health condition.

423.015 *(Poster)* Beyond the Exam Room: Partnering with Latino Families to Address Healthcare Disparities for Children with Autism

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Background: Research has demonstrated disparities in healthcare access and outcomes for children with autism based on demographic factors like ethnicity and socioeconomic status. This case study illustrates ways clinics can implement community outreach programs to address underserved populations in an effective, empowering, and culturally sensitive way.

Objectives: To improve access, information, and care for Latino Families raising children with autism by engaging parents from a Latino Family Advisory Committee (FAC) in the planning, development and implementation of educational and research projects at an autism center.

Methods: As part of the Autism Speaks Autism Treatment Network (ATN), The Center for Autism & Neurodevelopmental Disorders (CAND) at the University of California, Irvine, began recruiting families to form two FAC's in 2015. Because CAND serves a large Latino population, and there has been limited autism research focused on this population, CAND aimed to create an FAC specifically for Latino parents. A bilingual developmental-behavioral pediatrician and bilingual social worker helped form the Latino FAC. To maximize involvement, in-person meetings are held on weeknight evenings 6-9 times throughout the year to accommodate parents' work schedules. Children are welcome to attend and stay with the group during the meeting. The Latino FAC has collaborated on research projects with the ATN and planned and executed educational events for families at the local level.

Results: The Latino FAC has been instrumental at CAND in implementing research projects with the ATN and by providing feedback on protocols and forms translated into Spanish to make research projects more inclusive of and accessible to Latino families. The Latino FAC's local outreach and educational efforts with CAND began with quarterly Latino Family Day potluck lectures attended by 20-25 families. CAND applied for community level and state grants to expand these efforts. For the past 2 years the Latino FAC activities have included involvement in the planning and implementation of a California Department of Developmental Services grant aimed at reducing disparities in access to care for underserved families. Latino FAC parents have led discussions and shared their experiences during events.

Over the past year, the Latino FAC has contributed to the development and implementation of the following programs offered in Spanish reaching over 200 Latino families:

- Transition at age 3
- Transition to adulthood
- Autism 101
- Understanding Special Education
- Navigating Behavioral Health
- Developmental Screening events
- Ask the Experts panel
- Parent Empowerment Series

Participant feedback has indicated the Latino FAC parents sharing their stories has helped other parents feel less alone and more supported.

Conclusions: The Latino FAC has provided consultation on the planning of research with the ATN and educational activities at CAND so these efforts will appeal to and better meet the needs of the Latino community. Improving access to information and care, as well as providing research opportunities for traditionally underserved communities, can be achieved by creating and consistently involving a family advisory committee that includes members of the specific population(s). Developing projects with direct input from FAC parents and soliciting frequent input is essential for successful engagement of the community.

423.016 *(Poster)* Bilingual Language Practices of Mexican Heritage Families with ASD

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Background: Language and communication challenges associated with ASD are complex when we acknowledge the child's language exposure (e.g., the number of languages spoken), the quality of the interactions between the target child and caregiver, and the context in which these interactions occur. Historically, practitioners have not supported using multiple languages to interact with children with ASD (Kay-Raining Bird, Lamond, & Holden, 2012). To eliminate the challenges associated with language learning, practitioners encouraged children and families to interact in the societally dominant language (English) to eliminate "confusion." Current studies are now identifying strengths including a *bilingual advantage* in the language skills of multilingual children with ASD (Gonzalez-Barrero & Nadig, 2017). This study utilizes a language socialization lens to examine the bilingual interactions of children with ASD and their caregivers.

Objectives: The purpose of this study was to describe the bilingual interactions between children with ASD and their caregivers during routine daily activities at home.

Methods: Six Mexican immigrant families caring for a child with ASD were asked to video record themselves engaging with their children in their daily, routine activities over 10 days. We asked the following questions: (1) What is the dominant language spoken across these families' daily routines; 2) In what types of daily activities did Spanish language interactions occur? 3) In what types of activities did English language interactions occur? 4) Who dominated the language interactions (parent or child)?

Over 18 hours of video recordings were collected across 168 videos (R = 10 seconds to 39 minutes each). Mexican immigrant mothers' (M age = 36.5) all spoke Spanish at home, and reported an annual family income range from under $15,000 to $35,000. Child participants (M age = 5; all male) were receiving intervention (e.g. home behavior therapy or school based therapy) in English. Some families had a bilingual service provider who clarified instructions in Spanish.

Results: Less than half (48%) of all recordings (N = 80) featured Spanish language interactions as compared to English language interactions (39.5%). Very few video recordings (12.6%) contained no language. Spanish was spoken most frequently in Academic Caregiving (e.g., doing homework) (36.3%) and Non-Academic/Play Conversations (e.g., playing with play-doh) (31.2%). English was spoken in Non-Academic/Play Conversations (43.9%) and Adaptive Caregiving activities (36.4%). In most of these language interactions the target child dominated interactions (43.4%). Mothers dominated 40% of the conversations. Siblings, fathers, and extended families dominated the rest of the conversations.

Conclusions: To better understand immigrant families' language practices from a strength-based approach, we used a language socialization lens (Garret & Baquedano-López, 2002) to examine the context, content, and goals of the language interactions. Forthcoming analyses will examine the specific contributions of the parent and the child to the language interaction, the complexity of the language used by the parent and the child, the quality of adult scaffolding (e.g., how does the parent scaffold abstract thinking), the content of the language interaction, and whether the language used in the interaction is associated with the complexity of the adult and child language use.

423.017 *(Poster)* Building Acceptance and Support of Autism in the Community through Service Learning

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Background: Given the upward trend in the prevalence of autism spectrum disorder (ASD), it is highly likely that a person will at some point meet, work with, or befriend an individual with ASD. Myths and misconceptions have been associated with ASD by the general public, often influenced by media and word-of-mouth (Mitchell & Locke, 2015). As institutions of higher education increasingly tackle social justice and equity, service-learning initiatives show promise for addressing such issues by engaging undergraduate students in diverse communities (Lieberman, 2014). The nature of direct interaction with diverse children and families through service learning has been shown to support a developing understanding of difference as opposed to deficit (Able et al., 2014). Further, service learning can directly support individuals with ASD through the provision of family respite and volunteer support for community providers.

Objectives: Our study analyzed the impact of an undergraduate service-learning course on students' knowledge and attitudes regarding individuals with ASD and the benefits to families and community partners.

Methods: Fifty-six undergraduate students each completed 30 hours of service learning with individuals with ASD in family or community contexts including camps, recreation centers, and intervention clinics. Students completed pre- and post-course surveys of knowledge and beliefs about ASD and wrote a final reflection of their service learning experience. Eight students participated in a post-course focus group and ten family and community partners were interviewed. Closed-ended survey responses were analyzed using t-tests. Qualitative data was systematically coded and constantly compared by two coders.

Results: Students significantly increased their knowledge of ASD-related interventions, school-aged services and supports, and resources addressing the lifespan as a result of the community and family experiences. Students indicated increased confidence in explaining the characteristics of ASD and interacting socially with peers with ASD. See Table 1 for complete survey results. Qualitative data echoed the survey findings. Students highlighted a new appreciation of ASD as a broad spectrum and challenged assumptions related to competence, socialization, and sensory-related behaviors. Students also increased their understanding and appreciation of community-based services for individuals with ASD. Parent and community partners noted the importance of the students seeing individuals with ASD across multiple environments, including home, school, and community. Service recipients felt that these experiences helped to "demystify and humanize" individuals with autism, emphasizing the benefit for the students and their "buddies" with ASD, but also for other individuals with ASD these students may interact with in the future. Stakeholders also reported the value of the service learning for providing family respite, valuable social experiences for the individuals with ASD, and for staffing community programs in need of volunteers.

Conclusions: Our results endorse the positive impact service-learning experiences can have in shifting student perspectives and support for individuals with ASD they encounter in their personal and professional lives. Service learning presents a unique opportunity for mutual benefit, allowing both students and individuals with ASD to learn from each other in natural contexts.

423.018 *(Poster)* Caregiver Strain in Children with ASD Predicts Parenting Style

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Background: Autism Spectrum Disorder (ASD) is a rising healthcare concern, with prevalence rates estimated at 1 in 59 individuals (CDC, 2019). A recent meta-analysis concluded that parents of children with ASD exhibited more negative parenting behaviors toward their children than parents without (Ku, Stinson, & McDonald, 2019). The increase in negative parenting behaviors (e.g., expressions of anger, etc.) is presumably due to increased parenting stress (Abidin, 1992) but may also be due to caregiving strain associated with caring for a child with ASD. Indeed, parents of children with ASD report higher stress and greater caregiver strain than parents of children with other developmental disorders or typically developing children (Hayes & Watson, 2013; Khanna et al., 2012). Like stress, caregiving strain may predicate negative parenting behavior, and it is not known whether this differs for mothers and fathers. It is relatively unknown what sources of caregiver strain may elicit certain parenting styles and parenting behavior.

Objectives: The current study examines how different types of caregiving strain may be implicated in parenting styles in ASD. The aims of this study are twofold: 1) To evaluate whether different types of caregiver strain contribute to negative parenting styles and 2) To determine whether this association differs between mothers and fathers.

Methods: Participants were mothers (n=35) and fathers (n=21) of children with ASD who were recruited for participation in a co-parenting intervention study. The survey included demographic questions, the PDD Behavior Inventory (Cohen, 2003), the Caregiving Strain Questionnaire (Brannan, Heflinger, & Bickman, 1997), and The Parenting Scale (Arnold, et al., 1993). Stepwise regression models were constructed to examine the relative influence of 3 types of caregiving strain (objective, subjective-internalizing, and subjective-externalizing) on 2 different parenting styles. Parenting styles included overreactive parenting, which is characterized by criticism and/or argumentativeness, as well as hostile parenting, indicating use of physical or verbal force. Separate models were constructed for mothers and fathers. Covariates included child behavior problems, race, education level, and number of children in the home. Assumptions for multiple regression models were met.

Results: In the final models for mothers, only subjective externalizing strain emerged as a significant predictor for overreactive parenting (R^2= .40, β= .64, p<.001), and the model was not significant for hostile parenting. For fathers, the final models revealed that only objective strain emerged as a significant predictor for over-reactive parenting (R^2= .61, β= .83, p<.001), and no strain predicted hostile parenting.

Conclusions: Findings suggest that caregiver strain contributes to overreactive, but not hostile, parenting style. The patterns of association were different for mothers and fathers. Objective strain contributed to fathers' overreactive parenting, while subjective-externalizing strain contributed to mothers'. This difference may be due to the fact that mothers are more responsive to emotional strain, whereas fathers are more affected by situational strain. The lack of association with hostile parenting may be due to the relatively low ratings across parents. These differences are important to consider in treatment planning and service considerations for caregivers of children with ASD.

423.019 *(Poster)* Caregivers' Experiences and Requests for Support during Follow-up: Caregiver-Mediated Jasper Intervention

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Background: Caregiver-mediated social communication intervention can lead to gains in children's engagement and communication as well as caregivers' use of intervention strategies (e.g., Shire et al., 2015). However, after intervention ends, less is known about if and when caregivers may desire support to maintain these gains as their children's needs change.

Objectives: This mixed methods study uses (a) quantitative data from a novel mobile health questionnaire (MHQ) given weekly during the three months following intervention to examine if, when, and how often caregivers endorsed a need for support and (b) qualitative data from focus groups to explore caregivers' experiences during the follow-up period.

Methods: Fifteen children ages 2.0-8.7 years (*M*=55.8 months) with outside diagnoses of autism were included. Children and their primary caregivers received 12 weeks of a caregiver-mediated developmental social communication intervention- Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER: Kasari et al., 2006) from local community interventionists employed by a provincial public health system in Canada. The five interventionists were trained to fidelity in JASPER by the study team with fidelity checks all scoring at or above the required criterion of 80%.

Measures: The MHQ included 3 questions rated from 1 (typical/ no support needs) to 7 (getting worse/ high support needs), modeled after Clinical Global Impressions (Guy, 1976). Weekly, caregivers rated the child's social communication, engagement, and their perceived need for support. Three focus groups each with 3-4 families were led by the local health region leadership. Open-ended questions addressed families' experience in the 3-month follow-up period.

Results: Children's engagement and communication in follow up: MHQ scores ranged from 1 to 4 for question 1 and question 2 (*M*=2.16, *SD*=.875; *M*=2.10, *SD*=.854).

Need for support during follow up. Scores ranged from 1 to 5 for question 3 (*M*=2.29, *SD*=.74).

Caregivers reported a need for support (MHQ score of 3-7) on average 4 times over 12 weeks. Interventionists responded within 24 hours with an email to check-in and provided suggestions to resolve challenges.

Constant comparative analysis of coding of the focus group data led to five themes including feeling sufficiently supported by weekly check-ins during follow up which encouraged accountability and personal reflection on strengths and challenges. However, the families also reported challenges to maintain children's engagement and regulation, to replicate the intervention structure in their homes, and to integrate strategies into more 'naturalistic' daily routines.

Conclusions: On average, caregivers indicated a need for support 4 times during the follow up period. Caregivers were provided with email and phone calls from their interventionists which families reported were sufficient to resolve challenges such that no family requested a video conference or home visit. Focus group discussions indicated a desire for readily-accessible electronic resources (e.g., strategy videos, activity lists) to support continued learning. However, five families indicated no support needs. Understanding child and family predictors that may differentiate support needs may help plan to allocate limited resources.

423.020 *(Poster)* Challenges and Contributors to Self-Efficacy for Parents of Toddlers with Autism: Early Intervention Considerations

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Background: Early social challenges in autism can test parents' confidence as they seek interaction with their toddlers. A central purpose of early intervention (EI; IDEA: Part C, 2004) is to build family capacity through participatory experiences to enable parent competence and confidence, defined as parent self-efficacy (PSE), to support child learning. Participatory EI practices have been associated with PSE, which in turn relates to positive indicators of child functioning. Parents' perceptions of their ability to effect child learning may thus respond differentially to professionally-directed versus professionally-supported EI practices. Understanding of particular EI features that support PSE is needed to advance family-inclusive practices with potential to improve outcomes for parents and their toddlers on the autism spectrum.

Objectives: The study's purpose was to qualitatively explore how parents of toddlers with autism viewed their competency in relation to their EI experience as it pertained to facilitating toddler learning. The overarching research question was: How do parents' experiences undermine or support their perceived ownership of the parent-child social learning process and confidence to support child learning?

Methods: In-depth interviews were conducted with 11 parents of toddlers with autism (aged 16-30 months) who experienced both professionally-directed and professionally-supported EI approaches. Participants were drawn from a larger three-site study of parent-mediated intervention. Participants had also received community-based professionally-implemented intervention. Parents responded to open-ended questions on topics related to interaction with professionals and their own ability to promote their toddlers' active social engagement. Drawing from a thematic methodological and analytical framework, we conducted independent qualitative coding of transcribed interviews using codes that accommodated lower and higher levels of inference. Data triangulation was supported across investigators, supplementary data sources (e.g., intervention records), and participants. Following discussions and multiple coding cycles, 76 primary codes resulted, forming the basis for systematic interpretation. Codes were organized into categorical sets, followed by development of themes.

Results: Four themes and associated subthemes resulted from the analysis. The first, "autism-related early challenges to PSE," found an early period of adjustment sometimes followed by parents struggling to connect with the child as social challenges emerged. The second theme, "parent-professional roles and PSE," uncovered three subthemes: Parent as follower and professional as expert, parent involved in an ancillary role, and parent in the driver's seat, with increasingly strong evidence of PSE with each subtheme. The third theme, "manifestations and personal contributors to PSE," revealed parents' specific and general examples of their own expertise. Fourth, in "child autonomy as an extension of PSE," participants showed a high level of acceptance of their toddlers' natures and preferences, validating their awareness of the transactional nature of the parent-child social learning process.

Conclusions: Bandura's theory of self-efficacy informed our interpretation of findings that PSE supported parents' motivation to master tasks. Parents' shared perceptions revealed that parent-professional role inequality appeared to negatively impact their PSE while a more participatory approach fostered competency through conceptually-based learning and active engagement in the learning process, preparing them to take the lead in promoting toddler learning. Results highlight the importance of participatory EI practices.

423.021 *(Poster)* Characterizing Discussions between Pediatric Healthcare Providers and Autistic Adolescent Patients and Their Families about the Transition to Adulthood

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Background: The transition to adulthood is a significant challenge for autistic adolescents and young adults (AYA). The 2015 National Autism Indicators Report found that more autistic AYA reported feeling disconnected from work and education than peers with other disabilities such as speech-language impairment, learning disabilities, or emotional disturbances (Roux et al., 2015). The Interagency Autism Coordinating Committee, which is charged with advising the Department of Health and Human Services on concerns among the autistic community, highlighted the need for services to improve the functioning and quality of life of autistic AYA in the transition to adulthood. However, research has yet to characterize discussions between health care providers (HCPs), a resource for information regarding health and well-being, and patients and families as they prepare for this transition.

Objectives: To determine the extent to which HCPs (Physicians, Nurse Practitioners [NPs], Mental HCPs, and Social Workers) discuss transition to adulthood (TTA) topics with autistic and non-autistic AYA patients and their families. Specifically, we report the specific TTA topics different HCP groups discuss and their perceived level of comfort with these discussions.

Methods: We conducted a survey with HCPs who see both autistic and non-autistic patients from the Philadelphia metro-region to capture: 1) demographic information; 2) whether they discuss 16 TTA topics with their patients (yes/no); and 3) their perceived comfort with these discussions (not at all/a little/somewhat/very/extremely). As a first step, we explored the data to characterize trends across HCP professions and patient groups.

Results: 103 HCPs completed the survey. Compared to other HCPs, physicians and social workers had large difference in comfort discussing the TTA topics with autistic versus non-autistic patients. For example, approximately twice as many physicians reported feeling "very" or "extremely" comfortable discussing TTA topics with non-autistic (73%) patients compared to autistic patients (37%). Figure 1 depicts percentages of HCPs reporting TTA discussions by topic, profession, and patient diagnosis. With respect to specific topics, 45% of all HCPs reported discussing pregnancy and parenting with autistic patients compared to 64% discussing this topic with non-autistic patients. Conversely, 86% reported discussing community resources with their autistic patients compared to 62% discussing this topic with non-autistic patients. Across both patient populations, the majority of HCPs reported discussing transition to adult healthcare, mental health, and education planning; less discussed topics including housing, housekeeping, and legal skills.

Conclusions: HCPs reported discussing different TTA topics with autistic and non-autistic patients, which may be influenced by profession and clinical role. The majority of HCPs reported feeling uncomfortable with TTA discussions with autistic patients, but felt more comfortable having TTA discussions with non-autistic patients. This could potentially lead to HCPs failing to discuss important health topics, like pregnancy prevention, with autistic AYA patients. Future efforts to enhance HCPs comfort with discussing TTA topics with autistic patients may help to ensure that all AYA patients receive information needed to support healthy transition to adulthood.

423.022 *(Poster)* Communal Coping As a Moderator of the Relation between ASD Symptom Severity and Functioning in Typically-Developing Siblings.

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Background: Previous research on typically-developing (TD) siblings of children with ASD is often mixed (e.g., Meadan et al., 2010), suggesting that negative outcomes likely occur only under certain conditions. One potential predictor of TD sibling functioning is the degree of challenging behaviors in the sibling with ASD, with more severe problems associated with worse TD sibling functioning (e.g., Hastings, 2003; Petalas et al., 2012). To this end, elevated ASD symptom presentations may prove stressful for TD siblings and the family as a whole. Yet, a longstanding line of research shows that coping abilities can mitigate the effects of stressors (Compas et al., 2001). Communal coping, the extent to which a group (i.e., a family) works together to solve collective problems (as opposed to approaching them individually; Lyons et al., 1998), may be a particularly important determinant of TD sibling functioning.

Objectives: This study tested TD sibling-reported communal coping within the family as a potential moderator of the relation between caregiver-reported ASD symptoms in the child with ASD and TD sibling-reported emotional and behavioral functioning.

Methods: The sample was 106 dyads that consisted of a caregiver (87.7% female) and a TD sibling (M_{age} = 13.76; SD_{age} = 1.91; 53% female) of a child with ASD (M_{age} = 11.47; SD_{age} = 4.01; 13% female). Caregivers completed the Children's Social Behavior Questionnaire (CSBQ) as a measure of ASD symptoms in the child with ASD. TD siblings completed the Strengths and Difficulties Questionnaire (SDQ), which measures their own emotional and behavioral functioning, and the Communal Coping During Family Challenges scale (CCFC), assessing their perspectives on collective coping within the family.

Results: The overall multiple regression analysis predicting TD sibling emotional and behavioral functioning was significant, $F(3,102) = 4.87$, $p = .003$, $R^2 = .13$. TD sibling-reported communal coping moderated the relation between ASD symptoms in the child with ASD (as reported by parents) and TD siblings' own perceptions of their emotional and behavioral functioning, $B = .005$, $SE = .002$, $p = .03$. When communal coping was reported as low or moderate, the relation between ASD symptoms and TD sibling emotional and behavioral functioning was nonsignificant, $B = -.03$, $SE = .05$, $p = .53$; $B = .04$, $SE = .03$, $p = .15$, respectively. However, ASD symptoms and TD sibling functioning related positively when communal coping was high, $B = .12$, $SE = .05$, $p = .01$. Specifically, TD siblings reported the least emotional and behavioral problems when ASD symptoms were mild and communal coping was high (Figure 1).

Conclusions: The results of this study suggest that communal coping may serve as a protective factor or buffer for TD sibling emotional and behavioral functioning. Again, previous research suggests that TD siblings likely only experience negative adjustment under certain conditions, such as when the child with ASD has severe symptoms and the TD sibling perceives little communal coping within their family. As such, communal coping could serve as one potential target for interventions aimed at improving functioning among families.

423.023 *(Poster)* Connected Versus Disconnected: Perspectives of Latino Parents of Children with Autism Spectrum Disorder Regarding Their Child's Teacher

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Background: For Latino parents of children with autism spectrum disorder (ASD), forming collaborative relationships with teachers can be especially challenging because of possible barriers, such as language or power dynamics, as well as stereotypes that Latino parents are not involved in their child's education (Gonzalez & Ayala-Alcantar, 2008; LeFevre & Shaw, 2012; Burke et al., 2018). Outcomes related to parent-teacher partnerships such as academic improvement and quality of life (Eskow et al., 2018; Hsiao et al., 2017) make pursuing partnerships beneficial for families. Despite these benefits, little is known about how Latino parents feel about relationships with their child's teacher.

Objectives: The purpose is to determine the nature of the relationships that Latino parents of elementary school-aged children with ASD have with their child's primary school teacher, and to describe the characteristics that make up these relationships.

Methods: Forty-one Latino parents of elementary school-aged children with ASD who were recruited for a larger study (N=94) responded to the prompt: “Is there anything you would like to say about your child’s teacher?” Qualitative responders had a mean age of 39.50, lived in the U.S. an average of 24.89 years, and there was representation from kindergarten-5th grade. Spanish responses were translated to English by native speakers. Forty percent of responses were double coded. Consensus coding was used for discrepancies. Inductive coding was used to review responses. Main themes of parent-teacher connection and parent-teacher disconnect emerged. Deductive coding was then implemented.

Results: Of the 41 participants, 16 (39%) described feeling connected with their child’s teacher: they felt they understood each other and agreed with what the teacher was doing. Twenty (49%) parents described feeling disconnected with the teacher: the parent did not agree with the teacher’s methods, and did not feel like they understood their child. Five (12%) parents made general teacher or school comments, not related to relationships.

Within the connection theme, sub-codes emerged: makes the effort, child inclusion, good communication, and general positive. In general, parents felt more connected with teachers when they felt they were getting to know their child and their family, and contributed extra effort to ensure the child was learning.

Within the disconnect theme, sub-codes emerged: minimizes needs, lack of communication, teacher unprepared, mistreatment, and general negative. Parents felt more disconnected with their child’s teacher if they did not feel the teacher was properly trained, did not understand their child’s needs, or did not communicate with parents.

Conclusions:

Identified codes assist in dispelling the myth that Latino parents do not want to be involved in their child’s education (Gonzalez & Ayala-Alcantar, 2008). Results indicated that Latino parents, like most parents, want teachers to communicate with them and understand their family’s needs, which are key components that lead parents to feel connected or disconnected with teachers. This study found similar results to past studies that did not focus on Latino families (e.g., Blue-Banning et al., 2004), showing that communication and feeling understood is important. Themes could be used as tools for teachers to mitigate productive relationships.

423.024 *(Poster)* Developing and Evaluating an Autism-Specific Research Passport

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Background: There has been a dramatic increase in the amount of autism research taking place across the world. Despite the potential for autism research to benefit the lives of autistic people and their families, they often report negative perceptions of research: feeling excluded from research, reporting poor management of expectations, receiving little or no feedback (during and after the process) and viewing their participation as tokenistic.

In other areas that autistic people often report negative experiences, such as in healthcare and the criminal justice system, ‘passports’ have been developed to support and empower autistic people and their families, and to enable professionals to meet the needs of those with whom they are working. Yet, to date, there have been no published evaluations of their utility. In addition, no passports have been designed specifically for researchers working with autistic people and their families.

Objectives: This project aimed to develop and evaluate the utility of a ‘Research Passport’ for use by autistic people, their families and researchers, with the aim of improving participant satisfaction with autism research. It also sought to examine whether the Research Passport might enable researchers to improve their practice and approach to research.

Methods: This study involved three key phases of an iterative design process. In Phase 1, in-depth qualitative focus groups were conducted with autistic adults (n=10), parents of autistic children (n=4) and autism researchers (n=6) to gather their views on what kind of information the Research Passport should include. In Phase 2, a prototype Research Passport was co-created with community members. In Phase 3 (ongoing), the Research Passport prototype will be evaluated via a survey and interviews with autistic people, parents and researchers to gather their experiences of the research process with and without the assistance of a Research Passport.

Results: Thematic analysis of Phase 1 focus groups showed that autistic adults, parents and researchers thought a Research Passport would be a useful tool. The passport would be a means to start a dialogue between participants and autism researchers to ensure taking part in research was a supportive and respectful experience. Nevertheless, participants also highlighted that the Research Passport should not be considered a "cure all" for all problems in autism research, and it should not become a "burden" for participants or researchers by being too long and difficult to complete. User testing in Phase 2 helped to develop a refined version of the Research Passport by assessing how effectively participant and researcher contributions for the passport are gathered. Its perceived success will be evaluated through user testing in Phase 3 before and after using the Research Passport.

Conclusions: The Research Passport aims to be a novel, evidence-informed tool, freely available for autistic people and researchers' use for research projects. These findings from Phase 1 clearly demonstrate the perceived need and utility of this tool by community members. The co-creation of the Research Passport should ensure that it is tailored to the needs of community members *and* researchers.

423.025 *(Poster)* Development and Evaluation of the "Puente" Promotora Model to Reduce Ethnic Disparities in Developmental Disability Service Utilization

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Background: Ethnic disparities in access to evidence-based community services for youth with developmental disabilities are a pressing concern. In 2016, the California Department of Developmental Services launched an initiative to address significant disparities in service expenditures for Latinx clients. In response, the San Diego Regional Center (SDRC) initiated a partnership with academic and community partners to identify disparity reduction targets for its clients and develop and implement a disparity reduction model.

Objectives: This presentation will describe the development and initial outcomes from an evaluation of the "PUENTE" Promotora model developed by the partners.

Methods: Service utilization data from 27,343 SDRC clients were examined to identify targeted diagnoses and ages for intervention. Through collaboration among SDRC, researchers, a family resource center, and the developer of a Promotora-delivered psychoeducational curriculum, the PUENTE model was developed. The goal of the intervention is to promote psychoeducation and empowerment for parents of Latinx youth ages 11 to 16 with developmental disabilities.

SDRC case managers referred Latinx families identified to underutilize services. Promotoras were assigned to the families and conduct home visits for 12 weeks to deliver an adapted version of the *Parents Taking Action* curriculum (Magaña, Lopez, & Machalicek, 2017). Promotoras for the program were caregivers of individuals with developmental disabilities who have extensive experience navigating the service system. At intake and exit, an independent program evaluator administered a range of caregiver self-report measures. Measures examine caregivers' knowledge of disabilities, strain, depression, and self-efficacy. Promotoras and caregivers were also asked to complete surveys upon completion of the program to assess feasibility, acceptability, and adaptations.

Results: A total of 34 youth clients were identified by SDRC service coordinators and referred to the PUENTE program. Across all families who initiated the service, youth were an average of 13.5 years old (SD=1.8) and 64% male. Youth diagnoses were: 33% ASD, 33% ID, and 33% multiple diagnoses (ASD/ID, ID, CP, ID/CP/EP). The majority of families served reported incomes below the poverty line and less than a high school level of parent education (61% and 58%, respectively).

Initial feasibility and outcome data for the program are promising. Promotoras rated caregivers as highly engaged in the intervention (M=4.69 on 1-5 scale, SD=0.34) and caregivers indicated high satisfaction with the PUENTE program overall (M=3.88 on 1-4 scale, SD = 0.13). When asked what they learned through the PUENTE program, 62% of families reported becoming more knowledgeable about the Individualized Education Plan process and requesting services at or related to school specifically, and 62% mentioned becoming stronger advocates for their child broadly. Analyses revealed parents reported significantly fewer depression symptoms ($p<.05$) and significantly higher perceptions of parental self-efficacy after participation ($p<.05$).

Conclusions: Preliminary data demonstrate the feasibility and appropriateness of the PUENTE program to reach Latinx families with youth with developmental disabilities. These outcomes are in contrast to previous reports of Latinx families reporting low satisfaction with services and being less likely to receive guideline-concordant care, particularly for autism. Additional impact of the intervention and mechanisms for sustainability will be discussed.

423.026 *(Poster)* Differences in Caregiver and Child Factors Considering the Birth Order of Children with ASD

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Background: Parenting a child with a disability can negatively impact caregivers' distress (Raina et al., 2004). Though research has investigated the ways in which caregiver factors, such as self-efficacy and stress, are associated with one another (Kuhn & Carter, 2006), there is limited research on how these factors differ across varied family structures. Given the heightened distress among parents of children with ASD and the reliance of parent report in clinical evaluation, it is essential to understand how nuances in family structure (e.g., birth order) may impact caregivers' reports of their own wellbeing and their children's symptomatology.

Objectives: To investigate how the birth order of children with ASD may impact reporting of parental wellbeing/competency and child symptomatology.

Methods: Participants were 155 caregivers with one child with ASD categorized into three birth order groups: caregivers who have (1) a first-born child with ASD and then typically-developing (TD) child(ren) (First-Born condition); (2) TD child(ren) and then a non-first-born child with ASD (Non-First-Born condition), and (3) one child with ASD (Only-Child condition). Caregivers completed questionnaires related to parental factors such as family resources (FRS), caregiver distress (DASS), efficacy/satisfaction (PSOC), ASD knowledge (ASK-ASD), and perceived social support (MSPSS). Caregivers also reported on child factors including internalizing/externalizing behaviors of the child with autism (BASC-3) and ASD symptom severity (CSBQ).

Results: Zero-order correlations among the parent and child variables are presented by birth order condition in Table 1. A one-way ANOVA examining group differences (Table 2) indicated that the three birth order conditions did not differ significantly on caregiver distress, family resources, ASD symptom severity, and externalizing behaviors. The mean score for the not-first-born condition was significantly higher than the other two groups for satisfaction, whereas the mean score for the first-born condition was significantly lower than the other two groups for efficacy. The mean score for the only-child condition was significantly higher than the first-born condition for perceived social support, lower than the other two groups for ASD knowledge, and higher than the other two groups for child internalizing behaviors.

Conclusions: There is currently limited research on how child birth order may affect caregivers' reports of their own experiences when raising a child with autism. In the current study, despite comparable ratings on family resources and ASD severity, there was a significant effect of birth order on several parent factors and child internalizing behaviors. Given the findings on satisfaction and efficacy, having one or multiple TD children before having a child with autism may enhance feelings of readiness or competency as a parent. Interestingly, caregivers of the first-born group reported less efficacy and perceived social support than the only-child group, perhaps due to possible stress of having a second child while simultaneously navigating the autism diagnosis of the first child. The results suggest that having multiple children in the family may increase parents' actual knowledge of ASD. This finding, in combination with the only-child condition being the only group to have a significant negative correlation between efficacy and knowledge, prompts the need for further research.

423.027 *(Poster)* Do Serbian Parents of Children with Autism Spectrum Disorder Experience a Greater Degree of Stigma Than Parents of Children with Physical Disabilities

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Background: Although researchers have been exploring experienced stigma among parents of children with Autism Spectrum Disorder (ASD) in the past 10 years, no such studies were conducted in Serbia and in neighboring countries. The literature suggests that parents of children with ASD experience a greater degree of stigma compared to parents of children with different types of developmental disabilities.

Objectives: Aim of the present study was to compare stigmatized experiences of parents of children with ASD and physical disabilities (PD) in Serbia.

Methods: The convenient sample consisted of 82 Serbian parents (40 of children with ASD and 42 of children with PD) participated in the study. The parents were recruited via NGO and public schools across country. For the purpose of this study we developed the Experienced Stigma Scale. We applied EFA and CFA and out of 20 included items, 8-item solution clustered into 2 factors proven to be the best. It is 5-point Likert scale where higher score represents greater degree of an experienced stigma.

Results: The parents of children with ASD reported a greater level of experienced stigma in comparison to parents of children with PD (mean rank = 277.61 and 216.87 retrospectively; $U = -4.744$, $p = 0.000$). Additionally, parents of children with ASD reported that most negative experiences reported are: people on the street judged them when child misbehaves (AS = 3.58, SD = 1.107), the friends felt uncomfortable when child with ASD was present (AS = 3.18, SD = 1.238), and the friends visited them less often since they knew about the ASD child (AS = 3.08, SD = 1.559).

Conclusions: Results of the present study showed that parents of children with ASD experienced more stigma in comparison to the parents of children with PD. In addition, they experienced the most stigma in relation with their friends.

423.028 *(Poster)* Does Participatory Programming Promote Positive Outcomes for Autistic College Students? a Cross-Institutional Survey Study

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Background: As more autistic people attend university, available social supports may significantly impact their identity development and well-being in college. Prior research has examined programs at a single university (e.g., Hillier et al., 2018) or inferred general patterns by recruiting students and parents from numerous institutions without examining how institution-specific factors impact their perspectives (e.g., White et al., 2016; Cai & Richdale, 2016). While this research is important for gaining information about the needs of autistic students and their families, prior research does not consider how factors in the college environment may shape development. We, members of a participatory mentorship program for autistic university students, wished to examine the degree to which participatory programming may promote positive outcomes.

Objectives: We examined if specific types of supports are associated with individual and community identity and well-being across institutions. We hypothesized that:

- Students involved in participatory (or autistic-led) programs would exhibit heightened autism identity and pride;
- Autism identity would be positively associated with QoL (Quality of Life), well-being, and a sense of belonging at university.

Methods: Autistic college students and academics and non-autistic researchers collaboratively developed hypotheses and an online survey. Participants (*n*=85, *Mage*=23.88, 50.6% male, 67.1% White, 72.9% undergraduates; representing 8 countries and 48 universities) completed an online survey assessing supports, autism traits, involvement with the neurodiversity movement, QoL, well-being, university belonging, a text-based autism identity (assessing identification with the autism community) and a picture-based scale (assessing affect, anxiety, pride, and energy in response to core autistic experiences; developed by our participatory research group).

Results: Correlations revealed that involvement with autistic-led programming was associated with heightened well-being, belonging, and QoL but not autistic identity (Table 1). The autistic identity measures were unrelated to each other. Only involvement with the neurodiversity movement was associated with autism community identification. Follow-up regressions controlling for gender, age, autistic traits, and student level revealed that autistic-led programming, but not neurodiversity involvement, was associated with belonging.

Heightened autistic traits were associated with reduced well-being and QoL. Unexpectedly, neurodiversity involvement was *negatively* associated with QoL and well-being. Follow-up regressions revealed this was attributable to associations between neurodiversity involvement and heightened autistic traits.

Well-being and QoL, but not belonging, were associated with heightened affect, pride, and energy and reduced anxiety about autistic experiences. When gender, age, traits, and student level were included in regressions including all four emotional reactions to autism, heightened autism traits and reduced anxiety about autistic characteristics predicted QoL and well-being.

Conclusions: When autistic students play a leadership role in developing university supports, their peers benefit. While directionality cannot be inferred, clear relationships between participatory programming, well-being, QoL, and a sense of belonging at university were observed. Universities should include autistic students in developing and delivering autism supports to promote leadership skills and belonging. Positive attitudes toward autistic experiences may promote well-being and QoL among autistic students. Educators should focus on fostering a sense of pride in autistic students and researchers should prioritize participatory research methods to better understand and serve diverse autistic people.

423.029 *(Poster)* Early Detection, Diagnosis and Intervention Services for Young Children with Autism Spectrum Disorder across Regions of Europe According to the Gross Domestic Product (GDP)

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Background: The perspectives of parents and professionals towards detection and diagnosis of Autism Spectrum Disorder (ASD) play a fundamental role in guiding the improvement of services, but both viewpoints have rarely been considered jointly in the European regions. With regard to the socio-demographic aspects, studies have shown that individuals with ASD belonging to families with a high parental socio-economic status (SES) are detected and diagnosed earlier, and that their families report greater satisfaction with services.

Objectives: The aim of this study is to know the relationships between the Gross Domestic Product (GDP) across European countries and the access and quality of services of detection, diagnosis, and early intervention for young children with ASD, and how this relation can explain the satisfaction of the autism community (families and professionals). Hence, it is important to identify the variables that predict service satisfaction in all GDP regions to obtain detailed information about the views held by various European stakeholders on such services, in order to inform the decisions of policy makers -at both a national and European level- affecting the financing of services.

Methods: Twenty focus groups were carried out in 10 European countries within the framework of the Autism Spectrum Disorders in the European Union (ASDEU) network, leading to the development of two independent surveys that were distributed online among families with a child with ASD and professionals who reported working or have worked with same study population in the same period of time or in recent years (N = 2,032). Questions aimed to collect specific data about detection, diagnosis and intervention of young children with ASD (level of satisfaction, age of access, etc). Multinomial regression analyses were conducted to compare the different regions of Europe according to the GDP (low GDP (under 20,000 euros); medium GDP (20,000 to 30,000 euros); high GDP (30,000 to 40,000 euros); very high GDP (over 40,000 euros)).

Results: Overall, 60.2% of respondents reported positive satisfaction with services. Respondents in regions with low or medium GDP were more likely to give low ratings to detection, diagnostic and intervention services (4.48) than those living in regions with higher GDP (4.96). European regions with lower incomes reported delays to service access more frequently. However, in these regions residents reported an earlier age of access to services compared to European regions with higher GDP. Furthermore, a positive predictor of satisfaction among families and professionals in all regions was shorter waiting times (< 6 months) to access to the health services.

Conclusions: Although, overall, families and professionals express satisfaction with detection, diagnosis and intervention services for children with ASD in their communities, there are differences between countries with different GDPs. Considering that most of the respondents in the medium and low GDP groups were from Poland and Spain, discrepancies could be explained by sampling bias. Furthermore, policy makers should reduce waiting times between services as it was a significant predictor of satisfaction in all GDP regions.

423.030 *(Poster)* Effects of an Mbsr Parent Intervention on Internalizing Problems in Children: ASD Status As a Moderator

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Background: Children with autism spectrum disorders (ASD) are at high risk for increased levels of behavior problems and developing internalizing problems. Previous literature has highlighted the impact of parental stress on the development of behavioral problems in children with ASD, particularly externalizing behavior problems; however, little research has examined the relation between parenting stress and internalizing problems in children with ASD.

Objectives: We investigated whether decreases in parenting stress through the use of MBSR would lead to reductions in internalizing behavior problems among children with ASD and children with developmental delays (DD), and whether this relation would be moderated by the child's ASD status. Additionally, we examined whether individual increases in the mindful facets of acting with awareness and non-judgment, from pre- to post- treatment, would be associated with reductions in internalizing problems among children with ASD and children with DD, and whether this relation was moderated by the child's ASD status.

Methods: The current study utilized data from the Mindful Awareness for Parenting Stress (MAPS) Project which included 80 families of preschool children between the ages of 3 and 5 (M = 3.5, SD = .96) with ASD (N = 49) and DD (N = 31) whose parents reported high levels of parenting stress. Families were randomized to either to immediately attend a Mindfulness-Based Stressed Reduction (MBSR) intervention or to a wait-list control group.

Results: We found that children whose parents were assigned to the MBSR treatment group, were reported to have greater reductions in internalizing problems compared to children whose parents were assigned to the waitlist-control group, b = -5.71, p < .05. Furthermore, we found that children of parents who reported greater increases in acting with awareness post-treatment had greater reductions in internalizing problems, b = -2.57, p < .05. Additionally, results indicated that children whose parents had greater increases in non-judgment post-treatment had greater reductions in internalizing problems, b = -1.85 , p < .05. However, ASD status was not a significant moderator in any of the analyses, ps > .05.

Conclusions: These findings suggest that parents' use of MBSR, specifically acting with awareness and acting non-judgmentally, may lead to reductions in internalizing problems for both children with ASD as well as children with DD. Given that internalizing problems are highly comorbid in children with ASD, these findings have important implications for future parenting interventions and understanding how parents utilization of MBSR may lead to reductions in internalizing problems of children with ASD or DD.

423.031 *(Poster)* Environmental Barriers and Facilitators to Primary Care for Adults with Autism: Multi-Informant Qualitative Results

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Background: Primary care is associated with positive societal outcomes, including improved access to healthcare services, health outcomes, and cost savings. Few studies have documented the primary care health experiences of adults with autism spectrum disorder (aASD). However, those existing studies report that aASD experience numerous challenges in the receipt of primary care, reporting decreased satisfaction and increased unmet physical and mental healthcare needs.

Objectives: As the number of aASD who require primary care is likely to increase over the next decade, there is a pressing need to improve the quality of primary healthcare for aASD with empirically validated, client-centered strategies and tools. Therefore, the purpose of this study was to describe the barriers and facilitators to positive primary care health encounters for aASD and provide strategies to address these challenges.

Methods: As part of a larger mixed methods convergent parallel design study, interviews were conducted with adults with ASD (n=34) and caregivers (n=31) in Los Angeles and Philadelphia; interviews lasted an average of 28 and 37 minutes (respectively) and were transcribed verbatim. Thematic analysis was employed to describe barriers and facilitators to primary care health encounters, as reported by each group.

Results: Three main overlapping themes emerged from the interviews. The first theme, *It's All About the Doctor,* focused on the importance of provider attributes, and those attributes' ability to either positively or negatively impact the care experience for adults with ASD. The second theme, *The Environment Is So Overwhelming* highlighted the significance of the waiting room and private clinic room environments. Lastly, the identification and utilization of tailored *Strategies and Accommodations* was reported as essential by all participants; however, the need for advocacy was also expressed, as many participants reported feelings of shortcoming when trying to utilize strategies during care and/or engage the provider in their use.

Conclusions: Findings provide insight into the barriers and facilitators to care as well as the techniques perceived by aASD and caregivers to facilitate positive primary care health encounters for aASD. Areas of overlap provide a blueprint for high-priority obstacles to address in intervention development in order to improve the quality of primary healthcare services for aASD.

423.032 *(Poster)* Examination of Predictors and Mediators of Life Satisfaction of Caregivers of Children with Autism Spectrum Disorder

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Background: Research on caregivers of children with ASD has found increased risk of negative outcomes associated with parenting a child with ASD (e.g., Dabrowska & Pisula, 2010). Additionally, the severity of their child's autism symptoms is often examined as a predictor of negative outcomes for caregivers (e.g., Garcia-Lopez et al., 2016). More recently, the field of ASD research has recently begun to focus on more positive outcomes, such as life satisfaction, for caregivers of children with ASD (e.g., Ekas & Whitman, 2010). As such, examination of the potential relation between autism symptom severity and caregiver life satisfaction, as well as potential mediators of this relation is important for caregivers of children with ASD.

Objectives: The current study sought to 1) examine autism symptoms severity in the child with ASD as a predictor of caregiver life satisfaction, and 2) examine caregiver distress and caregiver social support as mediators of the relation between autism symptom severity and caregiver life satisfaction.

Methods: Participants included 106 primary caregivers (*M* = 41.40, *SD* = 5.12) and 68 secondary caregivers (*M* = 42.87, *SD* = 6.91) with of children ASD ages 3 to 17 years (*M* = 11.47, *SD* = 4.00). Caregivers completed measures to assess ASD symptom severity in their children with ASD, a self-report measure of overall distress, and a self-report measure of overall life satisfaction. Two parallel mediation models were examined such that autism symptom severity in the child with ASD served as the predictor of primary caregivers' and secondary caregivers' life satisfaction. It was predicted that autism symptom severity (X) would be related to caregiver life satisfaction (Y) through caregiver distress (M_1) and caregiver social support (M_2).

Results: For primary caregivers, autism symptom severity of children with ASD did not demonstrate a direct pathway to life satisfaction, when controlling for distress and social support (*B* = 0.001, *SE* = 0.03, *p* = .971). However, bootstrapped confidence intervals indicated an indirect effect through distress (*B* = -0.04, Boot *SE* = 0.02, 95% CI = [-.07, -.01]). In contrast, no indirect effect through social support was found (*B* = 0.01, Boot *SE* = 0.02, 95% CI = [-.03, .04]). For secondary caregivers, autism symptom severity of children with ASD did not demonstrate a direct pathway to life satisfaction, when controlling for distress and social support (*B* = 0.02, *SE* = 0.03, *p* = .608). Additionally, no indirect effects through distress (*B* = -0.03, Boot *SE* = 0.02, 95% CI = [-.08, .003]) or social support were found (*B* = -0.01, Boot *SE* = 0.01, 95% CI = [-.04, .02]).

Conclusions: Despite the general lack of support for the hypothesized parallel mediation models, this study highlights the importance of researchers continuing to explore positive outcomes for family members of children with ASD. These results suggest that clinicians working with families of children with ASD may want to assess for caregiver distress, social support, and life satisfaction to identify those family members who may be functioning at an adequate level and those who may be struggling.

423.033 *(Poster)* Examining the Impact of Familial and Sociocultural Factors on Concurrent Anxiety Symptoms in Children with ASD

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Background: Anxiety disorders are prevalent in about 40% of youth with ASD (Jennett et al., 2013), in contrast to the prevalence rate of approximately 10% in children with neurotypical development (Costello et al., 2011). While research regarding the etiology of anxiety in ASD is continuing to develop, there is a need to examine how familial and sociocultural factors may also be implicated in the development of anxiety. Lower socioeconomic status has been widely implicated as a risk factor of psychopathology, including anxiety disorders in typically developing children (Lemstra et al., 2008). Researchers have also found that lower SES is related to higher rates of comorbid psychopathology in children and adolescents with ASD (Rosa et al., 2016). Therefore, there is a need to investigate the relationship between SES and anxiety symptoms in children with ASD.

Furthermore, in studies examining family culture in children with neurotypical development, Latino youth have been shown to present with higher levels of anxiety symptomatology when compared to their White peers (Varela et al., 2004). Given that children with ASD are more likely to present with anxiety symptoms, it is imperative to examine whether Latino children with ASD may be significantly more at risk in order to help target interventions.

Objectives: The first aim of this study was to examine the relationship between SES and anxiety symptoms, as well as to examine the extent to which anxiety symptomatology varies by child ethnicity. We examined the following research questions: 1) To what extent does SES relate to anxiety symptoms in a sample of children with ASD? 2) To what extent do anxiety symptom levels differ between Latino and White children? A secondary aim was to examine a moderation model linking maternal acculturation, maternal familism, and child anxiety symptoms in Latino families.

Methods: Participants were mothers and their children with ASD. The sample was comprised of White (non-Hispanic; n=42) participants or Latino participants (n=74). We conducted a regression analysis, controlling for child sex and ethnicity, in order to determine whether SES was associated with concurrent anxiety symptoms. Next, we ran analysis of covariance (ANCOVA) in order to elucidate the ethnic differences in anxiety symptoms. Lastly, we examined the extent to which acculturation, familism, and child anxiety were related in the subsample of Latino children with ASD.

Results*:* We found that SES was inversely associated with child anxiety symptoms (*B* = -6.48, *p* < .05). Further, Latino and White children with ASD did not differ in their anxiety symptom levels (*F* (1, 116) = 0.27, *p* = 0.59). Additionally, maternal familism was found to moderate the relationship between maternal enculturation and child anxiety.

Conclusions: Our findings highlight the importance of identifying and targeting interventions for high-risk children. Additionally, enculturation and familism may be salient targets of intervention within the context of child anxiety treatment for Latino families.

423.034 *(Poster)* Examining the Role of Socioeconomic Position in the Quality of Life of Mothers Raising a Child/Children with ASD: A Qualitative Investigation in Greece.

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Background: There is amassing evidence suggesting that parents, especially mothers, of children with ASD are more likely to experience increased levels of stress and lower quality of life compared to parents of children without ASD. Researchers so far have focused on the possible role of ASD symptomatology and parental behavioural, cognitive and personality characteristics in the experience of parenting a child with ASD. Over the last years, research is growing on whether parental income, educational attainment, employment status and access to resources are possible factors contributing and differentiating the quality of life of parents raising a child/children with ASD.

Objectives: To explore the role of socioeconomic position, through the Erik Olin Wright's operational framework (1985), in the quality of life of mothers raising a child/ children with ASD.

Methods: The study was designed using a comparative qualitative methodology. By employing purposive sampling, 83 mothers raising either one or more children with ASD were recruited from an urban environment (Thessaloniki, Greece). Erik Olin Wright's conceptualization of social class position was adopted to classify mothers across four social class positions. Based on Wright's conceptualization of social class, mothers' position was classified by parental income, educational attainment, skills, credentials, control over productive assets and/or organisational assets. On this basis, 35 mothers were classified as low-income/working class, 25 as petty-bourgeoisie, 25 mothers as high-income with highly specialized credentials/upper class, and 8 mothers were classified as long-term unemployed. Semi-structured interviews were conducted using a guide covering a broad range of topics including: first signs of autism in their child and diagnostic process, explanations and perceptions on the causes of ASD, their lived experience of motherhood, their relationships with their spouse, relatives and wider social networks, perceived stigma and social support, pathways to healthcare, educational and therapeutic service use, personal development and coping strategies and expectations for the future. All the interview transcripts were, initially, analysed using template analysis in accordance with the principles of thematic analysis and computer software (NVivo, version 10.1.3).

Results: The analysis of the narrative material suggested that regardless of social class, parenting a child with ASD is a major life-changing event affecting several spheres of the emotional and social life of mothers, affecting ultimately their quality of life. However, low-income/working class mothers appeared to have limited access to specialized educational and intervention resources and negative experiences regarding healthcare system navigation. In addition, they seemed to have poor social networks and recalled experiencing stigmatization. Importantly, through these narratives, several factors of empowerment and resilience were identified- practical as well as psychological.

Conclusions: To our knowledge, this is the first and largest study investigating the role of the socioeconomic position in the quality of life of mothers raising children with ASD in Greece. The present empirical findings highlight the importance of the socioeconomic position in the lived experience of parenting a child with ASD as well as the urgency for designing and delivering of specialised services approachable and sensitive to mothers from disadvantaged socioeconomic positions.

423.035 *(Poster)* Exploring the Experience of Australian Parents and Caregivers in Noticing the First Signs of Autism Spectrum Disorder

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Background: The early identification of Autism Spectrum Disorder (ASD) is critical to ensuring that children and families receive appropriate and efficient access to services, resources and supports. Parents and caregivers are often the main source of information regarding the early signs of ASD in their children. There is currently limited evidence on what specific early signs are first noticed by parents/caregivers, and the experiences of parents/caregivers in reporting these signs and seeking advice and diagnosis.

Objectives: This study explored the first signs of ASD that parents/caregivers were noticing in their children prior to them receiving an ASD diagnosis and their experience reporting these signs to health professionals.

Methods: An explanatory sequential mixed method approach in two phases was utilised. Phase one involved secondary analysis of survey responses from 521 parents/caregivers of children with ASD. This secondary analysis included qualitative exploration of the first signs of ASD reported by parents/caregivers as well as quantitative investigation of gender differences in the age that first signs were initially noticed, when help was sought and when a diagnosis was obtained. Phase two included focus groups with 24 parents/caregivers of children with ASD to gain a deeper understanding of what signs first raised parents' concern about their children's development, and how parents/caregivers experienced the process of seeking advice and obtaining a diagnosis.

Results: Qualitative analysis of the survey data revealed four themes related to the type of signs of ASD parents first observed. These included: 1) difficulties with social interaction and engagement, 2) delayed or regressed milestones, 3) restrictive or repetitive behaviours and 4) sensory issues. A lack or regression of speech was the most commonly reported first sign by parents (50.59%), followed by odd and repetitive behaviours or play (26.6%), and difficulty meeting milestones (25.78%). There were no differences between the gender of the child and when the parents first sought advice or when a diagnosis was received. Signs leading to parental concern were identified earlier in female children compared to males. In Phase two analysis of interview data also identified four themes which reflected the parent's experiences. These themes included: 1) first signs, 2) seeking advice, 3) seeking diagnosis, and 4) after diagnosis.

Conclusions: Across both phases of the study, parents/caregivers commonly reported that sensory issues, a lack or regression of speech, social difficulties, repetitive and restricted behaviours and 'meltdowns' were the first signs they recognised that caused them to have concerns regarding the child's development. Parents/caregivers reported many barriers to support, including their own apprehension about seeking help, health professionals being dismissive, lacking knowledge about early manifestations of ASD and deficient in empathy for parents' concerns. Parents/caregivers also reported significant difficulty in navigating the healthcare system. Parents/caregivers required health professionals to take them seriously and implement a more empathetic approach when presenting concerns. Parents/caregivers also need more informed and clearer pathway to obtaining an ASD diagnosis to ensure more efficient and timely diagnosis.

423.036 *(Poster)* Exploring the Relationship between Family Empowerment and Quality of Life for Mothers and Fathers of Children with Autism Spectrum Disorder

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Background: Recent estimates show approximately 2.8 million people in the United States are diagnosed with Autism Spectrum Disorder (ASD). Parents of children with ASD consistently report reduced quality of life (QoL), due to the impact of caring for a child with ASD, which is a growing health concern in the U.S. While research has explored the role of challenging child behaviors and symptoms on QoL, more research is needed to understand intra-parental factors that contribute to QoL for both mothers and fathers. Family empowerment, or confidence to complete parent-related tasks, may play an important role in QoL for parents of children with ASD.

Objectives: The objective of this study is to examine the relationship between family empowerment and QoL for parents raising a child with ASD, and whether it differs between fathers and mothers.

Methods: Participants (Mothers n= 32, Fathers n=24) were recruited through a community organization as part of an intervention study. Parents were included if they were actively parenting a young child (age 4-8) with ASD and sharing parenting with a co-parent. Participants provided informed consent and responded to a baseline questionnaire. Family empowerment was measured using the family subscale of the Family Empowerment Scale. Quality of life (QoL) was measured with the Quality of Life Autism scale, which assesses domains such as satisfaction with life, emotional distress levels, achieved self-gratification, etc. Two multiple regression models were used to address the study aims, one for mothers and the other for fathers.

Results: All assumptions for regression analyses were met. Regression models accounted for possible covariates (i.e., level of education, employment, number of children in the home, and if the parent had a household partner); all emerged as nonsignificant predictors in both models. For mothers, the regression model explained 58% of the variance in QoL. Family empowerment was significantly associated with QoL (β=.63, *p<.000)*. For fathers, neither family empowerment nor the overall regression model was significant.

Conclusions: Study findings support the hypothesis that mothers' sense of family empowerment contributes to their QoL. However, this hypothesis was not supported for fathers. It is possible that this relationship is stronger for mothers because they generally devote more time and energy to parenting tasks. This finding can be further explored by comparing the effects of parent education and support programs on mothers' and fathers' empowerment and QoL over time. These differential effects have implications for future research, and practice.

423.037 *(Poster)* Family Accommodation in Children with Autism: Relation to Symptomatology and Child Characteristics

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Background: Family accommodation refers to ways in which parents modify their behavior to help a child alleviate distress associated with emotional disorders (Lebowitz & Bloch, 2012; Lebowitz, Scharfstein & Jones, 2014). Such accommodation is common among families of children with OCD and anxiety disorders and is associated with increased symptom severity, lower functioning, and poorer treatment outcomes (Caporino et al., 2011; Lebowitz, Scharfstein & Jones, 2014; Storch et al., 2007).

One study to date has examined family accommodation of repetitive and restrictive behaviors and stereotyped interests (RRBs) in autism. Feldman et al (2019) found such accommodation to be highly prevalent, positively correlated with symptom severity and negatively correlated with adaptive functioning.

Objectives: To confirm earlier findings in a larger sample and explore the relationship between family accommodation and clinical correlates.

Methods: Participants include 125 children (34 females; mean age = 6.37, SD = 3.09) diagnosed at a tertiary center in central Israel, and their parents. Participants underwent comprehensive diagnostic assessments including developmental/cognitive evaluations, the Autism Diagnostic Observation Schedule 2 (ADOS2; Lord, DiLavore & Gotham, 2012), and the Vineland Adaptive Behavior Scales 2 (VABS-2; Sparrow, Balla & Cicchetti, 2005). Additional measures include parent-report measures of family accommodation (FAS-RRB; Feldman et al, 209), RRBs (RBS-R; Bodfish, Symons, & Lewis, 1998), and child anxiety (SCARED; Birmaher, Brent, Chiappetta, Bridge, Monga & Baugher, 1999).

Results: Family accommodation was highly prevalent, with 81.51% of parents reporting accommodating at least once monthly and 56.3% reporting daily accommodation. Accommodation positively correlated with RRB severity (r=.799, p<.001) but not with autism severity as measured by the ADOS severity score (r=-.013, p=.901). Accommodation negatively correlated with adaptive behavior skills (r=-.496, p<.001) and positively correlated with anxiety (r=.544, p<.001). A multiple regression analysis found that accommodation was predicted by RRB severity, adaptive behavior and anxiety (F(2,62)=40.195, p<.001, R2=.660) with RRB severity predicting higher levels of family accommodation (B=.461, SE(B)=.067, t=6.901, p<.001) after accounting for adaptive behavior and anxiety. No other variable explained unique variance in FAS-RRB. A one-way ANOVA was conducted to evaluate the relationship between child gender and family accommodation, yielding an insignificant result (p=.35). These analyses were repeated separately for children above and below age six. Below age six, results indicated patterns similar to the total sample. Above age six, however, no correlation was found between VABS-2 and FAS-RRB. A multiple regression was conducted on the older group, examining the contribution of RRB severity, adaptive behavior and anxiety level to family accommodation (FAS-RRB). The overall model predicted the FAS-RRB score (F(2,30)=27.678, p<.001, R2=.728). RRB severity (B=.416, SE(B)=.074, t=5.639, p<.001) and the SCARED (B=.361, SE(B)=.12, t=3.014, p=.005) explained unique variance in the FAS-RRB total score.

Conclusions: This study provides additional evidence that parents of children with autism commonly accommodate their child's RRBs and reveals the relationship between family accommodation, clinical parameters and child characteristics. Results point to differences in the relationship between these variables and age and to no such differences between genders. Future work should focus on the developmental nature and impact of family accommodation.

423.038 *(Poster)* Family Relationships and Young Adults' Well-Being: The Moderating Role of the Broader Autism Phenotype

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Background: Research highlights that the quality of relationships with parents (Agerup et al., 2015) and siblings (Jensen et al., 2018) is linked to young adults' well-being. The positive benefits of social relationships, however, may be lessened for those who are higher in Broader Autism Phenotype (BAP) characteristics (Jobe & White, 2007).

Objectives: The current study extends this literature and focuses on two types of family relationships, parents and siblings, and examines whether links between relationship quality and young adults' well-being vary by BAP characteristics.

Methods: Data come from 866 young adults living in the United States, surveyed via Amazon Mechanical Turk. Participants ranged between 18 and 29 years old (*M age* = 25.43, *SD* = 2.54). The sample was mostly female (58%) and Caucasian (73%). Participants reported on their own BAP characteristics using the Autism Spectrum Quotient questionnaire (Baron-Cohen et al., 2001), and on their closeness and conflict with their parents and closest aged sibling, their depressive symptoms, and self-esteem.

Results: Analysis was conducted in a hierarchical ordinary least squares regression. Models were tested separately for each dependent variable: depressive symptoms and self-esteem. In the first model, each model included demographics (of the parent and participating young adult), sibling structural factors (e.g., age spacing, birth order, coresidence with sibling), conflict with parents (a composite score of conflict with mother and father), closeness with parents (also a composite variable), conflict with closest aged sibling, closeness with closest aged sibling, and the participants' BAP characteristics. In the second model, four two-way interactions were included: conflict with parents X participant BAP, closeness with parents X participant BAP, conflict with sibling X participant BAP, and closeness with sibling X participant BAP.

Results for depressive symptoms revealed main effects: BAP characteristics and conflict with parents were positively associated, and closeness with parents and sibling were negatively associated with depressive symptoms. An interaction between BAP characteristics and conflict with parents revealed that conflict with parents was positively associated with depressive symptoms, but was stronger for those lower in BAP characteristics.

Results for self-esteem revealed main effects: BAP characteristics and conflict with parents were negatively associated, and closeness with parents and sibling were positively associated with self-esteem. An interaction between BAP characteristics and conflict with parents (Figure 1) revealed a negative association between conflict with parents and depressive symptoms for those high in BAP characteristics, but a stronger negative correlation for those low in BAP characteristics. An additional interaction between BAP characteristics and conflict with a closest aged sibling (Figure 2) revealed that the association between conflict with a sibling and depressive symptoms was only significant for those high in BAP characteristics.

Conclusions: Overall, these results suggest BAP characteristics play a nuanced role in the link between family relationships and well-being. Although those with higher BAP characteristics typically displayed poorer well-being, conflict with parents was not linked to additionally poor well-being as was seen with those low in BAP characteristics. On the contrary, higher BAP characteristics may exacerbate the link between conflict with siblings and self-esteem.

423.039 *(Poster)* Family Satisfaction of School Services for Elementary Learners with Autism

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Background: Several researchers have examined family satisfaction with health and educational services for families of children with ASD (Rattaz et al. 2014; Renty & Roeyers, 2006). Some have focused on the satisfaction of a particular service (e.g., assistive technology services) (Bitterman et al., 2008; McIntyre & Zemantic, 2017), but few have looked at satisfaction from a more detailed perspective. This study aimed to evaluate families' opinions on detailed components of school services, interactions with school team, and general student outcomes.

Objectives: The purpose of this study is to evaluate the results of a family satisfaction survey for parents of elementary students with ASD and investigate the influence of family and school characteristics on data collection and results.

Methods: Participants included 375 parents and their elementary school student with ASD who were part of a larger randomized controlled trial of a comprehensive treatment model for elementary school students with ASD (Mean age= 7.83 years, SD= 1.81 years, Range 5-12). Parents completed the Family Satisfaction Survey. Most of the respondents were mothers (74.6%).The children were mostly Male (79%), Caucasian (44.0%), and Non-Hispanic (80.6%). Chi-square tests, *t*-tests, and correlations were performed to examine associations among family satisfaction question, child and family demographics, child characteristics, and school characteristics.

Results: A majority of parents and caregivers were generally satisfied with aspects of programs and services, interactions with the school team, and child outcomes (Overall Family Satisfaction Mean = 3.95, SD = .74). Most parents and caregivers were extremely satisfied with the level of respect school/program staff shows to their family culture, families feeling like full team members on their child's educational team, and communication between the family and school personnel. Satisfaction ratings did not differ by child age, child IQ, maternal education, or household family income. Parents of students in noninclusive programs rated satisfaction in communication as higher than students in inclusive programs, X^2 (4) = 18.58, p =. 001. Satisfaction ratings did not differ by school location, Title 1 eligibility, or percent of students on free and reduced lunch at the school. However, there were 143 students who were missing data who participated in the larger study. Missing data was from more schools that met Title 1 eligibility, $X^2(1) = 10.24$, p = .001, parents whose children were more likely to be Hispanic or Latino, X^2 (1) = 6.85, p = .002 and NonWhite, X^2 (6) = 51.3, p =.001.

Conclusions: Overall, a majority of families were generally satisfied with their child's school services. By investigating specific components of both educational services and interactions between families and team members, though, results from this survey can provide targeted areas for school teams to further improve experiences for families of children with ASD (i.e., improving support for families implementing IEP goals at home). Additionally, results from this survey show missing information for critical groups (i.e., nonwhite families and Title I eligible schools) indicating there is a need for researchers to examine methods of collecting data from diverse populations.

423.040 *(Poster)* Family Wellbeing in Parents Following Their Child's Early Diagnosis of Autism Spectrum Disorder: A Retrospective Study

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Background: The post-diagnostic experience can have a substantial impact on parental coping, resolution, mental health and overall Quality of Life (QoL). To date, there is limited research on factors that may contribute to a family's resilience in the context of a child's early diagnosis of ASD. Despite literature highlighting the impact and pressures of parenting a child with autism, research about what helps parents during the post-diagnostic period is scarce.

Objectives: The aim in the current study was to identify protective and risk factors associated with positive outcomes in family's post-diagnosis in order to inform the need for targeted parenting interventions at this time.

Methods: Eighty-nine parents (female = 78) of children who previously received a diagnosis of ASD (< 6 years) were asked to (retrospectively) reflect on the time of diagnosis when completing an online battery of questionnaires designed to measure individual, parent, and family wellbeing.

Results: Three simultaneous multiple regressions assessed the relationship between protective factors (family support, parenting self-efficacy, adaptive coping) and risk factors (parenting stress, intolerance of uncertainty, maladaptive coping and depression) and family wellbeing. Findings indicated that family support (spousal and familial support) and parenting stress had the strongest association with family QoL (emotional wellbeing, family interaction and parenting).

Conclusions: Strong family support following a child's diagnosis may play a key role in enhancing family quality of life and promoting resilience. Implications of the findings emphasise a need to strengthen internal family resources, such as familial and spousal support. Understanding the function of parenting stress and developing greater family support for parents, may be the first step in helping families successfully adapt to their child's diagnosis.

423.041 *(Poster)* Gender-Based Stereotypical Roles in Parents Caring for Autistic Children in Nigeria and South Africa

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Background: Gender-based stereotypical behaviours are not unique to larger social settings as they have been noticed within the family system in terms of definitive roles played by men and women. This situation though is more prevalent in some cultures and societies than others; but in most African society, women are less *voice-able and visible* through certain cultural and ideological stereotypical practices. It is important to better understand gender roles in this context because of the potential health implications for parents of children with ASD (e.g. caregiver strain and distress may be greater in women than in men), as well as influence of such situation on the quality of care to be received by these children.

Objectives: This study aimed to investigate the real-life stereotypical roles of women and men (parents) in Nigerian and South African contexts with regard to intervention and management of autism spectrum disorder (ASD).

Methods: A nonrandom purposive sampling was adopted to purposively sample parents of children with ASD within age 3-15 years (n=15) from Nigeria and (n=10) South Africa. A 15-item questionnaire was employed. Descriptive statistical analysis and thematic analysis were performed on the data. The analysis also drew introspection from van Dijk's model of critical discourse analysis to contextualize overt or covert gender-based ideology and stereotype and to reduce the level of bias in collected data.

Results: The study revealed that in Nigerian context and South African context respectively, 79% women and 21% men and 93% women and 7% performed the same (non-cumbersome ones) roles on interventions and management of ASD, while 87% women, 13% men, and 98% women and 2% men perform cumbersome roles in taking care of their autistic children. Lastly, the study found that African cultural hegemony and ideological leaning empower men to select roles being play at any social situation. This affects fostering of mutual collaboration between parents, and makes women's role in the intervention and management of autism more burdensome in terms of time and stress and distress they are exposed to.

Conclusions: The study's findings suggest that family ties are not strengthened and roles not equally shared. Additionally, reasonable awareness on ASD has not received necessary attention in that regards. The study recommends mutual collaboration devoid of stereotypical roles among men and women in selecting intervention and caring for their children with autism through increased parent education about the benefits of sharing responsibility in intervention and management of a child's ASD; or through clinician-facilitated planning that can be easily done after day work, free time and vacations.

423.042 *(Poster)* Increasing Rural Early Intervention Providers Use of Parent Coaching and Evidence-Based Strategies to Support Toddlers on the Autism Spectrum

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Background: Parent-implemented intervention is an established evidence-based practice supporting the development of very young children with Autism (Wong et. al., 2015). Few studies have examined implementation of a comprehensive family-implemented intervention program targeting rural families.

Objectives: The first aim was to determine whether a functional relationship exists between the FITT training and coaching model and provider use of parent coaching strategies. The second aim was to determine whether a functional relationship exists between the FITT training and coaching model and the EI provider fidelity in use of the FITT model.

Methods: The study utilized a single-subject ABAB design with three community EI providers examining the impact of FITT training and weekly coaching on the use of coaching strategies with parents and fidelity to the FITT manual.

Results: Following the implementation of the intervention, all three participants demonstrated immediacy of the effects, increases of 17.7%, 26,.7%, and 58.51%. PND calculations were 88.9% or higher across participants. Fidelity scores were also calculated following intervention implementation showing immediacy of effects, increases of 76.5%, 82.3%, and 32.3%. PND calculations of 100% across participants.

Conclusions: Results showed significant increases in use of FITT coaching strategies and fidelity of intervention implementation across participants. Study suggests FITT can implemented with fidelity in community settings, though more research is needed with larger, more representative sample size.

423.043 *(Poster)* Interaction of Children with ASD and Their Siblings, Mothers and Friends

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Background: The study of sibling interactions in the context of autism spectrum disorder (ASD) has been a neglected corner (Knott et al., 2007; Bontinck et al., 2018). This is surprising, considering the essential role of siblings in social development (Brody, 2004; Hughes et al., 2006) and the fact that social difficulties are a core characteristic of autism. Recently, it was found that having a typically developing (TD) sibling is associated with better social functioning among children with ASD (Ben-Itzchak, Nachshon & Zachor, 2018). This emphasizes the importance of studying the unique elements characterizing the sibling interactions.

Objectives: To investigate the interaction of children with ASD and their siblings in comparison to their interactions with other close, familiar social partners: mothers and TD-friends.

Methods: Qualitative and quantitative data were collected in a Multiple Case Studies design. Six case studies were performed; at the center of each case was a child with ASD, each was observed interacting with an older TD-sibling, the mother, and with a TD-friend. Friends were recruited according to matching reports of the ASD-children and their mothers and based on predefined criteria. Each dyad was observed in 3 different contexts (a total of 54 videotaped observations). The analysis was done both on a global and a micro-analytic level. Each case study was analyzed as a stand-alone, and further analysis of cross-case comparisons was conducted.

Results: The overall analysis revealed an 'intermediate pattern' in the spatial setting with the siblings: the pattern was very dynamic with the friends; with siblings, the pattern was less dynamic, and with mothers, the least. Similarly, an 'intermediate pattern' was found in the level of scaffolding by the partner: mothers scaffolded the most, and friends the least.

An analysis of variance was performed in order to compare the frequency and type of behaviours of the ASD-children with the three partners. Since the design included repeated measures in a small sample – a bootstrapping re-sampling was used (see table 1). Consistent with the research hypothesis, mothers demonstrated a higher frequency of discourse and pro-social behaviours compared to siblings or friends. As hypothesized, the ASD-children demonstrated a higher frequency of discourse behaviours while interacting with the mothers, compared to their interactions with friends. Contrary to the hypothesis, no significant difference was found in the performance of discourse behaviours by the children with ASD while interacting with their mothers, compared to interacting with siblings.

Results emphasize the investment of the mothers in supporting an intensive and structured interaction, as compared to the unstructured, 'scattered,' un-scaffolded interactions with the friends. Interactions with the friends were more challenging but offered more opportunities for the ASD-children to lead in social play.

Conclusions: The uniqueness of the sibling interaction is in being a '*zone of proximal social-communicational development*' (ZPSCD), where the challenge of interacting with another child is more accessible for a child with ASD. It is suggested that such experience support communication with peers. The findings have theoretical and practical implications regarding the involvement of siblings in social intervention programs.

423.044 *(Poster)* Interventions Addressing Stress Levels in Caregivers of Children with Autism Spectrum Disorder: An Examination of Parental Demographics

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Background: Extensive research studies have identified that parents of children with autism spectrum disorder (ASD) often experience higher levels of psychological stress and lower levels of well-being compared to parents of typically developing children (Abbeduto, et al., 2014; Woodman, 2014) and children with Down syndrome (Dabrowska & Pisula, 2010). Several researchers have investigated the efficacy of cognitive behavior therapy (CBT) in addressing stress levels in caregivers of children with ASD (e.g., see De Paz and Wallander, 2017). However, little is known about the demographic composition of parents who are included in those studies. Understanding demographics of participants included in these intervention studies is crucial in determining disparities for caregivers with diverse backgrounds.

Objectives: The objectives of this study were (1) to learn the ethnic, racial, and educational composition of caregivers included in CBT-based intervention research designed to address stress levels in caregivers of children with ASD; and (2) to compare demographic composition of these participants with those of the United States population.

Methods: Multiple databases were searched to review studies that met the following inclusion criteria: 1) an intervention was delivered to one or both parent caregivers of a child with a primary diagnosis of ASD under the age of 18 years; 2) the intervention was CBT-based, including CBT, Mindfulness, and Acceptance and Commitment Therapy; 3) the study participants were located in United States; 4) the study was published in English, in the United States, in a peer-reviewed journal, and between 2010-2018. Given improvements in research and intervention, focus was given to studies published in the last decade. Literature reviews were assessed for studies meeting inclusionary criteria, but the review article itself was an exclusionary criterion. A total of ten studies met inclusion criteria and were used for this literature review.

Results: Ethnic and racial data were collected on 10 studies with a total of 675 caregivers who participated in CBT-based intervention addressing stress levels in caregivers of children with ASD. A smaller sample of data on maternal education status was also collected (See Table 1 for demographic information of participants). Chi-square analyses demonstrated significant differences in the demographic composition of those included in this research than compared to that of the United States population. Specifically, results (see Table 2) indicated a significant underrepresentation of Caucasian, Native American, and multiracial caregivers. There was also significant underrepresentation of caregivers from lower education backgrounds.

Conclusions: Results indicated that parents from lower educational backgrounds are less likely to participate in interventions addressing stress. Also, an underrepresentation in participation was found of Caucasian, Native American, and multiracial caregivers. The reasons for this underrepresentation are likely to be complex, and factors such location of study (rural versus urban settings), limited knowledge/awareness about research studies in diverse communities, and decreased family resources (e.g., time, transportation) may contribute to decreased participation. Thus, reducing barriers to research participation, increasing education and awareness of available supports and treatments for caregivers, and providing access to such treatment in culturally and linguistically appropriate ways, might be crucial.

423.045 *(Poster)* Life of a Typically Developing Sibling of Individual with Autism: Impact of a Peer Support Group

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Background: Having a person with autism can be challenging for all family members, including the typically developing siblings of the person with autism. In most communities, parents of children with similar conditions have the opportunities to interact while availing services for their child or by participating in parent support groups. However, it is very common for typically developing siblings to be left behind, as there are not enough support groups for typically developing siblings. They go through life feeling 'alone', often resenting their sibling with disability, and not fully understanding the implications of having a brother or a sister with autism. Further, this is of greater concern in low and middle income countries like India, whereby no state support is currently available, and the unspoken cultural expectation is that the typical sibling will care for the autistic sibling once the parents are no more. To understand the experiences of typically developing siblings of individuals with autism, we conducted an Awesome Sibling Meetups (ASM), a peer support programme based on the American based sibling support model called *Sibshops.*

Objectives: This study aimed at highlighting the feelings and emotions felt by the typically developing siblings of children with autism. It further aimed at exploring the impact of the peer support programme on the experience of the typically developing siblings towards their sibling with autism.

Methods: 9 typically developing siblings participated in a peer-support programme at Action for Autism, the National Centre for Autism in India. 12 sessions of 3-4 hours each were conducted over a period of 4 months. The sibling support model *Sibshops* was adapted to the Indian cultural context and was considered a safe place for siblings to share their feelings with other sibling participants. The typically developing siblings as well as their parents were interviewed at the beginning and end of the programme. In addition, activities of the peer-support programmes were designed to capture different emotions and feelings towards the typically developing siblings. These were audio recorded and transcribed. Qualitative analysis was conducted for the same.

Results: Findings from the sibling measures indicated an increase in the knowledge of autism, a decrease in anger/resentful feelings towards autistic siblings as well as the use of more positive coping styles. Further findings indicated a decrease in the emotional conduct, as well as peer problems between the typically developing siblings and those with autism. Parents also reported a decrease in negative behaviours towards the autistic siblings by the typically developing siblings.

Conclusions: This is one of the few studies in a low resource country like India that focuses on typically developing siblings of children with autism. Results support the need for group interventions and controlled evaluation of sibling support groups to improve the mental health functioning of typically developing siblings. The study pointed to further implications for running sibling support groups in low resource countries.

423.046 *(Poster)* Lived Experiences of Siblings of Individuals with an Autism Spectrum Disorder (ASD): Informing the Design of a Stress Management and Resiliency Group Intervention

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Background: Many teen siblings of individuals with autism experience unique stressors that can impact their lives and the lives of other family members. The existing literature on the psycho-social well-being of siblings of individuals with an ASD has presented contradictory findings in that these siblings have the potential to both thrive and/or experience emotional adjustment difficulties while experiencing significant stressors. Factors leading to these disparate outcomes have not yet been identified. There are few studies focused on addressing the psycho-social needs of this population and, to date, an evidence-based mind body resiliency intervention, targeted to their needs, has not been developed.

Objectives: This study was designed to explore the lived experiences of teen siblings of individuals with an ASD as reported by teens and parents. The purpose of the study was to identify common stressors and concerns unique to siblings of individuals with an ASD to modify and adapt a stress management and resiliency group intervention.

Methods: In-depth semi-structured interviews were conducted via videoconferencing, with 8 neurotypical teen siblings (ages 13-17) and 6 parents (do we have mean age or range) of families who had at least one affected child (ages 13-17) and one neurotypical child. Participants were recruited from across the United States and Canada. The interviews were audio-recorded and transcribed. Multidisciplinary research team members coded and analyzed the transcription data using a content analysis approach.

Results: Key stressors and concerns endorsed by neurotypical teen siblings included 1) Wanting to help their sibling with an ASD and not knowing how 2) Reluctance to talk about their sibling with peers 3) Concerns regarding embarrassment and fear of judgment by others if the affected sibling should display maladaptive behavior when out in public 4) Worries about caregiver responsibilities in the future. Core themes which emerged from the parent interviews included: 1) Expectations for typical sibling to watch sibling with ASD, 2) Missing out on events that neurotypical teen is involved in due to needs of family member with ASD 3) Concern about typical sibling not wanting to invite friends over to their home, and 4) Not being able to do group activities together as a family. Both parents and siblings reported significant stress due to the unpredictability of behavior of the individual with an ASD.

Conclusions: The results of this study contribute to the existing literature on the impact and nature of the specific stressors experienced by teen siblings. These data will inform the development of an intervention designed to support siblings of individuals with an ASD. Addressing these concerns in designing the intervention will enhance its relevance to teen siblings of individuals with an ASD. This program will be aimed at building that can help buffer the impact of these stressors, which can have significant implications on peer and familial relationships.

423.047 *(Poster)* Longitudinal Transactional Associations between Child Functioning and Parenting Experiences in Families of Children with Autism

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Background: Raising a child with autism spectrum disorder (ASD) can present unique parenting challenges, as children with ASD have difficulty engaging in reciprocal social interactions and communicating their needs. Parenting and family adaptations may impact developmental outcomes for children with ASD. Further, parents and children can have reciprocal, or transactional influences on each other's behaviors and general functioning over time. Yet, limited work addresses these reciprocal associations in early childhood. Additionally, little attention has been paid to parents' experiences of positive impacts, or the perceptions and experiences that enrich parents' lives as a result of raising a child with a developmental disability.

Objectives: The current study examined longitudinal associations between child functioning (a latent construct comprised of ASD symptoms, communication skills, and social and emotional competencies) and parent-reported negative and positive impacts on family life across early childhood in families of children with ASD. Child functioning, negative impact, and positive impact were each conceptualized as multi-dimensional constructs. The role of social support was examined as a moderator in both sets of relations.

Methods: Data were drawn from a three-wave longitudinal study of 170 children recently diagnosed with ASD (ages 18-33 months at Time 1). Participants from the larger study were included in the current project if mothers responded to a measure of parent negative and positive impact at any study time point. Data were collected once a year over a three-year period. Per self-report, mothers predominantly identified as being non-Latinx White (84%), having a middle to upper class household income (88%), and having completed at least two years of college (79%). Longitudinal latent variable cross-lagged panel analyses were used to model associations between child functioning and parent negative and positive impact. An indicator of each latent construct was used in multiple regression analyses to explore the role of social support as a moderator in the association between child functioning and parent negative and positive impact.

Results: Results indicated that the associations between child functioning and parent negative impact were initially transactional and moved to being parent-driven as children entered preschool-age, with child functioning no longer exerting an effect on parent negative impact. No cross-lagged associations were identified between child functioning and positive impact. Social support did not moderate results.

Conclusions: Findings suggest that interventions aimed at reducing parent negative impacts may carry over to influence developmental outcomes for children with ASD, and that the capacity for reduced parent negative impacts to influence children's outcomes persists into the preschool years. Meanwhile, interventions to directly target social communication skills may have their greatest impact on parent well-being during the toddler years but less impact by the preschool years. The interrelatedness of child functioning and parenting experiences in early childhood lends evidence for strengthening parents' resources and capacities when their children are at an early age, as these pathways may be more malleable and may lead to greater benefits for children with ASD.

423.048 *(Poster)* Maternal Depression Surveillance: Optimizing Clinical Care and Support to Families Enrolled in a Longitudinal Assessment Study from Birth through 30 Months

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Background: Research estimates that 13% of women experience postpartum depression. Additionally, mothers of children with autism often experience higher levels of stress and depressive symptoms than mothers of typically developing children (Abbeduto et al. 2004; Singer, 2006; Zablotsky, Anderson, & Law, 2013). Despite some research regarding correlations between maternal depression and symptoms of autism, few studies have explored how depressive symptoms may impact child bearing decisions after the oldest child receives a diagnosis of autism, quality of life, and potential depressive symptoms related to diagnosis of later born child. (Zablotsky, Anderson, & Law, 2013).

Objectives: 1**.**.Present results from a maternal screening component within a longitudinal research study recruiting pregnant mothers and infants; 2. Describe strategies to clinically address any significant signs of depression identified and refer mothers for appropriate care; and 3. Examine influence of positive screens on study enrollment, attrition and follow through.

Methods: 150 high risk for autism infants and 100 infants at low risk for autism will be recruited. High risk (HR) infants are siblings of children already diagnosed with ASD; low risk (LR) infants have no familial history of ASD. Infants are enrolled at birth and followed through 30 months, with assessments at 12, 21 and 30 months. Mothers enrolled in the study will be administered two screening tools, pre-and-post-partum, to assess general and postpartum depressive symptoms: Edinburgh Postnatal Depression Scale (EPDS; Murray & Cox, 1970) and Patient Health Questionnaire (PHQ-9; Kroenke, Spitzer, & Williams, 2001). Score of 10 or higher indicates possible depression. In addition to total score >10, response to EPDS item 10 and PHQ item 9 (suicidal thoughts) is flagged. Mothers who screen positive on EPDS or PHQ are contacted by a Clinical Care Coordinator and receive support and resources including information about post-partum depression, post-partum support groups, community mental health/therapy referrals or emergency services.

Results: 132 infants have been enrolled to date, 75 HR and 57 LR. The number of mothers who screened positive was higher than anticipated. .18 of study participants (24 mothers) screened positive (+) on EPDS first screen (.20 high risk mothers and .14 LR); 40% of HR mothers (N=6) and .12 of LR mothers (N=1) endorsed item 10 (suicidal thoughts). Two high risk mothers who screened positive on EPDS reported receiving medication for depression during pregnancy.

Conclusions: In this study population, prevalence of depressive symptoms for HR mothers has been found to be much higher than expected (20%) and higher than in the general population. Among LR mothers, the positive screen rate was slightly higher than expected (14%). Longitudinal studies of HR infants should account for these findings and proactively establish mechanisms to assure the well-being of participant families. Maternal depression surveillance may also be helpful in understanding study participation and treatment decisions: to what extent does the presence of depressive symptoms in both HR and LR mothers contribute to study withdrawal or treatment refusal.

423.049 *(Poster)* Measuring the Impact on Parents of an Autism Diagnosis in Their Young Child

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Background: The impact of a child's diagnosis of Autism Spectrum Disorder (ASD) on parents has important implications for a family's wellbeing and adaptation. Understanding the impact of diagnosis may lead to improved outcomes for the child and family.

Objectives: The aim in this study was to develop a measure that will quantify the impact of an ASD diagnosis on parents/caregivers and examine demographic variables that may contribute to this impact.

Methods: The "Impact of Diagnosis Questionnaire" (IDQ) was developed to assess the perceptions of mothers and fathers who had a child diagnosed with ASD (< 6 years old). It was completed by 89 participants (mothers $n = 76$). Exploratory Factor Analysis (EFA) was conducted to determine the underlying factor structure of the IDQ. A series of one-way ANOVAs and independent samples t-tests were also conducted to identify the relationship between demographic variables (e.g., child gender, parent employment status, gestational age, number of autism diagnoses in family) and parents' perceived impact of diagnosis, as measured using the IDQ.

Results: The EFA identified a three-factor structure of the IDQ. The dimensions of impact were defined as 1) Emotional response/distress, 2) Attribution/cause, and 3) Acceptance. The IDQ demonstrated good internal consistency with Cronbach's alpha approaching .80 on each sub-scale: 1) Distress ($\alpha = .77$), 2) Attribution ($\alpha = .79$), and 3) Acceptance ($\alpha = .78$). Parents of male children reported more distress than parents of female children. The presence of other children diagnosed with ASD in the family was related to the impact of diagnosis, such that parents in multiplex families reported greater acceptance whereas parents in simplex families reported greater distress post-diagnosis. Parents of children born preterm reported more distress as a result of the diagnosis compared to parents of children born full-term.

Conclusions: A number of child characteristics were found to be related to parental responses of an early childhood diagnosis of ASD. With this knowledge, we may be able to provide more targeted support and intervention to parents who require it most. Further investigation of the impact of diagnosis on parents may also provide us with a greater understanding about potential protective factors for parental wellbeing post-diagnosis. Future studies should examine the validity of this novel measure.

423.050 *(Poster)* Mother and Father Effects on Child Problem Behaviors in Families with a Child with ASD: A Dyadic Structural Equation Model

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Background: Several studies have examined mother reports of problem behaviors in their children with autism spectrum disorder (ASD). However, few studies have examined the relative contributions of mother and father characteristics on child outcomes, largely due to limited father participation in research. Research testing dyadic models simultaneously examining mother and father effects is also lacking.

Objectives: Describe a sample of mothers and fathers and their children with ASD who were hospitalized in a specialized inpatient psychiatric unit due to problem behaviors. Test a dyadic model examining parenting efficacy as a mediator between parental stress and child problem behaviors for both mothers and fathers.

Methods: Fifty mother and father couples with a child hospitalized in a specialized inpatient psychiatry unit were prospectively enrolled in this study. ASD diagnosis of the child was confirmed by the ADOS-2, administered by a research-reliable examiner, and clinical evaluation with DSM-5 criteria. Both parents completed the Aberrant Behavior Checklist Irritability subscale, Parent Stress Index Short Form 4, and Difficult Behavior Self-efficacy Scale at hospital admission. Due to the high correlation ($л=.76$, $p<001$) between mother and father reports of child problem behaviors, a combined score was created with the average of the two. A variant of the actor-partner interdependence model (APIM) evaluated the effects of parent characteristics on child problem behaviors. Descriptive statistics were conducted using SPSS v.25, and the APIM was tested using AMOS v.25.

Results: Mothers were on average 42 years old (SD=7.3) and fathers were 44 years old (SD=8.2). The majority of parents were married (86%) biological mothers (82%) and biological fathers (76%). The average child age was 13 years (SD=3.7, range 5-19), 82% were male, 98% were Caucasian, and 94% were non-Hispanic/non-Latino. Average nonverbal IQ score was 71 (SD=28.8, range 30-145), and the mean Vineland Adaptive Behavior Scale II composite score and Vineland expressive communication subscale scores were 55 (SD=14.6) and 7 (SD=4.2) respectively. A slight majority completed ADOS-2 modules 1 or 2 (53%) indicating minimally verbal communication status. APIM results indicated mothers' parental stress was a significant predictor of mothers' parenting self-efficacy ($\beta=-.58$, $p\leq0.001$). Fathers' parental stress predicted both their parenting self-efficacy ($\beta=-.64$, $p\leq0.001$) and child problem behaviors ($\beta=.43$, $p\leq.01$). Fathers' parenting self-efficacy partially mediated the relationship between their parental stress and child problem behaviors ($\beta=.32$, $p\leq.04$) (see Figure 1).

Conclusions: Self-efficacy is the belief that one can produce a desired behavior change. For both mothers and fathers, parental stress reduced their parenting self-efficacy, which can reduce their persistence and effectiveness in managing their child's behavior. Interventions that reduce stress in mothers and fathers (such as mindfulness training) may enhance their parenting self-efficacy and subsequently improve child behavior. Surprisingly, fathers' parenting self-efficacy positively predicted child problem behaviors. The fact that only father characteristics predicted child problem behaviors suggests that greater effort should be devoted to collecting data from both parents and evaluating these data using the appropriate dyadic models.

423.051 *(Poster)* Occupational Well-Being and Organizational Outcomes in Registered Behavior Technicians

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Background: One of the largest certified occupational groups providing intervention services to individuals with ASD are Registered Behavior Technicians (RBTs). RBTs are human service professionals, or workers who respond to the needs of people (e.g., doctors, nurses, social workers; Freudenberger, 1974). As human service professionals, RBTs face significant occupational stressors that can be emotionally challenging and reduce occupational well-being (Maslach & Jackson, 1981). Studies repeatedly find that ASD service providers report elevated levels of burnout (e.g., emotional exhaustion; Griffith et al., 2014). Furthermore, the intention to leave one's occupation is particularly high among RBTs. Specifically, 41.6% of RBTs reported they were highly or somewhat likely to leave the occupation (Kazemi et al., 2015). This is significant as the national yearly average for employee turnover across industries is only 17.9% (Boushey & Glynn, 2012). RBT burnout and turnover impacts multiple levels of stakeholders, including individuals with ASD, RBTs, and organizations providing intervention services – yet to date no studies have examined the relation between job burnout and turnover in RBTs.

Objectives: 1) Explore the associations between job resources, job demands, and organizational outcomes (i.e., turnover intention, organizational commitment, and job performance). 2) Examine the relationship between occupational well-being (i.e., burnout and work engagement) and organizational outcomes.

Methods: The sample includes 311 RBTs (M_{age}= 27.71 years, *SD*=7.29) with diverse ethnic/racial backgrounds. Participants were primarily female and held a college degree or higher. Job resources included social resources (i.e., supervision, role clarity), and training satisfaction. Job demands examined included challenging behaviors and low client skill level. Burnout (i.e., negative emotional response to work-related stress) was measured using the Maslach Burnout Inventory. Work engagement (i.e., positive, fulfilling work-related state of mind) was measured by the short version of the Utrecht Work Engagement Scale. Organizational outcomes included turnover intention, organizational commitment, and job performance, which were all measured by self-report questionnaires. Multiple linear regressions were conducted to explore the relationship between occupational well-being and organizational outcomes.

Results: Correlations between job resources, job demands, and organizational outcomes are found in Table 1. Burnout, specifically emotional exhaustion, and work engagement were both significant concurrent predictors of RBT job turnover intention (Table 2). High emotional exhaustion and low work engagement were associated with poor organizational commitment. Low burnout (i.e., high personal accomplishment) was associated with better job performance.

Conclusions: Findings highlight that many job resources, including training and supervision, are associated with key organizational outcomes. Furthermore, burnout and work engagement are related with organizational outcomes, such that poor occupational well-being is related to poor organizational outcomes. Therefore, companies should aim to reduce negative organizational outcomes, such as turnover, by providing support or job resources to RBTs to help alleviate burnout and increase work engagement. By improving occupational well-being and organizational outcomes, there may be positive cascading effects for individuals with ASD receiving intervention services from RBTs.

423.052 *(Poster)* Parent Education and Community Experience (PEaCE): Results from 5 Cycles of Self-Report Questionnaires

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Parent Education and Community Experience (PEaCE): Results from 5 cycles of Self-Report Questionnaires

Background: Parents of children with Autism Spectrum Disorder (ASD) report greater parenting stress, marital distress, and mental health symptomology than parents of typically developing children, as well as parents of children with other types of disabilities (Hayes & Watson, 2013; Karst & Van Hecke, 2012; Dabrowska & Pisula, 2010). Research suggests that social support, parenting self-efficacy, and coping styles moderate the association between autism and parenting stress (Dunn et al., 2001; Kuhn & Carter 2006). Parent support groups in general have been shown to raise awareness, decrease stress, and increase empowerment among participants (Soloman, M., Pistrang, N., Barker, C., 2001). Although many support groups of varying structures exist for parents of children with ASD, little research exists on the mental health outcomes of these groups.

Objectives: The objective of the present study is to determine the impact of a 7-week Parent Education and Support group on the mental health and quality of life of parents of children with ASD.

Methods: Participants were 44 parents, families (i.e. parent dyads) were placed into 5 different cycles. Demographic questionnaires represented a diverse group of individuals with varying backgrounds consisting of Asian/Pacific Islander, Hispanic/Latinx, Middle Eastern, and Caucasian descent. Before the intervention, all parents completed standardized self-report assessment measures of parenting stress, anxiety, depression, marital adjustment, and satisfaction with life. All parents completed these measures again seven weeks later post intervention. The intervention consisted of a seven-week curriculum that incorporated educational components within a discussion-based support group. The curriculum included psycho-education about ASD, exploring strengths and challenges, discussion of resources for families with ASD (e.g. autism friendly hair dressers, dentists, community activities, etc.), navigating public education (e.g. advocacy in schools, Individualized Education Plans, Special Education, etc.), self-care, and coping skills. Parents met weekly with two graduate student clinicians, supervised by a licensed psychologist. Free childcare was provided for all participating parents to allow participation of parents who might otherwise not be able to attend.

Results: Paired samples T-Tests revealed a significant increase in the Service System subscale of the Family Empowerment Scale, and trends for increases on the Family and Community/ Political subscales. Analyses also revealed significant decreases in Pessimism as measured by the Questionnaire on Resources and Stress, as well as a trend for increased Satisfaction with Life after participation in the Parent Education and Support Group.

Conclusions: Trends in the parenting stress, family empowerment, and life satisfaction measures were promising and support the utility of this parenting education and support program.Additionally, parents who have participated in these groups frequently request ongoing support group meetings. The goal for these facilitated parent education and support groups is that parents will build social connections, increase their understanding of their child and how to support him/her, increase their awareness of resources available to them, and build effective coping strategies. It may also be of interest to collect qualitative data from future participants to better understand the impact of participation in this group.

423.053 *(Poster)* Parent Trajectories during Diagnostic Ascertainment in Families of Children with and without Autism Spectrum Disorder

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Background: Parents of children with autism spectrum disorder (ASD) report heightened levels of parenting stress,[1] poorer coping,[2] and lower levels of social support[3] relative to other parents; they also report that their children have a greater negative impact on the family.[4] Limited research has investigated these outcomes over time, among very young children (18-24 months) who have been screened for, and newly diagnosed with, autism, and are members of historically underrepresented and underserved populations (e.g. racial/ethnic minority groups, families with low socioeconomic status).[5-8]

Objectives: The current study explored trajectories of parenting stress, coping, social support, and negative impact on the family over four times points, from initial positive screening for ASD risk. Our research questions were: (1) Among low income, racially/ethnically diverse children with identified risk for autism, are there baseline differences in parenting stress, parent coping, parent social support, and negative family impact between parents of children with ASD compared to parents of children without ASD; and (2) In this same sample, are there differences in stress, coping, social support, and negative family impact trajectories (change over time) between these two groups?

Methods: The current study was a secondary data analyses of data collected as part of an NIMH funded randomized controlled trial of Family Navigationrom 340 parents/guardians of children, aged 15-29 months (*M*=21.54, *SD*=3.48), identified as "at-risk" on the Modified Checklist for Autism in Toddlers Revised with Follow-Up (MCHAT-R/F)[9] during routine screening for ASD across 11 urban pediatric clinics from 2015-2019. Parents reported on their own level of overall parenting stress (Parenting Stress Index – Short Form),[10] ASD-specific parenting stress (Autism Parenting Stress Index),[11] problem-focused coping (Brief COPE),[12] parental social support (Medical Outcome Study-Social Support Survey),[13] and their perception of the child's relative negative impact on the family (The Family Impact Questionnaire).[14] Baseline group mean comparisons were investigated using independent samples t-tests. Generalized estimating equation models were constructed to compare trajectories of parents of children with ASD to parents of children without ASD, while controlling for site, parent ethnicity, and treatment (i.e., the presence of a Family Navigator).

Results: Parents of children with ASD reported a lower level of negative impact on the family compared to parents of children without ASD (*M*=35.45 and 37.11, respectively, F=7.85, *p*=.005); no other statistically significant differences were apparent at baseline. Parents of children with ASD showed a steeper increase in their level of reported APSI (=2.04, *p*=.037) and their use of problem-focused coping strategies (=0.89, *p*=.043) over time compared to parents of children without ASD, when controlling for site, treatment, and ethnicity.

Conclusions: Results indicate that parents of children with ASD begin to experience higher increases in ASD-specific parenting stress, yet also increase their use of problem-focused coping early during the diagnostic process. Thus, it is important to consider how this type of coping may moderate stress in families of children with ASD at the unique time period in which they are going through the process of determining an ASD diagnosis.

423.054 *(Poster)* Parental Health Literacy and Services Use for Young Children with ASD

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Background: Health literacy (HL) is a modifiable capacity that includes parents' abilities to access, process, and use health information and services to make appropriate health decisions for young children. Because autism spectrum disorder (ASD) is complex, parents often face numerous decisions about treatment and services (hereinafter services) for their child's ASD. Their decision-making is further complicated by the many potential services available for ASD with varying evidence levels. It is, therefore, critical to better understand the relationship between HL and services use among parents whose young children have ASD.

Objectives: This study aimed to (1) describe key aspects of parental HL, (2) examine how HL influences ASD services use, and (3) identify HL improvement strategies related to ASD services use from the perspectives of parents whose young children have ASD.

Methods: This study used mixed methods including a telephone-administered survey followed by a video-based focus group. We recruited parents of a young child with ASD enrolled in the Simons Powering Autism Research for Knowledge study from November 2018 to June 2019. We targeted recruitment to 10 states with the lowest high school graduation rates. In total, 82 parents completed the structured survey and 44 of them also completed a focus group (Table 1). Survey items included family sociodemographic characteristics, ASD services use, and parental HL assessed by the Newest Vital Sign. Survey data were analyzed using appropriate statistical tests. The focus group guide contained questions about parents' perspectives on HL, how their HL influenced ASD services use, and strategies to improve HL. Directed content analysis was used to analyze focus group data.

Results: For Aim 1, the following HL aspects were identified: 1) ASD services information is often accessed from multiple sources and varies in quality and utility; 2) approaches to understanding information commonly involves "doing your own research", determining information credibility, and observing the child's response to a given service; and 3) ASD services information may empower parents to pursue services intended to optimize their child's health. Most focus group participants had adequate health literacy (88.6%). For Aim 2, the following themes emerged on HL and ASD services use: HL facilitated educational and behavioral services use, HL was one factor influencing decisions to use psychotropic medication, family support services were most influenced by perceived need and services availability, and parent resources and beliefs were other salient factors influencing ASD services use. Among focus group participants, HL level did not have statistically significant associations with ASD services use (Table 2). For Aim 3, the following themes were identified relating to improvement strategies: increased parent and clinician education on services and tools to facilitate holistic ASD care are needed, services information should be provided to parents throughout the diagnostic odyssey, and greater accessibility may increase parental uptake of scientific ASD services information.

Conclusions: Parental HL plays a role in services use for young children with ASD. Varying parental HL levels should be recognized and better integrated into ASD care, along with recognition that other factors (e.g., parent resources) may influence decision-making.

423.055 *(Poster)* Parentification and Family Relationships, Adjustment, and Caregiving Intentions Among Young Adult Siblings

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Background: Autism Spectrum Disorder (ASD) impacts the entire family system, including typically developing siblings (TDS; Karst & Van Hecke, 2012). Young adulthood (age 18-25) is a critical period for understanding the experiences of TDS because TDS may maintain caregiving roles with siblings rather than the expected decreases in contact during this developmental period (Lindell & Campione-Barr, 2016; Heller & Arnold, 2010). However, TDS may report poor sibling relationships (Orsmond & Seltzer, 2007). Given the potential for TDS to serve in caregiving roles across the lifespan and the risk to sibling relationships during young adulthood, it is critical to understand these processes.

TDS' childhood caregiving roles may influence sibling relationships in young adulthood. During childhood high levels of caregiving for siblings and parents are referred to as sibling-focused and parent-focused parentification respectively (Nuttall et al., 2018). Among young adults, experiences of parent-focused parentification are associated with less intention to provide future caregiving to siblings (Nuttall et al., 2018) and increased depressive symptoms (Tomeny et al., 2017). In contrast, experiences of sibling-focused parentification are associated with positive sibling relationships (Tomeny et al., 2017) and positive sibling relationships likely predict TDS' future involvement with siblings (Bigby, 1998). Furthermore, sibling-focused parentification may also result in positive parent-child relational and adjustment outcomes by freeing up parents to reciprocate TDS' caregiving (Walker & Lee, 1998).

Objectives: We examined TDS' relationships with siblings and parents as potential mediators between parentification experiences and caregiving intentions and adjustment outcomes, hypothesizing that sibling-focused parentification would be associated with more caregiving intention and better adjustment through positive relationships with siblings and parents.

Methods: Study participants were college students age 18 to 25 who self-identified as TDS. Parentification experiences were assessed with the Parentification Inventory (Hooper et al., 2011). Relationships with siblings and with parents were assessed with the Network of Relationships Inventory (Furman & Buhrmester, 1985). Adjustment measures included self-esteem (Rosenberg, 1989) and depressive symptoms (Radloff, 1977). Future intention was assessed with a single ordinal item as in previous studies (Nuttall et al., 2018).

Results: Indirect effects were tested using a Bayesian approach given the ordinal intentions outcome (Muthén et al., 2016). Sibling-focused parentification was associated with increased positive relationships with siblings and increased negative and decreased positive relationships with parents. Positive relationships with siblings with ASD were associated with greater intention to provide future caregiving whereas negative relationships with parents were associated with lesser intention to provide future caregiving. Positive relationships with siblings with ASD mediated the association between sibling-focused parentification and intentions to provide future caregiving to siblings with ASD [95% CI: 0.005, 0.069]. Sibling-focused parentification and sibling and parent relationship quality were not associated with adjustment.

Conclusions: The present study underscores the importance of caregiving experiences and current sibling relationships in understanding young adult typically developing siblings' intentions for continued caregiving involvement with their siblings in adulthood. Findings suggest relational interventions to improve sibling caregiving experiences.

423.056 *(Poster)* Parenting Stress and Related Factors of Preschooler with Autism Spectrum Disorder in Northern Taiwan: A Preliminary Result

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Background: Research shows that parents of children with Autism spectrum disorder (ASD) experience greater stress and other negative health outcomes than parents of typically developing children or children with other disabilities. Parents who have children with ASD, living in the urban area such as Taipei city, are more likely to have high socioeconomic status. Parents often take their children to multiple lessons either in hospitals or clinics because of unique features of National Health Insurance. Therefore, an understanding of parenting stress in children with ASD is needed for family-centered services of early intervention. Hou et al. have reported that Taiwanese mothers of children with ASD showed higher levels of parenting stress and depressive symptoms than parents of children with developmental delay. However, few studies have investigated potential factors that might result in high degree of parenting stress.

Objectives: This study aimed to (1) examine parenting stress in Taiwanese parents of children with ASD; (2) examine parents' demographic, child developmental and behavioral factors potentially relating to parenting stress.

Methods: Preschoolers, living in Northern Taiwan, aged 2.5-5 years with a clinical diagnosis of ASD were recruited in this study. At enrollment, a trained research staff administered the Mullen Scale of Early Learning (MSEL) to assess the children's developmental skills. Primary caregivers were asked to fill out the Child Behavior Checklist for Ages 1.5-5 (CBCL/1.5–5), Parenting Stress Index (PSI), and Social Responsiveness Scale Second-Edition (SRS-2). Father and mother were individually asked to fill out the Parenting Sense of Competence Scale (PSOC). Descriptive statistics were used to analyze demographic data (i.e., parental age and education, weekly time for early intervention and socioeconomic status index). A linear regression analysis with the stepwise method was used for exploring potential factors relating to parental stress.

Results: The present study recruited 19 children with ASD (17 boys and 2 girls, mean age: 47.74 ± 9.93 months). About 61% of caregivers reported high level of PSI total scores. Univariable regression analyses revealed that MSEL expressive language (ß = 1.90), CBCL/1.5-5 total (ß =1.01), SRS-2 total (ß =1.48) and PSOC mother's efficacy scores (ß = -7.46) were each related to PSI total scores (all p's < 0.05) (Table 1). Demographic variables, however, had no significant effects on PSI scores. The preceding significant variables were subsequently introduced into multivariable model using the stepwise regression (Table 2). The higher SRS-2 scores (ß = 1.11, p =0.002) and higher PSOC maternal efficacy scores (ß = -4.68, p = 0.01) were associated with higher parental stress.

Conclusions: Primary caregiver's in Northern Taiwan exhibited higher parental stress. The result showed that child's developmental and behavioral problems, the severity of ASD and parental sense of competence were found to associate with parental stress level, whereas family's socioeconomic status and the total time spent on receiving early intervention services did not. It is necessary to incorporate parents into early intervention programs and to empower parents to develop optimal parenting skills for children with ASD.

423.057 *(Poster)* Parents' Education Levels and Parent-Mediated Intervention Outcomes for Children with Autism

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Background: Sociodemographic factors, including parents' educational background, may influence the style of parent-child interactions or the dynamics of involvement with professionals. Intervention studies have found that involving parents has resulted in improved ability to support child learning, including learning for toddlers with autism. Less clear is whether educational background influences parents' success in promoting learning for toddlers with autism. Early interventionists may face challenges in providing effective guidance for parents to integrate their conceptual learning into daily activities. The Joint Attention Mediated Learning (JAML) intervention is a family-centered, parent-mediated intervention for toddlers with autism for which positive child and parent outcomes were found in previous studies. An important question for parent-mediated intervention is whether providing broad-based conceptual support with parent latitude in activity decisions is effective for parents of different educational backgrounds. The current study explored this question.

Objectives: To examine differences in parent and child outcomes when groups of JAML participants with and without college degrees are compared.

Methods: A total of 30 parent-child dyads from a larger three-site randomized control trial (RCT) of the JAML intervention were included in this study. Toddlers aged 30 months or younger who met ASD criteria were randomly assigned in pairs within sites to experimental or control groups. Intervention Coordinators (ICs) conducted weekly 1-hour home-based sessions with parents for 32 weeks. The ICs facilitated parents' learning of five mediated learning principles: focusing on social interaction (FO), organizing/planning for engagement (OP), encouraging self-reliance (EN), giving meaning and promoting motivation for engagement (GM), and expanding engagement across environments. Each week parents received conceptual guidance on integrating the mediated learning principles to promote developmentally ordered preverbal social communication outcomes. Further, ICs guided parent reflection on their use of the principles by reviewing videos of parent-child interaction.

The Preverbal Joint Attention Measure (PJAM; Schertz) was used to measure children's outcomes and parents' application of mediated learning principles was assessed with the Mediation of Social and Transactional Engagement Measure (MOSTE; Schertz & Horn, 2018). Ten-minute parent-child interaction videos were recorded pre- and post-intervention and three independent observers coded the occurrences of targeted child and parent outcomes for each. Inter-rater reliability was established and maintained between coders (kappa = .85). Parents' education background was categorized into two groups by the presence or absence of a 4-year college degree. A one-way MANOVA was used to analyze group differences for child and parent outcomes.

Results: Neither pre-intervention nor post-intervention differences were found to differ significantly in parents' application of JAML between the two groups, $F(5, 24) = 1.93$, $p = 0.13$, $F(5.24) = 1.73$, $p = 0.17$. Similarly, no significant group differences were found in children's outcomes, $F(3, 26) = 0.66$, $p = 0.58$.

Conclusions: Neither parent nor child outcomes from the JAML intervention were influenced by parents' educational backgrounds. The results suggested that the JAML intervention was effective for parents and toddlers regardless of parent educational backgrounds. Future studies should expand the number of participants and explore whether other sociodemographic factors impact intervention outcomes as well as possible effects over time.

423.058 *(Poster)* Perceptions, Experiences and Needs of Parents of Culturally and Linguistically Diverse Children with Autism: A Scoping Review

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Background: Recent findings show that the estimated percentage of children identified with autism spectrum disorder (ASD) is higher than in previous years. In the USA it is estimated that 1.7% of children are identified with ASD and in the UK approximately 1% of children are identified with ASD. Although ASD occurs in all racial, ethnic, and socioeconomic status groups, children with ASD from diverse backgrounds are consistently underrepresented and underserved.Researchers have reported that African-American and Hispanic populations are less likely to be diagnosed with ASD, often receive the initial diagnosis at later ages, and experience dispatities in access to services in comparison to other racial and ethnic groups. Furthermore, studies have also documented lower participation rates of minorities in research studies of ASD. To date, limited information is available in the literature about the lived experiences and specific needs of culturally and linguistically diverse (CLD) families with children with ASD.

Objectives: The purpose of this study was to explore the perceptions, experiences, and needs of CLD families with children with autism in the USA and the UK. A scoping review was conducted.

Methods: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was used to identify studies for the scoping review. A keyword search was performed in four databases and included all possible combinations of keywords from three groups related to autism, culturally and linguistically diversity, and family. Following screening and careful review for all inclusion criteria 32 studies were identified for the review. Data from all studies were extracted, reliability across researchers were assessed, and thematic analysis was conducted to identify themes related to the experiences and needs of CLD families with children with ASD.

Results: The majority of the identified studies were published after 2016 (n=19) and were conducted in the USA (n=25). In addition, most of the identified studies employed qualitative methodology (n=27) and included the mother as the participant. Four key themes were identified in the analysis of the 32 studies: (a) knowledge of and beliefs about autism, (b) autism and the impact on the family, (c) family experiences of accessing services and support, and (d) perceptions and impact of multilanguage.

Conclusions: Overall, the results indicate that the perceptions of autism by CLD families are influenced by lack of knowledge about autism and cultural, linguistic and religious contexts. The experiences of CLD families included coping with the autism diagnosis and the social stigma associated with autism, and difficulties in accessing services and support. In addition, many CLD families experienced challenges related to the language preference in bilingual environments. Future research needs to investigate the experiences of a wider range of cultural and linguistic communities. There is a need to identify ways for supporting individuals with autism which are sensitive to culture, religion and language and incorporate the CLD group's values and practices. The findings from this scoping review inform implications for policy, research, and practice.

423.059 *(Poster)* Positive Familial Effects of Autism Spectrum Disorders: A Phenomenology of Parents' and Siblings' Shared Experiences

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Background: There is overwhelming evidence of the burden and stress put on families of children identified with an autism spectrum disorder (ASD), yet there is a significant deficit in the literature regarding the positive impacts of ASD. Researchers investigating the effects of ASD report positive impacts in passing, but tend to focus on the prevalence and difficulties associated with the disorder. Effects like increased stress, marital discontentment, and stigmatization are commonly expressed by families, but the growth and joy anecdotally expressed by parents is not often reflected in the literature.

Objectives: Through the lens of Seligman and Darling's (2007) systems approach to childhood disability and in an effort to investigate the positive impacts of having a family member with ASD, I conducted a qualitative transcendental phenomenological study. The purpose of this study was to explore the shared experiences of immediate family members of individuals with ASD by identifying what traits and experiences parents and siblings associate with a positive outcome related to the individual with ASD.

Methods: After receiving IRB and district approval, recruited twelve individuals from seven ethnically diverse families from a North Texas school district's autism program email list. The final sample included six mothers, three fathers, two sisters, and one brother. Upon receiving informed consent, I administered a questionnaire followed by semi-structured interviews, including a picture presentation measure. Questionnaire results were analyzed using Google Form charts and graphs, while interview and picture presentation measures were transcribed, open-coded, analyzed, and triangulated with questionnaire findings to corroborate and give fuller understandings and description to the themes identified.

Results: The process of thematic analysis revealed the themes of (a) identity-centered positives, (b) growth-centered positives, and (c) environmental-centered positives, as the positive effects of having a family member with ASD. It was also clear that many of the positive effects parents attribute to their child's ASD are intellectual in nature as phrases like "increased understanding" and "more awareness" were used throughout interviews. Language level of the affected child was also a significant indictor of certain positive themes; families with a verbal child with ASD shared positive effects of humor and personality more readily than families with a minimally verbal child with ASD, whom were more likely to describe positive impacts of familial closeness and "finding joy in simplicity."

Conclusions: The clearest implication of this research on the field of ASD research is that it fills a significant gap in research investigating the positive effects of individuals with ASD on their family systems. These findings could lead to improved practice within various systems. For professionals and researchers, results are important for interventions and the initial diagnostic process. Families and self-advocates can be encouraged by these findings as they search for their own stories in the anecdotes of the participants. Research that illuminates the qualities individuals with ASD boast can encourage neurodiverse populations to confidently share their talents with the world.

423.060 *(Poster)* Predicting Positive and Negative Aspects of Psychological Wellbeing in Parents of Autistic Children: The Roles of Intolerance of Uncertainty and Coping

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Background: Research has consistently shown that parents of children with autism spectrum disorder (ASD) are more likely to report chronic stress and symptoms of anxiety and depression when compared to parents of typically developing children and children with other psychological or physical conditions. However, a significant proportion of parents does not show elevated affective symptoms, even reporting positive effects of raising a child with ASD. Certain individual characteristics might either put parents at risk or allow them to cope more effectively under the strenuous conditions of raising children with disabilities. Previous research has suggested that higher levels of intolerance of uncertainty (IU) and certain coping styles are associated with higher parental levels of anxiety and depression. However, no research has examined the inter-relationships between coping and IU in predicting anxiety and depression in parents of children with ASD. Further, the influence of these factors on positive aspects of psychological wellbeing remains unexplored.

Objectives: To characterize IU and coping (avoidant and problem solving coping styles) in relation to positive and negative aspects of wellbeing in mothers of children with ASD.

Methods: Fifty mothers of children with ASD (M_{age} = 44.28 years, SD_{age} = 6.58) completed questionnaires assessing anxiety and depression (Hospital Anxiety and Depression Scale [HADS]), positive psychological wellbeing (Oxford Happiness Questionnaire), IU (IU-12 Scale) and avoidant and problem solving coping (Ways of Coping Questionnaire).

Results: Higher use of avoidant coping and higher levels of IU were associated with higher levels of anxiety ($r = .46$, $p = .001$, and $r = .50$, $p < .001$, respectively) and depression ($r = .54$, $p < .001$ and $r = .41$, $p = .003$, respectively) but not positive wellbeing. While higher use of problem solving coping was associated with better positive wellbeing ($r = .42$, $p = .008$), the opposite pattern emerged for depression ($r = -30$, $p = .044$) and no significant association was found for anxiety. A series of regression models showed that 1) IU and avoidant coping were both unique independent predictors of anxiety ($t = 3.21$, $p = .002$, $\beta = .41$ and $t = 2.67$, $p = .01$, $\beta = .34$, respectively), with the full model accounting for 36.1% of variance ($F = 12.45$, $p < .001$); 2) IU, avoidant and problem solving coping were each unique independent predictors of depression ($t = 3.31$, $p = .002$, $\beta = .39$, $t = 3.23$, $p = .002$, $\beta = .38$ and $t = -2.94$, $p = .005$, $\beta = -.33$, respectively), with the full model accounting for 48.2% of variance ($F = 13.32$, $p < .001$); and 3) problem solving coping significantly predicted positive wellbeing ($F = 7.77$, $p = .008$) accounting for 17.4% of variance.

Conclusions: Our study identified unique contribution of different aspects of coping and IU to positive and negative aspects of wellbeing in parents of children with ASD. Identifying such factors is a crucial first step in developing intervention programs to help improve the psychological wellbeing of parents.

423.061 *(Poster)* Promoting Caregiver Integration into Clinical Care and Research across a Large Autism Treatment and Research Network

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Background: The combined Autism Speaks Autism Treatment Network (ATN)/Autism Intervention and Research Network on Physical Health (AIR-P) focuses on the improvement of health and well-being of children with ASD by conducting intervention research, determining and disseminating best practice, and developing resources for families and providers. While parent / family input has been solicited since the start of the network, we have now further extended this involvement to include partnering on all network activities.

Objectives: To increase patient / parent involvement in health care and conduct of research into autism interventions.

Methods: The ATN /AIR-P has a family advisory committee (FAC), with two or more members representing each of the 12 Network clinical sites. Each site has a local FAC that is typically led by the network FAC reps in conjunction with clinical site staff members. In 2017, a self-advocate was also added to the FAC in order to increase the patient voice across Network activities. Over the past three years we have increased the FAC involvement through several initiatives to ensure that there is FAC representation on all Network activities (i.e. committees, workgroups, and research team members). The network FAC has grown from a single voice in 2009 to now comprising over 35 members who are the parents of young children to young adults from multicultural, diverse backgrounds, representing a cross section of parents of individuals diagnosed with ASD, offering a comprehensive view of the issues and treatment needs across the lifespan. After an in-person meeting in 2019 and a training on research, the number of FAC involved in the Scientific Review Committee (SRC) increased from 4 to 15. FAC members participate in identifying external research grants, co-author manuscripts, review research proposals, participate in the development of research protocols, and are key members of the SRC. A panel of FAC members participated in network long-term planning, identifying the primary treatment areas of emphasis for the current five-year plan. Methods used to facilitate and promote FAC participation include a charter and contract to clearly define membership roles, expectations, and payment of stipends for participation in Network activities. Scheduling meetings / conference calls at times convenient to the FAC, hosting one-on-one calls with the FAC reps, and recording meetings are some ways the Network has found to be helpful for engagement. Increased FAC involvement has occurred thanks to active FAC leadership and strong support by Network leadership.

Results: As FAC members have become more integrated in network activities they have provided increasingly focused and pertinent topic areas for advancing care, many of which had not been considered by network clinicians and researchers.

Conclusions: Integration of caregivers and patients into clinical research and health care delivery processes can be successfully achieved with a goal to improve family and patient satisfaction with care. Families are best able to identify those issues of greatest importance to them and addressing these issues can lead to best outcomes.

423.062 *(Poster)* Promoting Translational Research: Assessing Successful Autism Genetic Discoveries from a Patient Perspective

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Background: Patient advocates have long voiced concerns over the need to improve translational aspects of genetics research studies and to engage community members in the research process. Researchers have also noted a paucity of translational research in the genetics field. While the majority of reports recognize the need to place the patient and family at the center of genomic medicine implementation, they only provide recommendations, but not actionable plans for building implementation science frameworks. There is a great need to increase public involvement in genetics research, and develop standardized methods of reporting their engagement; the impact of such involvement may be evaluated by assessing both qualitative and quantitative data. As one path toward addressing these challenges, we have developed AutGO (Autism Genetics Outcomes), an initiative to support broad stakeholder partnerships and advance a new integrated concept called GO (i.e., research approaches that draw on both genetics and clinical outcomes perspectives).

Objectives: One effective way to illustrate the potential product of a GO conceptual framework is through prototype representation; i.e., by identifying research example(s) that illustrate aspects of the GO concept. To do so, we conducted literature review and assessed three successful autism genetic discoveries from the GO perspective.

Methods: Traditionally, outcomes research focuses on identifying and prioritizing patient needs, however, addressing those needs may be beyond the scope of genetics research. This incompatibility has been one of the key obstacles that prevented formation of partnerships between these two disciplines. One solution is to build partnerships based on flexible and mixed methods, such as actionable GO projects. To date, we have accomplished the following: identified inclusion criteria for GO hypotheses, developed a semi-structured literature review protocol to collect stakeholders' perspectives for developing such hypotheses, and identified three autism related prototypes exemplifying a GO concept. Figure 1 summarizes the methodological concept behind our literature review process.

Results: By applying lessons learned from AutGO, we assessed autism genetic findings from a patient perspective. To do so, we evaluated three successful/replicated discoveries (related to *PTEN*, *MET*, and Fragile X genes) from the standpoint of both scientific impact and patient-centeredness. The following elements were distilled: (1) if/how patient and/or parent concerns contributed to the study inception/development process, and (2) if/how they contributed to developing treatments and improving patient health outcomes, and (3) highlight elements included in hypothesis generation, research design, and data evaluation that were key factors in making these discoveries successful. Figure 2 summarizes one prototype.

Conclusions: Such a unique retrospective assessment of the genetic findings will facilitate developing a practical set of recommendations (conceptual framework) for the policy makers, funding agencies, and the research community to further promote designing research protocols that have a higher likelihood of contributing to translational research. Gathering and sharing such dual perspectives could facilitate igniting interest on the topic of making a bridge between outcomes and genetics research in autism, and promote building synergistic frameworks among relevant, but currently disconnected, initiatives that are aiming to increase patient-centeredness.

423.063 *(Poster)* Quality of Life in Mothers and Fathers of Individuals with ASC: Different Patterns of Relationships in a Hungarian Sample

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Background: Parents of individuals with ASC were shown to have a lower overall level of quality of life (QoL) than parents of typically developing individuals and of individuals with other forms of atypical development (Eapen & Guan, 2016). Previous studies did not find significant differences in the levels of the QoL of mothers and fathers (Dardas, 2014), but the potential predictors did not totally overlap in the two groups (Shu, 2009; Dardas, 2015).

Objectives: The main objectives of the present study were to explore: (1) differences between mothers and fathers of individuals with ASC in their QoL and psychological well-being; and (2) the presence of the internationally known relationships between parental QoL and well-being in our sample from Hungary.

Methods: Data were analyzed from groups of parents (mothers and fathers) of 29 individuals with ASC (n = 58, 29 mothers and 29 fathers; mean age 44 years, SD 8.5, range 29-70 years), providing data on 54 male and 4 female individuals with ASC (median age 9.5 years, SD 7.4, range 3 – 38 years). There were no significant differences between parental groups in age and in type of residential settlement. Data were collected via an on-line questionnaire battery, which included the WHO-QoL BREF; the Quality of Life in Autism Questionnaire (QoLA); the Sense of Coherence Questionnaire (SOC); the Parenting Sense of Competence Scale (PSOC); the Depression, Anxiety and Stress Scales (DASS); the Support Dimension Scale (Kopp & Kovacs, 2006) and Social Communication Questionnaire (SCQ) on the offsprings' ASC-relevant behaviors.

Results: We found significantly lower values in case of mothers in autism-related QoL (F=0,646 p=0.008) and tendency-level differences in physical QoL domain (F=9.140 p=0.058) and PSOC total score (F=5.721 p=0.086) of mothers and fathers. The perception of offsprings' social-communication symptoms showed significant differences between parents (F=2.751 p=0.016); fathers rated higher the level of SCQ while mothers perceived more severe difficulties of their child. QoLA-A results of mothers and fathers had significant positive correlation with all domains of BREF and with SOC, PSOC total; and showed negative correlation with DASS domains. In case of mothers, autism-related QoL was strongly positively correlated with Physical QoL (BREF DOM1: R=-0.378 p=0.047) and with parameters of own psychological well-being (SOC, DASS, PSOC) and tendentiously with social supports; while in fathers autism-related QoL was in positive relation with SCQ total of their children (R=0.433 p=0.024), BREF physical and psychological domains, DASS Stress output (R=0.464 p=0.013) and PSOC total (R=-0.375 p=0.049).

Conclusions: Results, coming from the first ASC parental study on the issue in Hungary, are overall in line with previous findings from other countries: mothers seem to have an overall lower QoL than fathers, in relation to the autism of their children; and their various QoL indicators are more related than those of fathers. As a novel aspect, the different patterns of relationships between various QoL indicators in parents raises the possibility that factors influencing the parental perception of their QoL could be different in mothers and fathers - an issue which requires further analysis.

423.064 *(Poster)* Research Participants' Perspectives on a Peer-Coaching Intervention for Parents of Children with Autism

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Background:

Community-partnered approaches are increasingly used in research to increase interventions' feasibility and relevance to the community. Past research has shown success in engaging traditionally underrepresented families of children with autism by partnering with community members who serve as peer coaches that deliver interventions directly to families (Magaña, Lopez, & Machalicek, 2015).

Although studies report including peer coaches' feedback during intervention development and implementation, their perspectives in using the intervention *after* having participated in a study are not well documented. To improve community-implemented interventions, it is important to gain input from both types of research participants – intervention recipients and peer coaches, and to learn from their experience after having used the intervention.

Objectives:

This study examined feedback from peer coaches and intervention recipients to improve a peer-coaching intervention for under-resourced, minority parents of children with autism.

Methods:

Data for this project come from a 12-week pilot of Mind the Gap (MTG), a peer-coaching intervention for under-resourced parents of children with a recent diagnosis of autism who are new to navigating the service system.

To assess the feasibility of MTG, semi-structured interviews were conducted at the end of the pilot with thirteen participants at the four Autism Intervention Research Network on Behavioral Health (AIR-B) sites. Seven were experienced parents of children with autism who received training from the research team and served as peer coaches; six were coaching recipients and predominantly female, Hispanic and fell below the federal poverty level standards.

Open coding of interviews resulted in preliminary codes. Then, two independent coders applied codes to all interviews and reconciled differences through consensus, establishing a final list of themes.

Results:

Both peer coaches and coaching recipients were highly satisfied with the intervention content, coach-parent matching, and flexibility of the intervention that allowed both in-person and phone meetings. Parents especially liked coaches' guidance on who to contact for services, reminders to make calls, and encouragement. While most parents liked the pacing of the intervention, some suggested longer intervention sessions, spaced further out.

Peer coaches noted the importance of in-person meetings in developing personal connections with parents though meetings were sometimes difficult due to distance, traffic, and time. Another challenge was completing datasheets that were too complicated, redundant and hard to fill out while being present with parents. Coaches requested more space to write notes, to better capture families' complex situations. Feedback on technology was mixed.

Conclusions:

Overall, research participants were satisfied with the content, peer-coaching format, and flexibility of MTG. It was clear from interviews that peer coaches highly valued interpersonal relationships with parents they were working with, and sometimes data collection interfered with active listening. Also, as coaches were parents themselves, their limited availability served as a barrier. Future research should prioritize creating easier data collection methods and findings ways to reduce burden for community partners while maintaining research rigor.

423.065 *(Poster)* Rethinking Stakeholder Roles in ASC Early Interventions: Moving from Participants to Engaged Collaborators

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Background: Children with Autism Spectrum Conditions (ASC) experience a variety of challenges, including problems with social communication, cognition, and adaptive skills. Multiple types of early interventions (EI) are available; yet, data about how to select, prioritize, and individualize different intervention approaches for a particular child is absent. Further, there is a clear mismatch between the range of outcomes studied in research, and the outcomes/values described by stakeholders like adults with ASC, caregivers and clinicians. This may reflect the fact that stakeholders have rarely been engaged in discussions about which outcomes and measurement approaches should be used in EI research.

Objectives: The goal of this effort, called Project STEER (**St**akeholders **E**ngaging in **E**arly Intervention **R**esearch) is to develop a sustainable model that puts stakeholders at the center of ASC EI research.

Methods: In its initial year, Project STEER has used a Participatory Action Research approach to develop a research agenda that reflects strategies, measurement, and outcomes relevant to ASC EI stakeholder goals and priorities. Our participatory action approach uses collaborative reflection and systematic data collection to mobilize specific actions; this approach has been particularly well suited for the current project aims given that a lack of collaboration, focus and clearly defined next steps have hampered prior attempts to create a meaningful research agenda in this area. Project STEER stakeholders include adults with ASC, parents of children with ASC, and community-based clinicians/policy makers in Columbus, Ohio and Chicago, Illinois. Across Columbus and Chicago, Project STEER has successfully engaged a total of 34 stakeholders (10 autistic adults, 10 parents of children with ASD, 10 clinicians/policy makers, 4 researchers) in facilitated group meetings to collectively define problems with current approaches to identifying and measuring EI outcomes and jointly identify recommendations that put stakeholder-driven perspectives at the center of the EI research agenda

Results: Project STEER facilitated discussions elucidated several areas that are considered high-priority research topics by stakeholder groups. Themes identified by the groups focus on better support for families, more coordinated and cohesive service delivery systems, increased emphasis on quality of life for the child and family, and consideration of intervention approaches and treatment targets that account for the heterogeneity of ASC. In addition, stakeholders identified a need for more effective and accessible dissemination of research findings, particularly those outlining best practices and evidence-based interventions for young children with and at-risk for ASCs.

Conclusions: Project STEER represents a critical step forward in realigning the research questions and approaches considered and used by researchers with the goals and priorities of stakeholders. The first phase of the project has allowed for identification of topics that stakeholders believe should be at the center of scientific endeavors. Using this information, we will next use Delphi methodology to further refine this collaborative research agenda with a group of stakeholders across the United States. The finalized Project STEER agenda will be disseminated broadly across lay, scientific and policy-focused outlets.

423.066 *(Poster)* Satisfaction with Informal Supports Predicts Resilience in Families of Children with Autism Spectrum Disorder

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Background: Recently, research on families with autism spectrum disorder (ASD) has shifted from a deficits-based model to a more complex and nuanced understanding of adaptation and healthy functioning. For many families, resilience and strength is observed (Gardiner & Iarocci, 2012). While the majority of research on resilience has focused on identifying characteristics of the child with ASD and their caregivers, less research has been dedicated to examining factors and resources that may promote resilience in families. Informal supports may impact resilience by alleviating stress related to caregiving, preventing social isolation, and enhancing overall well-being (Gonza, Ruiz-robledillo, & Andre, 2014). Informal supports for families of children with ASD can take many forms and includes supports from family, friends, as well as other caregivers of children with ASD. By identifying protective factors that are impactful on resilience, professionals working with families of children with ASD can help to build upon these strengths and encourage strategies that promote optimal functioning.

Objectives: To examine the role of informal supports using the Beach Centre Family Quality of Life Scale (FQOL; Hoffman, Marquis, Poston, Summers, & Turnbull, 2006) in predicting resilience in families using the Family Resilience Assessment Scale-ASD (FRAS-ASD; Gardiner, Mâsse, & Iarocci, 2019) controlling for demographic variables (e.g., age, gender, and family income) and child behavioural problems.

Methods: The study is based on data from 174 caregivers of children with ASD between the ages of 2 to 35 (M=11.93, SD=5.85). Caregivers most frequently rated their children's intellectual functioning as 'high average' and their social functioning as 'low average'. Caregivers completed the satisfaction with informal supports domain of the FQOL Scale (e.g., my family members have friends or others who provide support) and the FRAS-ASD. Hierarchical multiple regression analyses were conducted with the FRAS-ASD total score entered as the dependent variable, demographic and child behavioural problems were controlled for in the first step, and satisfaction with informal supports entered as the main predictor variable.

Results: Findings revealed that satisfaction with informal supports significantly predicted family resilience after controlling for age, gender, family income, and child behavioural problems.

Conclusions: Greater satisfaction with informal supports (e.g., feeling that the family has the support from friends and outside help to relieve stress) predicted greater resilience in families of children with ASD. Findings highlight the importance of targeting these informal support networks in services and interventions in order to support families in achieving their optimal well-being.

423.067 *(Poster)* Seeking Help and Support: The Trajectories of Parents with Young Children on the Spectrum

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Background: Parents are usually the main actors in seeking help when concerns are raised about their child's development. In the context of autism, seeking for information and specialized intervention is often described as an emotionally difficult obstacle course entailing a series of tasks that does not always lead to obtaining the desired support (Singh 2016, Nicholas et al. 2016). However, the relations mobilized (or neglected) by parents in this trajectory have never been explored.

Objectives: To analyse parental trajectories in seeking for help and support taking into account the different relationships parents mobilize to obtain information and specialized services for their young child on the autism spectrum. The theoretical framework combines the cultural approach of social networks (Eve 2002) and the concept of trajectory as a social process (Allen et al. 2004, Singh 2016, Strauss 1985).

Methods: Qualitative interviews with a name generator questionnaire were conducted with 18 Quebecer parents with children between 4 and 10 years old (Canada). A qualitative analysis of content by emerging themes was conducted in order to identify the different actions undertaken over time and the different actors mobilized in the parent's support networks.

Results: The results show 4 component phases of the parental trajectories: 1) the entry into the trajectory initiated by the first concerns about to the child's development, 2) the deployment of the trajectory of seeking for help and support mainly oriented towards the diagnosis, 3) the pursuit of the trajectory aimed at obtaining specialized intervention and 4) the stabilization of the trajectory characterized by an anticipation of the child's future needs and the possible extension of the parental trajectory beyond the child's majority.

Different persons have helped or hindered in these phases: 40 types of significant relations were identified in parental trajectories originating from informal (e.g. family, friends, co-workers) and formal (e.g. physician, teacher) support networks.

During the first three phases, the presence of a large number of professionals was often the result of seeking and consulting for information and specialized intervention without obtaining the desired support. A decrease in the relations with family members and friends during the second phase was noted. The perceived quality of the information or support received was not associated with the kind of relationship, except for the other parents of children in the spectrum. In fact, these parents met on self-help groups and social media, were identified in all families as having provided information and helped in obtaining formal services.

Conclusions: In order to better understand the parental trajectories in seeking help for the child, we must take into account all the relationships that are likely to provide them with informal and formal support. The contribution of the community sector in parental trajectories shows the importance of mutual support between parents. This result must be put in the current Quebec context where the public service offer does not yet meet the needs of all children on the spectrum.

423.068 *(Poster)* Sources of Stress for Parents of Children with ASD Studying in Hong Kong Mainstream Schools

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Background: Studies have shown parenting stress for parents of children with autism spectrum disorder ("ASD") are higher than typically developing children or children with other disabilities (Hayes & Watson, 2013). However, previous studies usually employed measurements of parenting stress directly linked to behavior characteristics of the children, e.g. the Parenting Stress Index (Abidin, 1990), less focus has been put on stress induced from the school life of their children, such as homework supervision or relationship with teachers. Previous studies showed parenting stress in typically developing students increased when homework load increased in US (e.g. Pressman et al., 2015). In places like Hong Kong with a competitive education system, helping children to strive better at school could be a top stressor for parents.

Objectives: Understand how school life plays a part in parenting stress for parents of children with ASD in mainstream schools among other stressors, and how the severity of social impairment of their children relates to the stressors.

Methods: This study is part of a territory-wide school support project, "JC A-Connect Jockey Club Autism Support Network", for students with ASD in Hong Kong mainstream primary and secondary school. We asked parents about difficulties they encountered in parenting, then compiled a list of 20 stressors into a Source of Stress checklist ("SOS", See Table 1 for the items). Parents rated the stressors using a 6-point Likert scale to indicate to what extent they agree each was a source of their stress.

Exploratory factor analysis was performed on SOS and the items were classified into six subscales, namely general parenting, child's schoolwork, parent-child relationship, child's school-life related, child's peer relationship, and child's difficult behaviors (See Table 1).

Parents also filled in the Social Responsiveness Scale – Second edition (SRS-2), a rating scale measures social impairments associated with ASD symptoms (Constantino & Gruber, 2012). Correlations on total score of SRS-2 with subscale scores of SOS were examined.

Results: Table 1 shows the mean SOS rating obtained from parents of children with ASD. Items with mean over 3.5 suggest parents in general agreed them to be stressors. Both primary (N=4581) and secondary school (N=1246) parents reported "the future prospect of their child to fit in the society" as the top stressor. "Helping child with homework" and "prepare for exams" is similarly stressful for primary school parents, while for secondary school parents, it is the second top stressor. Child's difficult behaviors and child's peer relationship are also mild stressors. On the other hand, child's school-life and parent-child relationship were less likely to be parents' sources of stress.

Upon inspecting correlations between total score of SRS-2 and item/subscale scores of SOS, the SRS-2 correlated strongly with the top stressor "child's future prospect". However, it correlated mildly with the factors "child's schoolwork" and "school-life" (see table 2)

Conclusions: The top stressors, "child's future prospect" and "child's schoolwork", correlate at different level of strength with the child's ASD symptoms. Results suggest that studying parenting stress focusing on child's behavior characteristics alone may not represent its full picture.

423.069 *(Poster)* Stick to It: Parental Stress, Resilience, and Satisfaction in Caregivers of Children with Autism

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Background: A link between parental stress and children with behavioral problems for families of children with autism spectrum disorder (ASD) and other developmental disabilities has been demonstrated (Hayes & Watson, 2013); the same findings have been replicated in ethnically diverse/minority populations, as well (Valicenti-McDermott et al., 2015). Parents' satisfaction with their parental role has been found to influence their reported feelings of stress (Samadi et al., 2014); yet, the need to better understand parental satisfaction in parents of children with ASD continues to require more scrutiny. There has been a call to better understand the protective factors that help explain resiliency of families of individuals with developmental disabilities (Leone, Dorstyn, & Ward, 2016).

Objectives: This study seeks to answer the call for research which highlights the importance of considering the family system in research on youth with ASD (Schiltz et al., 2018). The current study seeks to understand how parental satisfaction predicts parent stress and the degree to which resiliency and gender impact the relationship.

Methods: Survey and self-report questioners were provided and completed by 101 parents of a child or multiple children diagnosed with autism spectrum disorder in a regional children's hospital in the American Northeast region. The survey was composed of a demographic questionnaire and three self-report scales, including a Resiliency Scale (Sui et al., 2009), Caregiving Stress Appraisal Scale (Abe, 2001), and Parental satisfaction with caring for a child with Developmental Disability Index (Samadi & McConkey, 2014).

Results: To assess how parental stress is a function of multiple risk factors, specifically whether resiliency moderates the relationship between parental satisfaction and parental stress, a hierarchical multiple regression analysis was conducted; gender was entered as a covariate. Gender was not a statistically significant predictor significant, $b = .09$, $t(96) = .49$, $p = .63$. The overall model was statistically significant, $R^2 = .28$, $F(4, 96) = 9.12$, $p < .001$. The interaction between resiliency and parental satisfaction was a significant change to the model $F(1, 96) = 5.17$, $p < .05$, ΔR^2 change = .04. Examination of the interaction plot showed a statistically significant effect for high scorers of resiliency, satisfaction positively predicts parental stress; as satisfaction increases, stress increases, $b = .39$, $t(96) = 1.93$, $p = .05$.

Conclusions: Findings demonstrate the importance of resiliency and parental satisfaction for parents of children with ASD. Parents with higher scores had lower overall levels of parental distress than those with lower of average resiliency levels. Parents of children with ASD may benefit from evidence based interventions focused on increasing resiliency. Behavioral parent training, cognitive behavior therapy third wave cognitive behavioral therapies have been found to have empirical support to increase resiliency in parents (McConnell & Savage, 2015; Öst, 2008). The pattern of higher levels of parental satisfaction predicting higher levels of parenting stress seems counterintuitive but may be suggestive of stress being a derivative of parents placing high importance on their caregiver role and a drive to maintain a standard of care and investment.

423.070 *(Poster)* Stigma Among Latin-American Caregivers: The Impact of Parental Education Level, Severity of ASD Symptoms, and Child Age.

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Background: Caregivers of children with Autism Spectrum Disorder (ASD) report high levels of stigma. Caregivers stigma plays a pivotal role in timely access to service and the quality of services received by children with ASD. Results suggest that stigma negatively correlates with services received and the educational level of mothers. Additional, due to the stigma associated with ASD, caregivers delay seeking services for diagnosis and treatment. Furthermore, higher levels of stigma among caregivers also correlates to more severe symptoms and behavioral problems in children. The majority of data about perceptions of stigma in caregivers of individuals with ASD comes from the body of the research conducted on in English speaking developed countries, with few reports on Latino populations.

Objectives: This study aims to examine the role of parental education level, the severity of ASD symptoms, and child age in the experience of stigma among caregivers from Latin-America countries.

Methods: This study includes data from an online survey of 2817 caregivers from six Latin-America Countries. The survey requested information about family demographics, affected individual characteristics, and parent/caregiver perceptions, including stigma and parent education.

Results: An ANOVA demonstrated significant differences in stigma among the different age groups [F (2, 2436) = 8.698 p<.01]. A post-hoc test revealed that the caregivers of children of ages 0-6 years of age had significant higher mean levels of stigma (M= ,1.86 SD= .61) compared to the 7-17 (M= , 1.76 SD= .60) and the >18 (M= 1.83, SD= .60) groups. A multiple regression analysis demonstrated that the education levels of the primary caregiver only explains 0.4 % of the variance [Adjusted R^2 = F (1, 2432) = 9.63, P<.01A second multiple regression analysis found that intellectual, language, and symptom severity levels combined accounted for only 1.5 % of the variance [R^2 = F (2, 1463) = 9.58, P<.01]. Language level (β =.036, p<.01) and symptom severity level (β = .062, p <0.05), but not level of intellectual functioning (β = -.012, p >.05). were significant predictors of stigma.

Conclusions: Education and severity explain minimal variance of the stigma experienced by Latin-American caregivers. A limiting factor to our study was ceiling effect caused by a highly educated sample (81%% with a high school diploma or higher); which might be a potential confounding variable. Caregivers of preschool age and adult individuals reported higher levels of stigma compared to elementary school children and adults. For the younger children, the impact on receiving a new diagnosis could explain the results. Results could be also related to the unmet needs regarding health and educational services for their children. Understanding how Latino parents perceive stigma across the lifecycle of their children will help in tailoring services, which will result in better outcomes

423.071 *(Poster)* Teaching Transferable Workplace Skills in a Business Setting - a Pilot Program

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Background:

When young adults exit high school or college they don't have the critical skills for success at work which are: motivation and ability to persevere, good social communication skills, problem solving skills, cognitive and emotional adaptability, flexibility, collaboration skills, ability to understand another's perspective, and good emotional regulation. These skills are not natural to people with ASD. Special education does not teach these skills. Furthermore, they are not the focus of conventional "pre-vocational" Medicaid funded programs for people with developmental disabilities.

In order to address this gap, a business-focused model was developed in 2013 by Yes She Can to teach these critical skills in an authentic business environment – a resale store for American Girl dolls. These skills are directly taught using techniques that are effective for ASD. Clinical social workers and psychologists and business managers coach and assess trainees regularly on their achievement of these targeted skills. While the business itself may change based on the demographic and interest of autistic adolescents and adults, the training model may be replicated to increase the number of individuals served and increase the employment rate.

Objectives:

The pilot program has demonstrated that this approach is effective in teaching critical workplace skills, based on rigorous assessments of participants. The objective is to determine if the model can be replicated by other organizations, with published and licensed manuals documenting the curriculum and teaching processes.

Replication of a proven model will speed time to market with minimal risk for new or existing organizations with the outcome of increasing the number of young adults with essential skills for success in the workplace.

Methods:

Yes She Can created their original job skills curriculum applying basic business processes and behaviors that are typical in most work environments, and coaching methods based on proven clinical techniques.

Yes She Can clinical staff created a comprehensive assessment process to measure progress towards trainee acquisition of 32 key skills and the impact of the program on achieving them. Data is collected daily in 4 categories: general business skills, technical skills, communication and emotional regulation skills, and self-advocacy and personal care skills.

Results:

Yes She Can has served 40 trainees in the past 5 years. In 2019, 16 trainees attend 2-3 times/week, have received 3500+ hours of coaching, with 3 staff coaches, 4 volunteer coaches, 3 peer mentors, 2 MSW candidates. Of the 20 participants enrolled since 2017, 7 became employed in jobs in their interest areas, 2 have internships, 6 are enrolled in college, 3 are in the job search.

All participants have been able to apply their new skills to their personal lives, enabling them to increase independence and self-esteem, reducing isolation and depression.

Conclusions:

Starting and implementing a non-traditional job skills program takes creativity, business acumen, and autism expertise. Yes She Can's pilot program is a proven success and should be replicated in other communities. By presenting the program at INSAR 2020, established agencies and potential startups will learn about Yes She Can's success and be inspired to partner for replication.

423.072 *(Poster)* The Cultural Validation of the PEERS Social Skills Program for Ethnically and Linguistically Diverse Families

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Background: Treatment efficacy of the PEERS social skills (SS) program has been demonstrated through significant improvements in social skills, frequency of social engagement, and reduced autism-related deficits in social responsiveness (Laugeson et al., 2015). However, individuals who are Latinx are often not included in such studies (Schohl et al., 2014). In order to have more representative participant samples in SS interventions, researchers must determine ways to adapt SS interventions to be more inclusive and culturally sensitive.

Objectives: This study addressed the following research questions: 1. Are culturally and linguistically diverse parents satisfied with the PEERS program? 2. Do parents find the program valid and useful? 3. What cultural adaptations are necessary for program success?

Methods: Two groups were recruited (1) an active treatment (AT) group and (2) a waitlist control (WLC) group. The AT group contained 7 adolescents (*M* age=13.3, *SD*=2.0) and their parents. Ethnicity included 2 White, 4 Latinx, and 1 biracial participant. Six families primarily spoke English and 1 participant was Spanish-speaking only. Of the 4 English-speaking Latinx, all indicated some level of Spanish language comprehension on the Bidimensional Acculturation Scale (BAS; Marin & Gamba, 1996), suggesting that the group was predominately bilingual. A WLC group contains 8 adolescents (*M* age=13.5 *SD*=2.2) and their parents, 3 White and 5 Latinx families. Parents received post- intervention satisfaction questionnaires; they also participated in semi-structured interviews conducted at two time points post intervention. Data collection from the first group has been completed; the WLC group will be completed in February 2020.

Questionnaires included a general satisfaction survey and a modified Intervention Rating Profile (IRP15; Martiens et al., 1985). Social validity was measured through an interview adapted from the Gresham and Lopez (1996) framework for determining validity from post-intervention interviews.

Results: With regard to research question #1, 100% of parents reported high levels of satisfaction regarding their overall experience and with skills taught during PEERS. In terms of validity, (question #2) all families agreed that the intervention was appropriate for their child's behavior problems and would recommend the intervention to teachers and parents. During open-ended interviews, parents noted that the group felt inclusive, despite language and cultural differences. However, interviews also indicated that cultural adaptations may be necessary (question #3). Latinx parents reported feeling overwhelmed with weekly homework assignments (major component of PEERS) that required them to deviate from what they considered cultural parenting norms (e.g. the program requires adolescents to have get-togethers with same-aged peers, rather than with family). One mother described the experience as "making her feel like she was changing her culture," and having to "overcome the fear of having to parent differently" to avoid limiting her child's growth.

Conclusions: Forthcoming qualitative analyses should reveal additional insight into the dynamics that cultural parenting norms play in an intervention that has been validated primarily with White participants. Future suggestions include adapting portions of the program to allow Latinx families to practice homework assignments with extended family members instead of non-related adolescent peers.

423.073 *(Poster)* The Effect of Resilience and Social Support upon Stress, Anxiety and Depression Among Danish Parents of a Child with Autism

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Background: Parenting a child with autism is associated with specific and general challenges increasing the experience of psychological distress including a higher prevalence of anxiety and depression. High levels of stress, anxiety and depression may further impact family functioning. It is thus important to understand the factors that may help protect against the development of mental health difficulties and which can be targeted in interventions. In a previous study Bitsika and colleagues showed a buffering effect of resilience upon stress, anxiety and depression in parents of a child with autism.

Objectives: The objectives were to investigate the effect of resilience and social support upon stress, anxiety and depression in Danish parents of a child with autism.

Methods: Data was collected as part of a larger longitudinal survey among Danish parents of a child with autism. Zungs self-rating anxiety scale (SAS) and depression scale (SDS) were used to assess anxiety and depression. A SAS total score above 36 or SDS total score above 40 have previously been used as an indicator of a clinically significant level of anxiety or depression respectively. Connor-Davidson Resilience Scale (CD-RISC) was used to assess resilience and the Multidimensional scale of perceived social support (MSPSS) was used to assess the experience of social support. Demographic information was collected on child and family characteristics including parents experience of daily personal stress levels on a scale from one to ten, with 10 indicating a very high level of daily stress.

Results: 849 parents participated in the survey (86% females) with a mean age of 44.88 (SD=6.94) years. Mean total SAS score was 38.89 (SD=10.02) and 56% of the parents met the criteria for a clinically significant level of anxiety. Mean total SDS score was 46.79 (SD=7.54) and 78% of the parents met the criteria for a clinically significant level of depression. The mean of average daily stress was 6.70 (SD=2.38).

The level of daily stress correlated significantly with both SAS (r=.526; p<.000) and SDS (r=.562; p<.000). When controlling for resilience the correlation remained significant for both SAS (r=430; p<.000) and SDS (r=.471; p<.000). However, the correlation was significantly reduced for both SAS (z=2.55; p=.011) and SDS (z=2.54; p=.011). When controlling for the experience of social support the correlation remained significant for both SAS (r=.466; p<.000) and SDS (r=.502; p<.000) and there was no significant change in the correlation for either SAS (z=1.63; p=.103) or SDS (z=1.72; p=.085).

Conclusions: In line with previous studies high levels of anxiety and depression symptoms were found among parents of a child with autism. Replicating the study of Australian parents, resilience was found to buffer the effect upon stress, anxiety and depression. A buffering effect was not found for social support. The results indicate that while the stress associated with parenting a child with autism poses a risk for mental health difficulties, this risk may be reduced by supporting the development of parental resilience. However, it is important to further investigate how these factors may interact over time.

423.074 *(Poster)* The Experiences of Autistic Mothers during Pregnancy and the Postnatal Period

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Background: Research into how autistic women experience the challenges involved in pregnancy, childbirth and parenting is scarce. For autistic women, it is possible that the sensory challenges of pregnancy and childbirth, as well as the social demands of interacting with medical professionals may make the perinatal period additionally challenging. It is therefore important to explore whether autistic women feel that they are receiving the support they need and what adjustments or additional support may be required.

Objectives: The study aimed to explore autistic women's experiences of pregnancy and the postnatal period, in order to identify how autistic women can be best supported during this time.

Methods: An anonymous online survey was completed by 660 non-autistic mothers (mean age 40.61 years (SD = 9.95)) and 529 autistic mothers (mean age 42.43 years (SD = 9.53)). Groups were matched on ethnicity, educational level and number of children. Respondents from both groups were predominantly UK based. Mothers completed questions concerning their experiences of pregnancy, birth and the postnatal period, including their relationships with healthcare professionals, their level of satisfaction with the health care they received and whether they chose to disclose to their autism diagnosis to professionals.

Results: Autistic mothers tended not to disclose their diagnosis to professionals, with 81% not disclosing to their midwife during pregnancy and 93% not disclosing to their health visitor postnatally. Only 23% of autistic mothers felt that their midwives had a good understanding of autism and only 6% of autistic mothers felt that medical professionals understood how autism affected them while giving birth. Autistic mothers were significantly less likely than non-autistic mothers to be satisfied with the health care they received during pregnancy and childbirth, as well as being significantly less likely to feel that medical professionals had an accurate understanding of what they were perceiving physically during childbirth. They were also significantly more likely to feel judged by medical professionals during the postnatal period and significantly more likely to worry that their baby would be taken away from them. Results remained significant after controlling for age, country of residence, income, marital status and the presence of medical and psychiatric conditions.

Conclusions: These findings highlight that autistic mothers are not receiving the support they need during pregnancy, birth and the postnatal period. The findings point towards the need for greater autism understanding among medical and healthcare professionals who work with autistic women during the perinatal period. This is one of the first studies of autistic mothers who are a vulnerable group and whose support needs require further research.

423.075 *(Poster)* The Interaction of Caregiver-Reported Family Functioning and ASD Symptom Severity in Predicting Caregiver Depressive Symptoms

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Background: Previous research has demonstrated that caregivers of children with autism spectrum disorder (ASD) report more stress than caregivers of typically developing children (Keenan, Newman, Gray, & Rinehart, 2016). Further, caregivers of children with elevated autism severity experience increased rates of stress and depressive symptoms (Ingersoll & Hambrick, 2011). Beyond the child's functioning, however, mothers' level of stress predicts maternal depressive symptoms, warranting the investigation of factors contributing to caregiver functioning (Weitlauf, Vehorn, Taylor, & Warren, 2012). Discrepancies between parental perceptions of family functioning, for example, are related to caregiver mental health outcomes, with caregiver disagreement predicting poorer caregiver mental health (Johnson, Frenn, Feetham, & Simpson, 2011).

Objectives: The present study investigated whether caregiver reported depressive symptoms are predicted by child autism symptom severity and whether this relation is moderated by caregiver perceptions of the general functioning of the family.

Methods: One hundred and six caregivers (M_{age} = 41.40, SD_{age} = 5.12, 88% female) of a child with ASD completed a series of questionnaires as part of a larger study. Caregivers reported on their child's ASD symptoms via the Children's Social Behavior Questionnaire (CSBQ; Luteijn et al., 2000), their own depressive symptoms via the Depression, Anxiety, and Stress Scale (DASS; Lovibond & Lovibond, 1995), and family functioning via the short form of the McMaster Family Assessment Device (FAD; Epstein et al., 1983).

Results: The multiple regression analysis explained significant variance when predicting caregiver depressive symptoms, $F(3,102) = 19.39$, $p < .001$, $R^2 = .36$, with family functioning moderating the relation between ASD symptom severity and caregiver depressive symptoms, $B = .18$, $SE = .09$, $p = .04$. When family functioning was reported as moderate to good, no relation between ASD symptom severity and caregiver depressive symptoms emerged, $B = .06$, $SE = .05$, $p = .17$: $B = -.05$, $SE = .07$, $p = .49$, respectively. The relation between ASD symptom severity and caregiver depressive symptoms was significant, however, when family functioning was relatively poor, $B = .18$, $SE = .07$, $p = .02$. Specifically, caregiver depressive symptoms were highest when ASD symptoms were high and family functioning was poor (see Figure 1).

Conclusions: The results of this study demonstrate that poor family functioning may be a specific risk factor for caregiver depressive symptoms, particularly when the child exhibits severe ASD symptoms. These findings suggest that improving functioning within the family unit may serve as a beneficial target for intervention, particularly when aiming to improve caregivers' moods.

423.076 *(Poster)* Timing of Placement and Transition Practices in Primary and Secondary School Transitions of Children with ASD

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Background: Transitioning to new schools is challenging for students with autism spectrum disorder (ASD), due to difficulties managing change, insistence on routines/sameness, and anxiety in unfamiliar settings. Existing transition programs may not address the needs of these students by utilizing effective transition strategies (Nuske, et al. 2018). In particular, concerns about latency of placement within the school year have been raised by community stakeholders, which may affect a team's ability to plan for transition, prepare the child, and coordinate services. "Building Better Bridges" (BBB) seeks to improve the transitions between school systems for students with ASD through parent, student, and teacher-level supports that encourage communication and engagement with school teams, particularly for those in under-resourced communities (e.g., low income; racial/ethnic identities that are under-represented in research).

Objectives: Describe baseline characteristics of participants in the BBB program, gather educator report on current practices, and potentially inform future exploration of associations between these characteristics and latency of placement.

Methods: Participants were recruited into this RCT across four sites of the Autism Intervention Research Network on Behavioral Health: Los Angeles, CA; Sacramento, CA; Philadelphia, PA; and Rochester, NY. We recruited primary caregivers (n = 165) and pre-transition educators (n = 128) of students with ASD transitioning to primary (Kindergarten 55%) or secondary (Middle school 27%; High school 18%) placements. At baseline (during pre-transition school placement), caregivers provided demographics. Educators completed the Information on Transition Practices Questionnaire (ITP), developed to describe current transition practices occurring in educational settings (e.g., meetings, information offered to families, communication between pre- and post-schools). ITP items were obtained through reviews of school transition literature (Nuske et al., 2018). Throughout participation, caregivers reported on when they received information on their child's new school placement.

Results: Caregivers were mostly female (88%), English-speaking (79%), with average household incomes of less than $50,000 a year (76%), and ethnic/racial diversity (41% Hispanic/Latinx; 16% African American/Black). Pre-transition, only 51% of caregivers reported knowing the new school name, and only 4% of caregivers reported knowing the new teacher's name. Families averaged 3 months (*SD* = 2.36 months) between finding out the new school placement and the first day of school (range 0 - 9 months). On the ITP, pre-transition educators reported a mean 28.6% of items as typical transition practices, with the most common practices being to "attend or hold a transition planning meeting," and "maintain communication with the family before a child starts at a new school." Educators completed 25.4% of the items only some of the time, and did not regularly complete 46% of items. The most commonly neglected items were "having a process for assessing the effectiveness of school transitions," and "hav[ing] the receiving teacher visit the current school or classroom before a child transitions."

Conclusions: These data represent a mismatch between effective transition strategies and teacher utilization. School placement information is not always timely, and is often provided when teachers are unavailable to offer transition supports. Variability in placement latency suggests that future research should explore associations among latency and transition outcomes.

423.077 *(Poster)* Training Immigrant Parents of Children with ASD Who Have Limited English Proficiency

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Background: As noted by the National Research Council (2001), parent training is an essential component of successful interventions for children with autism spectrum disorder (ASD). Conventional training procedures often involve verbal instructions and verbal feedback. However, a parent whose first language is a not English might not necessarily speak or understand the language used by the trainer. The probability of this occurring is high, given the increase in people in the US with limited English proficiency. Research suggests that the number of people who reported themselves as being of limited English proficiency increased from 13 to 25.1 million between the years 1990 and 2013 (Zong & Batalova, 2016).

Objectives: The primary aim of the present study was to address the question of how to provide effective parent training in the presence of a language barrier between the trainer and the parent. Specifically, the effectiveness of a video prompting intervention on the fidelity of implementation of immigrant mothers of children with ASD was investigated.

Methods: A multiple baseline design across three mother-child dyads was used. Spanish-speaking, immigrant mothers with limited English proficiency were trained to teach their children with ASD to dress themselves. During baseline, the trainer provided each mother with the visual schedule and terminated the session if the mother performed a step incorrectly. Intervention involved video prompting and role-playing with the trainer. Post-intervention sessions were identical to baseline in that sessions were terminated if the mother performed a step incorrectly. Termination of sessions did not occur during maintenance and follow-up. No verbal feedback was given by the trainer during all sessions across phases.

Results: All mothers reached mastery criterion (i.e., fidelity of implementation was at 100% across two consecutive sessions) during role-plays with their trainers. Average number of trials to criterion was 12.67. Generalization to sessions with their children was observed for two out of three mothers. The third participant could not complete post-intervention sessions due to scheduling conflicts. Treatment gains for mothers who completed post-intervention sessions were maintained during 1- and 4-month follow-ups. Child independence in getting dressed also increased for both children. Social validity was assessed and all mothers rated the intervention to be highly acceptable. Blinded inter-observer agreement was collected for at least 33% of sessions across phases and was at 90% or above across participants. Treatment fidelity was collected for 33% of intervention sessions and was at 98% or above across all participants.

Conclusions: This pilot study suggests that video prompting could potentially mitigate language barriers and successfully teach immigrant mothers with limited English proficiency to use visual schedules and the least-to-most prompt hierarchy to facilitate child independence in dressing. An area for future research is whether a video-based intervention can be delivered via technology without the presence of the English-speaking trainer to increase cost-effectiveness. Another area for future research is to explore how video-based interventions can be used to teach parents with limited English proficiency when a model who speaks their primary language is unable to be found for the creation of the videos.

423.078 *(Poster)* Trends in U.S. Autism Research Funding: Interagency Autism Coordinating Committee Autism Research Portfolio Analysis Report

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Background: In this poster, the Office of Autism Research Coordination (OARC) of the U.S. National Institutes of Health (NIH) will present findings from the upcoming *2017 Interagency Autism Coordinating Committee (IACC) Autism Research Portfolio Analysis Report* that describes autism research investments spanning government and private funders.

OARC/NIH coordinates and manages the IACC, a federal advisory committee composed of federal officials and public stakeholders. The Committee was established by Congress to coordinate federal agency activities and to provide advice to the Secretary of Health and Human Services related to autism spectrum disorder (ASD). The IACC's *Strategic Plan*, created with input from public stakeholders, provides a framework to guide the efforts of U.S. federal agencies and partner organizations to support ASD research. OARC conducts an annual portfolio analysis of U.S. research projects to help guide the IACC's strategic planning efforts and inform the IACC of progress toward implementation of the *Strategic Plan*. The portfolio analysis can also be used by government agencies and non-government organizations to better understand trends in ASD research funding in the U.S.

Objectives: OARC will present findings from its *2017 IACC ASD Research Portfolio Analysis Report*, which reflects the most recent information available on autism research investments made by federal and private funders of ASD research in the U.S.

Methods: Research project data including project description, institution, and funding amount were collected from multiple U.S government and non-government funders of autism research. All projects included in the *Portfolio Analysis* were coded according to the seven research questions and 23 objectives outlined in the *2016-2017 IACC Strategic Plan*. Each of the questions in the *Strategic Plan* address general topic areas that are represented as community-focused questions (e.g., How can I recognize the signs of ASD, and why is early detection so important?). Each question includes three to four broad objectives; there is also one cross-cutting objective on the topic of ASD in females. The data were analyzed in several ways to provide information on the types of research being funded and the research topic areas supported by each funder.

Results: OARC collected U.S. ASD research project data for 2017 and aligned research projects with the 23 objectives in the *Strategic Plan*. The analysis provides an overview of the distribution of research projects and funding across the seven *Strategic Plan* Question areas, analysis of projects across multiple scientific subcategories, a breakdown of federal and non-federal funders' contributions to ASD research investments, geographical distribution of research projects, and trends in research funding over time. The data provide information on the degree to which the objectives and budget recommendations described in the *IACC Strategic Plan* are being met.

Conclusions: These analyses of ASD research funding provide a broad overview of the autism research landscape in the U.S. and the roles of government and non-government funders in supporting ASD research.

423.079 *(Poster)* Understanding Barriers to Minority and Underrepresented Populations' Participation in Autism Research

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Background: Racial, ethnic and socioeconomic disparities are well documented and continue to persist in almost every facet of health (Barrett et al 2017). SPARK (Simons Foundation Autism Research for Knowledge) is an autism research initiative, sponsored by an additional research grant dedicated to reducing persistent racial and ethnic disparities among participants in the study. Surveys were administered to community members and healthcare providers in two children's hospital networks.

Objectives: To better understand the prevalent disparities in autism research participation amongst community stakeholders and healthcare providers of various ethnic and racial backgrounds. More importantly, the study seeks to implement the suggestions obtained from the surveys to improve recruitment efforts and increase participation amongst underrepresented communities.

Methods: IRB approval was obtained to administer surveys to community members and healthcare providers across the SPARK Disparities Sub-Study network. Presently, two SPARK sites (CHOP and UCLA) administered 5 provider surveys and 20 community surveys. Provider survey respondents were of similar race, age, and gender identity (80% were white females aged 35-59) but provided a vast array of services, ranging from social workers to medical doctors, to the autism population in their community.

Community member survey participants varied in nearly every demographic measure captured. Respondents self-identified as 35% Black, 40% Asian, 20% White and 5% Other; 90% female and 10% male. Participants' education and income levels varied from some college to MD/PhD/JD with income ranging from $20,000-34,999 to $200,000. Printed survey forms were distributed and collected for analysis following focus group participation.

Results: Survey results highlighted multiple barriers to autism research participation including knowledge and awareness of the study, logistical barriers, fear of research and mistrust of clinical/research staff. Participants reported their desire of increased incentivization including compensation with Amazon and Prepaid Debit cards. Moreover, community members expressed the need for email communication of research updates and novel findings from SPARK.

All providers also noted the potential benefits of additional incentives such as links to other studies and social/clinical resources at SPARK clinical sites. To better equip providers for participant recruitment, all survey participants suggested clinical sites offer parent workshops in the community, regular provision of promotional materials and periodic SPARK email updates.

Amongst community members, 40% of participants reported feeling "very comfortable" participating in SPARK and 85.7% believe a study like SPARK is beneficial. However, 50% of survey participants do not seek care at the associated SPARK clinical site.

Conclusions: Providers and community members alike shared SPARK participation is beneficial to communities of interest but also perceive the barriers, including mistrust of staff and the need for additional family resources. Providers emphasized the importance of their role in recruitment and their need for more accessible printed materials to be better equipped for study promotion. Addressing these barriers and implementing these suggestions will be critical to increasing participation of underrepresented populations in autism research, specifically in SPARK. Ongoing data collection from all four sites will allow us to make regional comparisons about participation trends in survey responses with a more generalizable sample.

423.080 *(Poster)* Understanding Patients' and Caregivers' Experiences in Autism Spectrum Disorder through Social Media Listening Analysis

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Background: Understanding the unique experiences of children and adolescents with autism spectrum disorder (ASD) and their caregivers is vital to improve their medical care and to support caregivers. Conventional methods to assess patient experience using surveys are limited by biases and may therefore not adequately reflect the challenges of patients and their caregivers. Social media platforms and other internet resources are used by patients and their caregivers to obtain disease-related information, identify healthcare resources, network with fellow patients, and communicate daily-life challenges and experiences online. These resources could provide a more reliable view of the challenges related to ASD.

Objectives: The objective of the present study was therefore to use social media listening (SML) to better understand patients' and caregivers' expectations, challenges and life goals.

Methods: Publically available verbatim in 5 languages (English, French, Italian, Spanish, German) posted by patients, caregivers, healthcare professionals and patients associations between May 2018 and May 2019 on the Web, social networks and other digital media were searched using children or adolescent ASD-related terms.

By using the software Opinion Tracker© and Talkwalker© based on natural language processing (NLP), posts were retrieved by patient- and disease-related keywords to derive a large set of verbatim. The software assessed relevance and excluded duplications. Online content was anonymized, and all relevant global and local laws affecting and relating to the use of social media were aligned with the conduct of this study.

Results: Nearly 2 million posts containing any word, sentence or expression related to children and adolescent ASD were retrieved. Following the automatic sort, a total of 4 000 posts were selected for further analysis by manually reading these verbatim. Most posts were by parents (51.8%) and other caregivers (18.8%), while 8.0% were by individuals with ASD, 8.8% by patients associations and 9.4% by health care professionals (HCPs). Out of the 4 000 verbatim, a total of 504 (US: n=204; Spain: n=75; France: n=75, Germany: n=75; Italy: n=75) were selected for further qualitative assessment and categorizing below:

With regards to ASD, 89% viewed it as a functional variation and 11% as a disability. The main themes of comments were centered on parenthood/education (28%), social acceptance (18%), therapies for autism (15%), schooling (13%), how to relate to persons with ASD (13%), and diagnosis (6%). Most comments (73%) related to parenthood/education were centered around parenthood difficulties, while most comments (47%) on social acceptance were centered on issues of discrimination.

Conclusions: To our knowledge, this is the first time that SML has been used as a method to assess the experiences of children and adolescents with ASD and their caregivers on an international scale. Most comments were centered on parenthood and social acceptance, reflecting the difficulty that parents face and the perceived discrimination and lack of social acceptance that children and adolescents with ASD experience. These results highlight the need to further support caregivers and to increase the understanding and acceptance of the unique capabilities that children and adolescents with ASD hold.

423.081 *(Poster)* Understanding the Emergency Department and in-Patient Hospital Experiences of Autistic Adults

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Background: Autistic people are high users of emergency department (ED) and in-patient hospital services, often seeking care in times of physical or mental health crisis. Research into the experiences of autistic children found communication and sensory challenges are common in hospital settings (Muskat et al., 2015) and that creating "sensory friendly" environments (Wood et al., 2019) and training staff about autism (McGonigle et al., 2014) may be beneficial. However, we know little about the experiences of autistic adults accessing ED and in-patient hospital services and what resources may improve their experiences.

Objectives: We aimed to 1) identify the needs of autistic adults and their supporters when accessing the ED and in-patient hospital services; 2) identify the support needs of hospital staff caring for autistic adults; and 3) understand what resources could improve the hospital experiences of autistic adults.

Methods: We used a community-based participatory research (CBPR) approach, whereby academics and community members serve as equal partners throughout the research process. Team members worked collaboratively to develop study materials, analyze and interpret data, and disseminate project findings. We conducted interviews with 42 participants (see Table 1) in their preferred format (telephone n=14, email n=14, in person n=8, video call n=4, online text-based chat n=2). Verbal interviews were transcribed verbatim. We conducted a thematic analysis using an inductive approach, on a semantic level, and a constructivist paradigm. The academic team members reviewed 10 transcripts and devised an initial coding schema that was discussed with community partners and refined following their input. All interviews were then coded by two members of the academic team to ensure trustworthiness.

Results: Many, but not all, autistic adults reported traumatic hospital experiences and felt that hospital staff were not knowledgeable about autism. Whether or not the autistic adult felt the staff were knowledgeable influenced their decision to disclose their autism diagnosis, with some adults choosing not to disclose due to fear of discrimination. Difficulties with hospital staff not communicating in an accessible manner were common, with staff often deferring communication to a supporter if they were present. Experiences of overload, meltdown and/or shutdown due to sensory sensitivities, and the busy and unfamiliar hospital environment, were also common. Use of accommodations such as earplugs or headphones reportedly improved experiences. Hospital staff stated establishing effective communication with their autistic adult patients was key to providing effective care. Participants provided suggestions for implementing accommodations in hospitals including having a paper-based report outlining the accommodations a particular autistic patient requires that can be handed to hospital staff upon arrival and having information about the patient's accommodation requirements in their electronic health record.

Conclusions: ED and in-patient hospital visits are often challenging for all people, but they may be more so for autistic adults. However, providing individualized accommodations to autistic adult patients during their ED or in-patient hospitals visit could reduce trauma and improve their healthcare experiences. Our next steps are to develop resources based on our findings, and to implement and trail them in multiple ED and in-patient hospital settings.

423.082 *(Poster)* Unveiling the Service Delivery Landscape for Individuals with Autism Spectrum Disorders: Parents' Experiences of Service Navigation within Urban and Rural Areas in Alberta.

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Background: Across their lifespan, children with autism spectrum disorder (ASD) and their families will have multiple needs and thus require finding services from a variety of different sectors. There is limited understanding about how 'navigation' is experienced by families with ASD and how they manage the intersection across ministries and services.

Objectives: As part of a larger study, the aim is to learn how families navigate services and resources and to understand the lived experiences relative to navigation and its impact.

Methods: Using a mixed methods approach surveys and individual and group interviews were conducted in urban and rural areas. NVivo data management and analysis software was used. Content of the navigation experience was identified, including contextual elements that shaped the navigational processes. Analysis was comprised of 1) line-by-line coding, 2) review of codes for textual linkages both within and across transcripts and 3) examination of the emerging categorization of codes in yielding themes. Interrater review of data by leaders in the ASD field verified themes.

Results: Survey as well as individual and group interview data were collected from 44 parents of a child or children with ASD. Findings demonstrate that the search for services across health, education, disability and the social care sectors is fraught with multiple gaps. Parents describe the service delivery landscape as a 'maze' comprised of 'multiple hoops' that involve lengthy paperwork, engaging with multiple people, enduring long waiting times for services, and tirelessly advocating for services that the child with ASD is qualified for and needs. This landscape is further complicated with frequent changes in program and funding eligibility, and parental gaps in awareness of services, and a lack of knowledgeable service providers regarding service access pathways. This has resulted in parents feeling "burnt out" and distrustful of services, and parental worry about whether or not services will be available for their child in the future. To buffer these stressful experiences, parents have relied extensively on their personal skills/resourcefulness (e.g., being proactive) and their social networks accrued throughout their journey of navigating services. Implications of these findings suggest that facilitating the experience of searching for services for parents must move beyond individual capacity-building initiatives.

Conclusions: Systemic processes need to be developed, with continual updating to ensure ongoing and equitable access to services.

423.083 *(Poster)* Use and Benefit of Dyadic Coping for Marital Satisfaction in Parents of Children with Autism

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Background: Parents of children with autism spectrum disorder (ASD) have been found to be at increased risk of experiencing dissatisfying marital relationships (Sim et al., 2016). It is critical to identify the specific couple-level processes that contribute to this risk that could be modified in interventions.

Objectives: The goal of the study was to understand the use and benefit of dyadic coping (defined as the processes used by partners in the face of stress) in parents of children with ASD. The study aims were: 1) compare the self-reported use of *positive* and *negative dyadic coping* in parents of children with ASD versus a comparison group of parents of children without neurodevelopmental disabilities; 2) determine whether *positive* and *negative dyadic coping* mediates the association between level of parenting stress and marital relationship satisfaction.

Methods: In total, 184 couples who had a child with ASD (aged 5 to 12 yrs) and a matched comparison group of 183 couples who have a child without neurodevelopmental disabilities participated in the study (N = 734 parents). Children with ASD had a documented diagnosis of ASD via medical or educational records that included the Autism Diagnostic Observation Schedule. Parents were interviewed about family socio-demographics and separately completed self-report measures on their dyadic coping behaviors, perception of parental stress, and level of marital relationship satisfaction. Dyadic coping was measured using the Dyadic Coping Inventory (Bodenmann, 2008). Marital relationship satisfaction was measured with the Couple's Satisfaction Index (Funke & Rogge, 2007). Parental stress was measured using the Burden Interview (Zarit, Reever, & Bach-Peterson, 1980).

Results: A multivariate analysis of covariance (MANCOVA) indicated a significant difference in dyadic coping between parents of children with ASD and the comparison group parents (F (33, 2124.903) = 10.3788, $p < 0.001$, *Wilks'* $\lambda = .635$, $\eta p2 = .141$). Univariate tests indicated significant group differences in *Positive Dyadic Coping* (F (358) = 10.45, $p < 0.001$) and *Negative Dyadic Coping* (F (358) = 11.12, $p > 0.001$). Multilevel models conducted in Hierarchical Linear Modeling software indicated that both *Positive Dyadic Coping* and *Negative Dyadic Coping* mediated the association between-level of parenting stress and level of marital relationship satisfaction across couples.

Conclusions: Mothers and fathers of children with ASD report using less positive dyadic coping and more negative dyadic coping than parents of children without ASD. Mothers of children with ASD, in particular, reported providing and receiving lower levels of support from their partner as well as taking on more stress responsibility in the relationship than their peers who have children without ASD. D*yadic coping* may be an important couple process that drives the pathway between level of parenting stress and marital relationship dissatisfaction, and thereby a key target for interventions.

423.084 *(Poster)* Use of Stakeholder Focus Groups to Develop Content and Structure of a New Measure of Social Communication for Young Children with Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) show pervasive, often severe deficits in social communication that are a major target of early intervention programs. Sensitively and efficiently tracking both long- and short-term change in early social communication skills is essential in both research and community settings. However, current measures of social communication in ASD suffer from limited sensitivity to change, incomplete content coverage, and high burden of administration (Anagnostou et al., 2015).

Objectives: As part of a larger effort to develop a new parent- and teacher-report measure of social communication in young children with ASD, this study aimed to identify key social communication domains, skills, and behaviors considered most important to parents, teachers, and experts.

Methods: Twenty-one parents, nine teachers, and fourteen expert clinicians participated in a total of seven focus groups regarding their perceptions of social communication challenges and needs in young children (ages 2-6) with ASD. Thematic analysis was used to analyze focus group transcripts and extract themes and subthemes from the groups.

Results: Participants identified challenges with expressive language, receptive language, and social skills. In addition, they noted important differences in social behaviors across contexts and partners, and described ways in which communication challenges and emotion regulation problems compounded and interacted with one another. Respondents also identified strategies for supporting and building social communication skills. Sub-themes included content regarding differences in interactions with adults vs. peers, key deficits in use of expressive communication in flexible and functional ways, and difficulties with understanding and responding to others' emotions.

Conclusions: Parents, teachers, and experts identified a number of key concerns with social communication in young children with ASD. Some identified areas of concern (e.g., interaction between communication and emotion regulation deficits; differences in communication capacities and strategies across settings) are not well represented on existing measures of social communication intended for use in this population. As development and validation of this new measure of social communication continues, focus group content will be integrated during the item development process, including addition of items in areas tapping key areas of divergence between focus group themes and current measure content. This strategy is consistent with best practices in development of patient-reported outcome measures (Food and Drug Administration, 2009) and will likely result in a measure with increased relevance and sensitivity to changes in key areas of social communication related concerns for parents and teachers.

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423.085 *(Poster)* Using Parent Reported Outcomes to Prioritize Quality Improvement Initiatives in the Autism Learning Health Network

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Background: The combined Autism Speaks Autism Treatment Network (ATN)/Autism Intervention and Research Network on Physical Health (AIR-P) is developing an Autism Learning Health Network (ALHN) focused on improving the health and well-being of children with ASD. A Learning Network (LN) integrates research, quality improvement (QI), and clinical care and leads to more rapid integration of successful practices into care. A LN uses rigorous QI methodology to identify aims, drivers of change, and intervention strategies and to measure outcomes. Input from patients, family members, clinicians, and researchers is crucial to this work. ALHN was developed to achieve this goal of transforming and disseminating best practices more rapidly.

Objectives: To determine priority areas to improve the health and quality of life (QoL) of children with Autism Spectrum Disorder (ASD) based on parent-reported concerns.

Methods: Families of children with ASD, clinicians, and researchers participated in a formal QI design process to identify the purpose and goals of ALHN. In the design process, families identified challenging behaviors as the priority target for improvement and a driver of overall health and QoL. Data collection tools were developed to address the aim. Parent-reported outcome (PRO) measures in the form of ALHN-specific questionnaires and standardized assessment tools for behavior (Aberrant Behavior Checklist-ABC) and Quality of Life (QoL; PROMIS measures) are collected to assess and track over time. Families of children, ages 18 months to 17.5 years, enrolled in ALHN through 12 participating clinical sites are provided access to a mobile application (app) and are asked to complete PRO measures at enrollment and over time. Descriptive data regarding the type, frequency, and severity of behavior challenges reported at enrollment for the first 750 children enrolled in ALHN are presented as proportions or means as appropriate. Student's T-test was used to compare differences between genders.

Results: The mean (SD) age of the ~750 children enrolled in ALHN is 8.4 (2.7) years, with 80% male. Challenging behaviors occurred in the past month in 94% of children with 86% of these behaviors described as moderate, severe or extremely severe and with 62% occurring on a daily basis or multiple times / day. Behavioral symptom domains most frequently reported as problematic include Attention Deficit / Hyperactivity Disorder (ADHD) (63%), Irritability (54%), and Anxiety (47%). On the ABC, the mean (SD) scores for the hyperactivity and irritability scales are 18.2(10.5) and 13.9(9.3), respectively, with no statistically significant differences by gender. The mean (SD) score on the PROMIS is 23.5 (3.7), significantly lower than reported general pediatric population means, and similar between genders.

Conclusions: Preliminary findings from ALHN PRO data indicate high rates of challenging behavior and lower than population-average QoL for children enrolled in ALHN, with no significant differences by gender. Parent reported data support prioritization of QI initiatives focusing on the most common drivers of challenging behaviors (ADHD, irritability, anxiety) as an approach to improving behavioral impact and QoL in children with ASD.

423.086 *(Poster)* Using Visual Methodology to Learn about Eating Preferences and Oral Care in Latino Children with and without Autism

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Background: Few children and adolescents meet the current recommendations concerning optimal nutrition guidelines. When race/ethnicity is considered, Latino children eat less healthy than their non-Latino White counterparts. Studies focusing on diet and its relation to oral care in Latino children have been minimally researched. However, this is a key area to focus inquiry, as Latinos disproportionately experience oral health problems when compared to other ethnic groups.

Objectives: Using a photo-based food journal as an inclusive participatory visual research, the primary aim of this study was to explore what Latino parents/caregivers of children with and without Autism Spectrum Disorders (ASD) learn about their child's diet and food habits in relation to their oral health following a visual food journaling activity. As a secondary aim, the study sought to explore whether differences in diet emerged between children with and without Autism.

Methods: Participants were Latino parents/caregivers from 18 families (10 with children with Autism and eight with neurotypical children) who completed a visual food journal and photo elicitation interview. Each family was interviewed twice by the research team. The data for this study was drawn from interview data and a visual food journal completed by the participants between the two interviews. To complete the journals, participants were instructed to take pictures of their child's meals for 3 days of the week, to cover both weekdays and weekends, including the contents of the meal. Each family was empowered to choose the layout of each photo so long as they included photos pertinent to diet and food choices

Results: The process of taking photos and discussing them with the researcher helped to attune the parents to the eating and food habits of their children. The themes that arose were: "Maybe I don't do as well as I thought I did" (Visual methodology (VM) as opportunity to identify areas where the parent wants to improve eating patterns); "He is actually pickier than what I thought" (VM as opportunity to learn more about children's eating patterns); "Food became fun" (VM as means of creating change and encouraging children to try new foods); "At home, we eat better" (VM as opportunity to highlight strengths of family's eating patterns); and "Sugar is the devil" (VM as highlighting the negative impact of consuming too much sugar). Though there did not appear to be major differences between diets of children with ASD and neurotypical children, parents with children with ASD noted how the process of documenting food intake affected their children who were food selective to be slightly more open to trying new foods.

Conclusions: Visual research methodologies, such as photo journaling, are an important strategy to consider to empower participants to be part of the research process and part of the outcomes. The process of taking photos helped Latino parents better situate the barriers, beliefs, and behaviors influencing diet and food consumption in their children within the larger context of relating to their overall oral health.

423.087 *(Poster)* Validation of a Novel Community Disability Stigma Scale Among Parents from WIC Clinics

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Background: Stigma and its presentation differs across socio-demographic groups, and may impact access to care for children with disability. Knowledge about developmental disabilities may differ by socio-demographic category, which may impact community stigma. While there is growing literature with regard to stigma in diverse cultural groups, no validated measures of community disability stigma designed for families living in diverse, low-income communities, who may be at high risk for disability disparities exist.

Objectives: (1) To develop and validate a brief English and Spanish measure of stigma perceived by community members towards children with disabilities and (2) assess variation in community disability stigma by parent demographics and awareness of developmental disabilities, in a sample of low-income families.

Methods: A cross-sectional survey was self-administered to 539 parents at the Supplemental Nutrition Program for Women, Infants, and Children (WIC) in six Oregon counties from July-October 2015. Eligible families had a child aged 2-5 years enrolled in WIC. Surveys were conducted in English or Spanish with bilingual oral administration if needed. Seven questionnaire items assessed perceived disability stigma by people in the participant's community. Items were adapted from the Community Autism Stigma Scale. The questionnaire also included self-reported measures of knowledge about developmental disabilities (e.g., autism) and contact with individuals with developmental disabilities. Child and family sociodemographic characteristics were also assessed. Internal consistency reliability was examined, and structural validity was examined using factor analysis. Nested multivariable linear regression was performed to determine (1) associations of child and family sociodemographic characteristics and (2) additional associations of parent knowledge and contacts related to developmental disabilities with community disability stigma.

Results: 522 parents provided data on the seven disability stigma items and comprised the analytic sample. Most participants were Latinx (58.2%), had lived outside the U.S. (54.6%), had a high school education or less (60.5%), received WIC services in a metropolitan area (89.3%), and knew someone with a developmental disability (55.8%). Based on initial results, two disability stigma items were dropped from subsequent analyses. The remaining five items had reasonable internal consistency (SD=0.76) and performed well in the confirmatory factor analysis (Figure 1). The average score on the 5-item community disability stigma scale was 1.99 (SD=0.7). "People do not know very much about children with disabilities" and "People are uncomfortable around children with disabilities" were the most strongly endorsed items. Multivariable analysis results revealed Latinx (English proficient and Limited English Proficient) parents reported significantly less community disability stigma than white, English proficient parents. Parents who knew one or more individuals with a developmental disability versus those who did not reported higher community disability stigma (Table 1). When adjusting for knowing someone with a disability, Latinx English proficient families, continued to report less community disability stigma than white, English proficient families.

Conclusions: The disability stigma scale demonstrated sound psychometric properties in this diverse, community-based sample suggesting it may be more broadly used and adapted. Latinx families perceived less community disability stigma than other groups, indicating that cultural differences exist in how most low-income families perceive stigma in their communities.

423.088 *(Poster)* Validation of the Parent Empowerment and Efficacy Measure, Taiwan Version in Taiwanese Preschoolers with Autism Spectrum Disorder: Preliminary Results

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Background: The Parent Empowerment and Efficacy Measure (PEEM) is widely used to measure parents' sense of control of capacity to engage confidently with the challenges of being a parent. However, the psychometric properties of the PEEM in Asian populations such as Taiwanese people has not been established. In addition, research shows that primary caregivers of children with Autism Spectrum Disorder (ASD) face emotional and psychological strains, changes in lifestyle, and economic hardship associated with caring for their child. Such distress has been documented to place children at risk for adverse developmental outcomes. Parent's empowerment and efficacy in children with ASD is necessary to be evaluated and addressed.

Objectives: The study aimed to describe the translation of the PEEM to Mandarin Chinese as a Taiwan version, and to examine the psychometric properties of reliability and validity of the PEEM-T among the caregivers of Taiwanese preschoolers with ASD.

Methods: Translated Procedures

We adapted Beaton's (2000) procedures for translating the PEEM into the Taiwan version. These guidelines serve as a template for the translation and cultural adaptation process. The process involves five stages: translation, synthesis, back translation, expert committee review and pretesting.

Data collection and Analysis

The translated version of PEEM was administered to a study sample that comprised 30 Taiwanese parents of preschoolers with ASD and 30 parents of typically developing (TD) preschoolers. Each parent is required to fill up the PEEM-T for two times within a week of interval. The PEEM-T was either sent to the parents through postal service or parents came to our laboratory to complete the questionnaire.

The internal consistency of the PEEM Taiwan version was analyzed by calculating Cronbach's α coefficient. Besides that, the caregivers who completed the second assessment after one week were assessed for the test-retest reliability by calculating the Pearson correlations coefficients.

Results: The PEEM was translated by our team members that fluent both in Chinese and English. The resulting translated versions then was back-translated and compared to the original PEEM. Furthermore, we discussed some of the specific terms with the primary author through e-mail communication to make sure that the items reflected the meanings of original items accurately. The content validity of this measure was then confirmed by an expert meeting. The final version of PEEM-T approved by the author was used to examine reliabilities.

Our preliminary results with a study sample of 19 parents of preschoolers with ASD showed that the PEEM-T exhibited excellent internal consistency that the value of Cronbach's α coefficient was 0.954 ($p < 0.05$). Besides that, the items in two PEEM-T subscales also revealed excellent internal consistency that the value of Cronbach's α coefficient was 0.917 ($p < 0.05$) and 0.922 ($p < 0.05$), respectively. Furthermore, PEEM-T revealed moderate to high degree of test-retest reliability for all items (see Table 1, r=0.475-0.901, all p's < 0.05).

Conclusions: Our preliminary findings revealed PEEM-T is a reliable questionnaire. We will continuously to expand the sample size and test the reliabilities and validities for the translation version.

423.089 *(Poster)* What Researchers Should Know to Maximize Subject Recruitment and Retention

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Background: Many autism studies experience poor or slow recruitment, leading to early termination of the study, and low statistical power to test the questions of interest. Unfortunately there has been little systematic data collection directly from potential study participants on their personal experiences with research and what prevents them from participating in studies. The present study directly assessed autistic individuals and their caregivers to determine which factors affect participation. The sample included those who had participated and those who had never participated. This study, the Autism EXPECT study (Experience of People Enrolled in Clinical Trials), included 31-questions about logistical and personal factors that may affect enrollment in and completion of studies that require in-person visits. The results will be used to create a blueprint for researchers on how to motivate potential participants and engage in effective recruitment and retention strategies.

Objectives:

1. To estimate the frequency of various barriers to research participation among autistic individuals and their families
2. To examine factors associated with endorsing particular barriers and categories of barriers.

Methods: Survey development occurred in multiple stages, including conducting cognitive interviews and focus groups with autistic individuals, caregivers, advocates and researchers. The finalized survey was fielded using the SurveyMonkey Platform and was approved through the University of Pennsylvania IRB. Results were summarized using descriptive statistics and differences between groups estimated using Chi-Square and t-tests.

Results: Data collection is ongoing. To date, 398 autistic individuals or their caregivers provided complete survey information. Three quarters had participated in research before. Of those who had participated in research, commonly-endorsed factors that would increase the likelihood that they would participate in research included: the study will help me or my family (96%); there will be follow up (88%); a coordinator will guide us through visits (85%); and there will be help navigating local service providers (84%).

Of those who had not participated in research, 48% responded that they had not heard of opportunities that would be relevant to them. In general, this group endorsed fewer and often different factors that may motivate them to participate in research than did the other group. Most commonly endorsed motivating factors to participate in research were: the study would help families like mine (96%) and I cared about the research question (89%). Factors like being given access to treatment (30%); being asked by their doctor or teacher (15%); or given a report that could be used for IEP planning (33%) were not endorsed by most.

Conclusions: There were distinct but sometimes overlapping factors that influenced study participation in those that had participated vs. those that had not. The biggest influence to future participation in both groups was personal satisfaction or reward, such as helping their own family or others. Surprisingly, logistical barriers related to factors like hours when studies occurred or availability of parking or childcare were not frequently endorsed These results provide actionable information that researchers and IRB committees can use when designing protocols and determining incentives for families and individuals across the spectrum.

423.090 *(Poster)* When Should Parents Talk with Their Autistic Child about Autism? Insights from Autistic Young Adults

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Background: A large body of literature examines parental interpretations of their child's autism diagnosis. Positive interpretations of autism by parents have been found to lead to desirable parent and child outcomes (Pakenham et al., 2004; Wachtel & Carter, 2008). However, research linking parents' descriptions of autism with their children's understanding of autism and autistic identity development had not been conducted. Autistic adults who learn they are autistic late in life often share a sense of relief associated with knowing their diagnosis; some indicate that they wish they had known earlier.

Objectives: 1. Analyze if parental decisions to disclose/withhold their child's autism diagnosis influence adolescents' perceptions of autism and 2. Evaluate when autistic college students recommend that parents disclose their child's autism diagnosis to the child.

Methods: Adolescent participants (n=15, $Mage$= 16.2) and their mothers were recruited from an informal educational program in NYC. Adolescent participants completed in-person interviews; mothers completed online questionnaires. Autistic college students (n=85, $Mage$=23.88, 50.6% male, 67.1% White, 72.9% undergraduates representing 8 countries and 48 institutions) completed an online survey including the question: "If you had a child with autism, when would you tell them about autism?"

Results: Only participants whose parents disclosed their diagnosis voluntarily (n=6) described strengths (n=3) or neutral differences (n=3) when asked to define autism. All participants who were told about their diagnosis by a parent involuntarily (n=6) or not yet been informed of their diagnosis (n=3) focused solely on challenges associated with autism, compared with a third (n=2) of those whose parents voluntarily disclosed (Table 1).

Autistic college students highlighted the importance of developmental level, particularly self-understanding, as the guiding factor to consider when deciding when to disclose their child's diagnosis. When students specified an age (28.75% of sample), they recommended disclosing during early/middle childhood. An autistic author selected this quote as an example of the open communication that parents should have with their autistic children: "I would never attempt to hide the information, and would treat it in a fully natural way in order to avoid giving the impression that there was any stigma surrounding autism. As they grew older and depending upon fluency of communication, I would casually drop information as it became relevant and answer any questions they might have on the subject."

Conclusions: Data from autistic adolescents suggest that parents deciding to voluntarily disclose their child's autism diagnosis to their child positively impacts their children's perceptions of autism. Data from autistic college students indicates that autistic people feel that the timing of disclosure should be tailored to the child's developmental level, particularly their understanding of themselves and autism. When they did specify a preferred age of disclosure, autistic people tended to recommend disclosure in early childhood. The key recommendation from this research is that parents should explain their child's diagnosis to them in a way that they can understand soon after diagnosis. Future longitudinal research should examine how parental disclosure decisions contribute to autistic identity development over time.

423.091 *(Poster)* 'When You'Re Going to Talk to a Family about Concerns, Your Language Matters': Parent Experience Related to Participating in Prospective Infant Sibling Research

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Background: Little is known about parents' experiences of discussing early signs of ASD in their children with clinicians. It is generally assumed that parents want to be informed about concerns as early as possible, but uncertainty about future implications of concerns may influence parental receptivity. Understanding parental experiences is vital, given growing evidence for the role of parents' feelings of efficacy, and hope in supporting their coping as well as in promoting positive child outcomes. 'Infant sibling' research (i.e., prospective studies of infants with an older sibling with ASD) offers a unique opportunity to explore changes in parental perspectives over time.

Objectives: We used a qualitative approach to better understand factors that influence parental receptiveness to information about early concerns with respect to their infants. Specifically, we asked parents about their experiences of receiving information about their children, what was perceived as helpful vs. unhelpful approaches to information sharing, and recommendations for improvement.

Methods: Eight parents who had completed the Canadian infant sibling study participated in a semi-structured interview. Development of the interview was informed by a focus group with five parents who had participated in infant sibling research (non-overlapping with participants in the current study). The interview was conducted over the phone by an interviewer naïve to the families, and took approximately 60 minutes to complete. Transcriptions of interviews were coded in NVivo 12, using an interpretive description approach, which garners experiential and theoretical understanding of informants' perspectives.

Results: All parents reported that they had been informed about the possibility of receiving unexpected information as a result of participating in infant sibling research. Analyses of parents' study-related experiences informed a conceptual model (Figure) that included three key components: (1) Motivations for participating in the study (e.g., have 'another set of eyes' on child, 'get foot in the door' for supports, helping future families through research), (2) Mitigating factors influencing positive and/or negative experiences (e.g., parent readiness, experience of diagnostic journey with older child) which led to varied outcomes, and (3) Parent responses to these experiences. Parents described that perceived positive experiences (e.g., respectful communication, clear 'presentation of facts', consistency of study, 'unbiased set of eyes') resulted in increased engagement, and parents reported improved outcomes (e.g., earlier detection, diagnosis, access to services). Experiences perceived as more negative (e.g., disagreement about concerns, perceived bias of study staff, study staff unfamiliar with child, ambiguous feedback, unsympathetic feedback) led some parents to disengage from the study, completing only selected assessments or interviews, and losing trust in study staff.

Conclusions: These preliminary findings indicate that language used when sharing concerns is important, but there is no one right way to communicate concerns to families. These findings inform approaches related to sharing early ASD-related developmental concerns in both research and clinical contexts. This work is ultimately aimed at building personalized approaches to sharing concerns with families that meet them 'where they are at' in order to promote positive parental experiences and child outcomes during a potentially overwhelming time.

423.092 *(Poster)* "Mama, Vamos a Informarnos [Mom, We Are Going to Educate Ourselves]": The Many Roles of Typically-Developing Siblings in Low-Income Latino Familie

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Background: Sibling relationships tend to be our longest lasting and most influential (Cicirelli, 1995); however, little is known about these relationships in ethnic and racial minority groups of individuals with a sibling with autism (Lobato et al., 2005). In typically developing siblings, Kao et al (2011) found that Latino siblings were more likely to report having "caregiving" responsibilities in comparison to their European American sibling counterparts, yet little is known about the roles and responsibilities of neurotypical siblings of children with autism.

Objectives: This study aims to understand the roles and responsibilities of neurotypical siblings of children with autism, particularly within underserved/low-income Latino families, who live within Los Angeles County.

Methods: 25 self-identified Latino parents of children with ASD and 3 key informants (community leaders) were interviewed. Participants were recruited using snowball sampling and targeted Facebook advertisements. Criteria for study participation included residence in Los Angeles County, being of Latin American descent, and a parent of a child between the ages of 2 and 10 years with a professional diagnosis of ASD. Enrollment was limited to participants with low socio-economic status (SES) as defined by the U.S. Federal Poverty Guidelines used to determine financial eligibility for federal programs. In addition, key informants were eligible if they worked with low-income, Latino parents of children with autism. Focus groups and interviews were audio-recorded, transcribed verbatim, and independently coded for major conceptual models. Exploratory, qualitative analysis was conducted using a modified grounded theory approach. Six raters coded each transcript to ensure reliability. Data triangulation and methodology triangulation were employed to ensure validity and reliability of data interpretation.

Results: Most parents reported that their neurotypical children actively sought to help and supervise their child with autism. For instance, some mothers would use phrases, such as "little mom" or "*cuidador* (protector)" in reference to their neurotypical child. Monolingual Spanish-speaking mothers often reported relying on their neurotypical children for emotional and informational support as well, especially as it related to seeking out autism-related resources and information. As one mother recalled, "my daughter, the eldest, was always on the computer and [she would say,] 'We are going to educate ourselves. We are going to do this, this, and that.' And there she was, everywhere with me." Many of the monolingual Spanish-speaking mothers also reported turning to their neurotypical children when they needed support with technology, such as in finding ways to translate webpages and how to navigate their mobile technology to find autism related information.

Conclusions: Among low-income Latino families with a child with autism, neurotypical siblings adopt roles as caretakers and advocates for their siblings. They also help their parents navigate autism related services and information, especially information available digitally. Once a child receives an autism diagnosis, parents have access to many support systems and parent-specific resources; however, within Los Angeles County, there remains few services available to support and educate neurotypical siblings. These findings call attention and may promote development and dissemination of sibling-centered services, such as support groups.

423.093 *(Poster)* "Setting Them up for Success": Extension Educator Experiences with Inclusion of Youth with Autism in 4-H

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Background: People with Autism Spectrum Disorder (autism) living in rural communities often have difficulty accessing services compared to those living in higher resource areas. People with autism also face the challenge of un- or underemployment in adulthood and a lack of services to specifically support the transition to independent adulthood. Educational experiences in community settings that provide opportunities for school aged children and adolescents to learn job-related skills may be one way to increase employment for people with autism when they transition to adulthood. Participation in extracurricular activities also provides opportunities to learn social skills, develop relationships, and engage with the community. 4-H, an inclusive community based program that provides real-life educational activities, is well positioned to address the needs of youth with autism in rural communities; however, minimal empirical evidence exists about the implementation and effectiveness of inclusive practices in 4-H programs.

Objectives: To identify barriers to accessing 4-H programs and gaps in support for students participating in 4-H programs

Methods: Two, one-hour focus groups (total N =20) were conducted with Extension Educators from throughout the state of Indiana. Topics of discussion covered: 1) perceived barriers to enrollment for youth with autism; 2) Extension Educator background and training; 3) challenges for Educators and youth related to inclusion; 4) effective inclusion strategies; and 5) areas of additional need and support. Focus group sessions were transcribed and analyzed to extract themes, with a specific focus on existing supports, current challenges, and potential new resources.

Results: All Extension Educators reported working with youth on the spectrum within their programs, including livestock, crafts, public speaking, Junior Leaders, and summer camps. Several of the Extension Educators were also parents of children with autism or other disabilities. Although inclusion of youth with autism was common and encouraged, minimal formal training or resources were provided to Educators. Their training typically occurred on their own or through Educator-to-Educator sharing of resources. Educators reported challenges with working with club leaders and judges who are sometimes resistant to accommodations and with lack of clear communication with parents about their child's needs. Educators also described 4-H as having it's own unique culture that could be difficult for families new to the program to navigate. Suggestions for additional supports included training that Educators could receive and then share with their volunteer/club leaders and materials that focus on how to meet individual needs vs autism specific so participating in 4-H could still be the "one time they are not singled out."

Conclusions: Initial analyses indicate a strong desire from Education Educators to fully include youth on the spectrum within their programs; however, Extension offers minimal formal supports and training to implement inclusive practices. Fully inclusive programming will require buy-in from multiple levels of the 4-H organization, particularly club leaders and judges who work directly with the youth and have demonstrated some resistance to accommodations. Future directions include conducting interviews with club leaders, parents, and youth with autism with the long term goal of developing new training materials that incorporate multiple stakeholder perspectives.

Gastrointestinal (GI)

POSTER SESSION — GASTROINTESTINAL (GI)
424 - Gastrointestinal (GI) Posters

424.001 *(Poster)* A Qualitative Study of Family Experiences with Having a Child with Autism Spectrum Disorder and Co-Occurring Gastrointestinal Symptoms

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Background: Despite the high prevalence of GI symptoms in individuals with ASD, there has been little research aimed at understanding the experiences of individuals with co-occurring ASD and GI symptoms. Qualitative research is a valuable tool for identifying the scope of an issue, capturing the complexities and nuances of human experience, and identifying targets for intervention.

Objectives: We conducted semi-structured interviews to explore parents' perceptions of their and their children's experiences of gastrointestinal symptoms while living with ASD. We sought to 1) understand how parents identify when their child is having GI symptoms or distress, and 2) gain a deeper understanding of the challenges families and individuals with ASD face regarding GI symptoms.

Methods: One-on-one semi-structured interviews were conducted with 12 parents of children with ASD. Parents were also given the option to have their child join the interview. Participants were eligible if they were a parent or primary caregiver of a child with an ASD diagnosis who experienced GI symptoms anytime from the age of 3 to 17. Directed content analysis was conducted using core interview questions to partially inform the identification of themes across interviews following a general inductive approach.

Results: Three themes emerged from qualitative interviews. First, most parents reported that their child did not verbally communicate that they were experiencing GI symptoms or had difficulty expressing the nature of their symptoms. Parents relied on non-GI-specific behaviors (e.g. irritability, sleep issues, aggression) and more obvious signs/symptom (e.g. bloating, gas). Next, GI symptoms were associated with poorer functioning and lower wellbeing of the child and family. The child's GI symptoms affected their ability to attend, stay, and focus in school, as well engage in social or extracurricular activities. Parents reported that the child's GI symptoms affected the temperament of the whole household and in some cases was traumatic. Parents also reported financial stress associated with the child's GI symptoms. Lastly, while some parents reported satisfaction with a particular provider or health care setting, they tended to have negative experiences when seeking medical help for their child's GI symptoms. Common frustrations were the shortage of providers, long wait times, financial and insurance obstacles, and office environments not being accommodating to children with ASD. Parents felt they were not taken seriously due to their child having ASD, or that providers were not adequately trained to treat children with ASD. Some families were turned away from care because of their child's behavior. Parents expressed wanting to find someone who is curious enough to dig deeper and help them find solutions for their child.

Conclusions: These findings stress the importance of better understanding the landscape of GI-related issues in individuals with ASD, including the importance of accurate measurement of symptoms, the association with wellbeing, mental and physical health issues, and access to quality health services. GI symptoms in children with ASD place an incredible toll on the wellness of both the child and also the surrounding family.

424.002 *(Poster)* Gastrointestinal Issues Affect Psychometric Measurements in a Sex-Specific Manner

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Background: Autism Spectrum Disorder (ASD) is currently estimated to affect 1 in 59 children. Although ASD primarily impacts the brain, links with other systems have become increasingly clear—in particular gastrointestinal (GI) issues seem to occur more often in individuals with ASD. Several studies have found strong links between GI symptoms and autism severity in children. Considering the brain and gut functions are closely integrated by a bidirectional communication called the gut-brain axis, the pain and discomfort caused by GI symptoms can understandably worsen behavior and contribute to the severity of the disorder. Furthermore, boys are disproportionately affected by ASD (with an estimated 4:1 male to female ratio). However, little is known about how sex differences in association with GI issues affect cognitive/behavioral outcomes.

Objectives: The objective of this study was to investigate the correlation of GI issues among boys and girls with ASD compared to typically developed (TD) controls in association with psychometric measurements.

Methods: Children (ASD n=245 (male=183, female=64); TD n=210 (male=154, female=56)) in this preliminary investigation are a subset of the Childhood Autism Risk from Genetics and Environment (CHARGE) Study. Cognitive skills were measured using the Mullen Scale of Early Learning (MSEL). The child's adaptive function was evaluated using the Vineland Adaptive Behaviors Scales (VABS). Additionally, the Aberrant Behavior Checklist (ABC) was used to rate inappropriate and maladaptive behaviors. GI issues were assessed using a parental reported questionnaire to determine if abdominal pain, gaseous/bloating, diarrhea, constipation, pain on stooling, blood in stool, and/or blood in vomit were present in the last 3 months. Three-way ANOVA, followed by the Tukey test, was used to determine how psychometric measurements were affected by child's diagnosis, the presence of GI issues and sex.

Results: Children with ASD scored significantly poorer on all MSEL and VABS subscales assessments and had greater inappropriate/maladaptive behaviors on the ABC subscales as compared to TD controls. Additionally, the presence of +GI issues correlated with significant impairments in MSEL and VABS subscales and correlated with increased maladaptive behavior on the ABC compared to individuals without -GI issues. Interestingly, girls with ASD and +GI issues had significant deficits in daily living skills, and overall poorer composite scores on the VABS, as well as trends for decreased socialization, decreased visual reception, and increased social withdrawal compared to ASD girls without -GI issues. Furthermore, ASD girls with +GI issues also had significantly increased inappropriate speech compared to ASD boys without –GI issues. The results for the final presentation will include all eligible children in the CHARGE study.

Conclusions: The results from this subset of CHARGE participants shows that GI issues negatively affect behavioral and neurodevelopmental measurements. In particular, females with +GI issues were more negatively impacted. These results suggest sex-differences may differentially affect the gut-brain axis among individuals with ASD.

424.003 *(Poster)* Integrative miRNA-mRNA Co-Expression Analysis of Right-Sided Colonic Hypomotility in Children with Autism

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Background: Gastrointestinal (GI) symptoms are more common in children with autism spectrum disorder (ASD) compared to typically developing (TD) children. Of the GI symptoms most commonly observed in children with ASD, chronic constipation is reported by parents to be especially problematic. In children with ASD who have sought medical assistance for chronic constipation on a background of colonic inflammation, two clinical trends (phenotypes) were observed based on the children's response to anti-inflammatory therapy: (1) patients who experience remission from constipation while undergoing anti-inflammatory therapy (*fast responders*), and (2) patients who experience recurrent right-side fecal loading while undergoing anti-inflammatory therapy (*slow responders*). In an earlier study we showed that total gene expression derived from right colon biopsies of 35 patients (*15 fast responders, 20 slow responders*), distinguished the fast responders from slow responders.

Objectives: The objective of this study is to further characterize the two ASD subgroups through microRNA (miRNA) and total gene (mRNA) co-expression analysis to identify potential molecular regulators of the atypical constipation phenotype.

Methods: In the original pilot study, heirarchical clustering of the right colon gene expression profiles from 35 patients resulted in two distinct clusters; the separation was based largely on clincal phenotype (*fast* vs *slow* responder; **Figure 1** - left panel). In this follow-up study, miRNA expression profiles were assessed for 12 of the 35 original right colon biopsies (*6 fast responders, 6 slow responders*) and analyzed together with mRNA profiles. Total RNA was quantified using NanoDrop and miRNA expression was assessed based on ~800 known miRNAs using NanoString nCounter SPRINT protocol. Differential expression of miRNA in fast vs. slow responders was determined using nSolver software and miRNA-mRNA co-expression was evaluated using Ingenuity Pathway Analysis (IPA).

Results: We identified 12 significantly differentially expressed miRNAs (p=0.05; **Figure 1** - right panel) between fast and slow responders and 8 of those had been experimentally observed to target 400 unique mRNAs (IPA). IPA co-expression analysis showed that of the 400 mRNA targets (p=0.05), there were 24 mRNAs that overlap with the 1500 total differentially expressed transcripts (DETs) (p=0.01) between slow vs fast responders. Results demonstrate an upregulation of transcripts involved in oxidative phosphorylation, reactive oxygen species and oxidative stress, and a downregulation of oxidative-stress response elements in slow responders that may suggest an overall decreased mitochondrial function in cells.

Conclusions: The central finding of the co-expression analysis was an increased expression of genes involved in mitochondrial dysregulation pathways in slow responders compared to fast responders, resulting from a decreased expression of their respective inhibitory miRNAs. As mitochondrial function contributes to intestinal epithelial cell homeostasis, this dysregulation in the right colon suggests an underlying mechanism to explain atypical motility that is observed in slow responders even after treatment for inflammation.

424.004 *(Poster)* The Gut Microbiome in Youth with Autism Spectrum Disorder Whom the Presented Lower Diversity in Bifidobacterium Spp. and Veillonellaceae Family with Worse Communication and Language Ability

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Background: Gastrointestinal (GI) symptoms are a common comorbidity in patients with autism spectrum disorder (ASD), but the underlying mechanisms are unknown. Many studies have shown alterations in the composition of the fecal flora and metabolic products of the gut microbiome in patients with ASD. Convergent evidence supports that gut microbiota can influence brain development and behavioral phenotypes through the neuroendocrine, neuroma, and autonomic nervous systems. Literature documents an abnormal gut microbiota is associated with ASD. Here, we hypothesized that bidirectional interactions between the central nervous system (CNS) and the gastrointestinal tract (brain-gut axis) and the role of the gut microbiota in the CNS and ASD.

Objectives: This work aimed to discover microbiome- mediated ASD symptoms and identify the potential biomarker for developing a safe and effective treatment for ASD in the future.

Methods: The sample consisted of 56 youths with clinical diagnosis of ASD (aged 4-18 years old) according to the DSM-5 diagnostic criteria. The diagnosis of ASD was further confirmed by the Autism Diagnostic Interview-Revised and Autism Diagnostic Observation interviews. They and their parents also received the psychiatric interview (K-SADS-E) about other diagnoses. Their parents reported their autistic symptoms (SRS, CAST, SCQ), psychopathology (CBCL, SNAP-IV), and social functions/quality of life (SAICA). The participants received neuropsychological functions (CPT, CANTAB) if applicable. The stool samples of all the subjects were collected and prepared for the 16s rRNA amplicon and V3V4 sequencing of microbiome analyses. The statistical analyses were performed by the principal coordinates analysis and random effect model applied to connect the microbiota and behavioral assessments.

Results: We have collected the multi-dimensional data from 56 children with ASD. Based on the microbiome analysis of stool samples collected from 56 children with ASD, we found that children with ASD had a lower abundance of Bifidobacterium spp. and Veillonellaceae family, but a high presence of Bacteroides spp (25.27%) followed by Faecalibacterium prausnitzii (9.6%) as compared to "MicrobiomeDB-HMP I." We found that the Bacteroides and Klebsiella were against each other in ASD children, and worse language/communication ability was associated with a higher percentage of Bacteroides and lower percentage of Klebsiella. We also found the gender effects on alpha diversity that ASD males presented the lower alpha diversity than ASD females. In fecal metabolites, principal coordinates analysis (PCoA) revealed that social behavior deficits might relate to beta diversity.

Conclusions: Our results provide evidence to support the altered gut microbiome in youths with ASD, specifically, lower amount of Bifidobacterium spp. and Veillonellaceae family, but a high presence of Bacteroides spp and Faecalibacterium prausnitzii; and these altered gut microbiomes were associated with some clinical features. Further studies with increased sample size and advanced analysis combining neuropsychological and neuroimage measures are warranted.

Gastrointestinal (GI) / Immunology

ORAL SESSION — **GASTROINTESTINAL (GI) / IMMUNOLOGY**
316 - Understanding Gastrointestinal and Immune Symptoms, and their Interactions

316.001 *(Oral)* Identifying Factors That Alter the Gut Microbiome and Affect Associated Gastrointestinal Symptoms in Autism Spectrum Disorder

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Background: The microbiome-gut-brain axis has become a compelling area of investigation in autism spectrum disorder (ASD), specifically in the pediatric population where the microbiome is dynamically developing. Chronic gastrointestinal (GI) symptoms remain a significant co-morbidity in ASD, with implications for behavioral challenges and quality of life in children and adults. Microbially-mediated therapies have shown promise for the treatment of GI symptoms in both pre-clinical models of ASD and in open-label trials, and the baseline functional gut microbiome may prove to be an objective indicator of which individuals would benefit from these types of interventions. However, a multitude of confounders have been identified that have contributed to the discordance of findings from multiple studies of the gut microbiome in ASD.

Objectives: This presentation will focus on the identification of clinical factors that are important considerations when evaluating microbiome and metabolome data. Using the extensive data obtained from a large, well-controlled pediatric cohort (including children with and without ASD, with and without GI issues, and unaffected siblings), the effects of dietary preferences, medication regimens, behavioral characteristics, and therapeutic options will be discussed.

Methods: Previously collected data, including detailed clinical history, several behavioral surveys, and diaries (stooling pattern, diet, and GI symptoms) from a total of 300 children (autistic and typically developing (TD)) recruited across the United States has been integrated with stool-based laboratory data that includes microbiome (bacterial and fungal), metabolome, metaproteome, and metagenomic (whole genome sequencing) characterization. Beyond the evaluation of the larger cohort, serial samples were evaluated following antibiotic and probiotic administration (separately) in two pilot studies. Dietary differences were also explored with regard to the level of processed food consumption, dietary variety, and in comparison with participants from a residential facility that employs nutritional intervention.

Results: The presence of GI symptoms was significantly ($p<0.05$) associated with specific behavioral patterns, with the strongest associations to higher scores on the Sensory Profile-2 and Repetitive Behavior Scale-Revised. As expected, a variety of microbes and metabolites correlated with behavioral variables associated with GI symptoms. Increased GI and behavioral scores were observed in the ASD+GI group compared to the TD+GI group even when on the same ultra-processed food diet. Participants from the residential facility had a mainly unprocessed food diet compared to their peers and also showed improved GI and behavior scores as well as microbiome and metabolome differences compared to an age-matched subset.

Conclusions: Based on our large comprehensive study, there is no single microbe or group of microbes associated with a diagnosis of ASD. This is likely due to the inherent heterogeneity within the single diagnostic code of autism spectrum disorder, and moving forward, it is vital that the clinical characteristics that comprise complex phenotypes in ASD be considered when stratifying cohorts. Diet, age, behavioral and GI profiles, and medications all play crucial roles in shaping the functional microbiome. Significant efforts are still needed in the investigation of the microbiome-gut-brain axis in ASD, especially in adults as almost all research in this area has been focused on the pediatric population.

316.002 *(Oral)* CD8+ T Lymphocyte Numbers Are Greater in Colonic Tissue from GI-Symptomatic Children with Autism Compared to Controls

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Background: Gastrointestinal (GI) problems are more common in children with autism spectrum disorder (ASD) than in typically developing (TD) children. Moreover, many children with ASD present with GI symptoms suggestive of an inflammatory bowel disease-like (IBD-like) condition. However, following investigative ileocolonoscopy with biopsy, conventional histology with hematoxylin and eosin (H&E) staining often does not reveal significant inflammatory infiltrate. Using immunohistochemistry, an earlier study reported an increase in cytotoxic T lymphocyte (CD8+) cell density and intraepithelial lymphocyte numbers in children with ASD and GI symptoms that was disproportionate to the inflammation seen on routine histologic evaluation, indicative of a distinct lymphocytic colitis.

Objectives: The goal of this study was to investigate this finding further by comparing levels of CD8, a cytotoxic T cell and gut inflammation marker, in colonic biopsy samples from GI-symptomatic children with ASD, with and without a histological finding of inflammation, compared to TD children either without colonic inflammation ('control') or with Crohn's disease.

Methods: Biopsies from the right colon were obtained via colonoscopy from children with ASD and from TD children representing 4 groups: (1) ASD with inflammation in the right colon on routine H&E stain, (2) ASD without colonic inflammation on routine H&E stain, (3) TD without colonic inflammation on routine H&E stain and, (4) TD with Crohn's disease (CD) on routine H&E stain. Immunohistochemistry staining was performed on thin sections using mouse anti-human CD8 antibody (1:750) followed by biotinylated anti-mouse antibody (1:300). Next, a peroxidase kit reagent (Vector, #PK 7100) was added, followed by the addition of ImmPACT DAB peroxidase (HRP) substrate. Samples were observed under the light microscope until the brown CD8 color stain became apparent (usually ~1 minute) and the reaction was immediately stopped by submerging the tissue slide in water. Tissues stained with secondary antibody *only* served as the negative control. For CD8+ T cell quantitation, slides were scanned using a Hamamatsu scanner and the scanned images were analyzed with Visiopharm software using specific custom apps developed in-house.

Results: Preliminary immunohistochemical analysis using a CD8-specific antibody revealed a range of CD8+ cells from 118 (± 48) to 184 ((± 70) between the four groups (**Figure 1**). While group means differed, the lone statistically significant difference was between group 1 (ASD with colonic inflammation) and group 3 (TD 'control') ($P=0.0088$).

Conclusions: Preliminary data suggests three under-recognized histologic inflammatory observations in ASD-associated colitis. First, CD8+ cells are present in concentrations significantly higher in the GI symptomatic ASD colon compared to normal colonic mucosal tissue. This confirms a pathologic presence of mucosal CD8+ as described earlier (Furlano 2001). Second, this CD8 colonic mucosal inflammatory presence was greater than that seen in CD. Third, even mucosal tissue without cellular infiltrate on routine H&E had elevated CD8 presence as compared to controls, approaching statistical significance. All three of these cellular inflammatory observations are in accord with numerous publications describing the pro-inflammatory cytokine presence in both GI mucosa and peripheral blood in ASD, and our own clinical observation of improved GI symptoms following treatment with anti-inflammatory agents.

316.003 *(Oral)* The Relationship between Gastrointestinal Symptoms and Gastrointestinal Polygenic Risk Scores Among Children with and without Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) are reported to have a greater prevalence of gastrointestinal (GI) illnesses and symptoms than children without ASD. Identification of specific risk factors related to increased GI symptoms in children with ASD may inform prevention and treatment strategies.

Objectives: We sought to test whether polygenic risk scores (PRS) using common genetic risk variants for 3 gastrointestinal (GI) conditions: Crohn's disease (CD), ulcerative colitis (UC) and inflammatory bowel disease (IBD) were related to any of 9 co-occurring GI symptoms, such as diarrhea or constipation, in children with and without ASD, and whether the GI condition PRS liability differs between children with and without ASD.

Methods: We used data from phase 1 of the Study to Explore Early Development (SEED), a multi-site, case-control study of children 2-5 years of age born between 2003 and 2006 (589 with ASD, 725 controls without ASD). Using publicly available genome-wide association study (GWAS) consortia results for the above 3 GI conditions, we computed a PRS for each condition for each SEED participant to capture genetic liability for GI condition risk. Logistic regression models, adjusted for genetic ancestry, were used to estimate the association between standardized GI condition PRS values and (dichotomous) GI symptoms in typically developing children to assess performance of the GI condition PRS in the SEED sample. The same logistic regression was then run among children with ASD to compare whether GI condition PRS performance is similar in ASD. Finally, we estimated associations between odds of ASD and standardized GI condition PRS via logistic regression, adjusted for 10 genetic ancestry principal components.

Results: Among control children, we observed increased odds of diarrhea, gas, loose stools, and loose stools with alternating constipation for each 1 SD increase in UC-PRS adjusted odds ratio (aOR) diarrhea: 4.55 (95% (confidence interval) CI: 1.55-18.20); aOR gas: 1.81 (95% CI: 1.03-3.33); aOR loose stool: 1.87 (95% CI: 1.02–3.62); aOR loose stools with constipation: 2.62 (95% CI: 1.31-5.82)). Similar results for diarrhea were observed for CD-PRS and IBD-PRS among controls although not statistically significant (e.g., aOR diarrhea for CD-PRS: 2.00 (95% CI: 0.61-7.54); for IBD-PRS: 2.42 (95% CI: 0.86-8.03)). However, among children with ASD we did not observe significant associations between any GI symptoms and GI condition PRS. Further, none of the GI condition PRS differed significantly between ASD cases and controls (CD-PRS: aOR ASD: 0.97 (95% CI: 0.85-1.08); UC-PRS aOR ASD: 1.05 (95% CI: 0.93-1.20); IBD-PRS aOR ASD: 1.06 (95% CI: 0.92-1.22).

Conclusions: We found expected associations between GI symptoms and PRS for 3 GI conditions in typically developing children enrolled in SEED but did not observe this relationship in children enrolled in SEED with ASD. Further, we did not observe associations between GI condition PRS and ASD outcome. Our results suggest that risk factors for GI symptoms may be different among children with ASD than in typically developing children; this warrants further investigation into the relationships between GI symptoms and ASD.

316.004 *(Oral)* Large-Scale Transcriptome Analysis in Autism Spectrum Disorder Identifies Diminished Monocyte-Specific Metabolic and Inflammatory Pathways

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Background: Autism spectrum disorder (ASD) is a common neurodevelopmental disorder with high phenotypic and genetic heterogeneity. Much effort has been made to identify whether the apparently distinct genetic and environmental risk factors that give rise to ASD tend to converge into one or more unifying pathophysiological mechanisms that are shared across a broad collection of individuals with ASD. Given the emerging link between ASD and immune function, it is plausible that immune dysregulation is a likely converging point, where a diversity of factors could contribute to ASD symptoms.

Objectives: The overall objective of this study is to uncover robust and reproducible changes in peripheral blood transcriptome profiles with ASD. Moreover, we seek to explore whether common and rare genetic risk loci for ASD display changes in blood transcriptome data and whether these genes share common immune cell-type properties.

Methods: We performed a large-scale RNA-sequencing study of peripheral blood leukocytes derived from infants diagnosed with ASD (n=499) and other neurodevelopmental disorders (NDD; n=365). These data were integrated with several single-cell RNA-sequencing data sets to inform immune cell type-specific changes in genes and molecular pathways that are discretely associated with ASD in the blood circulation.

Results: In ASD, we observed consistent down-regulation of cell-cycle, neurotrophic-, mTOR-, PI3K-AkT-, MAPK-, cytokine- and IGF1-signaling. Several transcription factors were identified that drive these differential molecular responses, including STAT5B, STAT3 and STAT6. Importantly, these down-regulated gene signatures in ADS were enriched for both rare and common ASD genetic risk loci. Integration with scRNA-sequencing data revealed that these genes collectively converged on monocyte-specific gene expression signatures. Notably, these results cross-validate in a non-overlapping sample of ASD (n=626) and typically developing children (n=447) mined from the public domain.

Conclusions: Collectively, these findings provide new insights into how the heterogeneous genetic basis of ASD converge on diminished monocyte-specific molecular pathways in peripheral blood. Deeper study into these findings may accelerate the identification of actionable biomarkers and drug targets leading to next-generation screening and treatment approaches.

Genetics

ORAL SESSION — GENETICS
317 - Functional Dissection of Autism Genetics

317.001 *(Oral)* Autism-Linked Mutations Disrupt the Protein Network States That Mediate Synaptic Plasticity

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Background: Protein products of autism risk genes do not act in isolation, but as a complex networks of interacting proteins that control neuronal development, synaptic homeostasis and socially motivated behavior. These protein networks translate information about external cues into biochemical logic circuits, allowing the cell to perform molecular calculations and execute an appropriate response to a given stimulus. Autism-linked mutations to individual members of a protein network have the potential to cause network-wide disruptions, altering these molecular calculations and leading to inappropriate cellular responses.

Objectives: To characterize the molecular calculations performed by a synaptic protein interaction network composed of the protein products of autism-linked genes, and to understand how autism-linked mutations alter those calculations.

Methods: We developed a multiplex co-immunoprecipitation system capable of measuring 400+ binary interactions among a 21-member protein interaction network. We performed NMDA and DHPG stimulation on acute cortical slices from juvenile and adult wild-type mice and mice carrying autism-linked mutations ($FMR1^{-/y}$, $Shank3B^{-/-}$, $Ube3a^{OE}$, $Homer1^{-/-}$), and compared the acute changes in protein network structure following stimulation. We also examined homeostatic plasticity by shaving the whiskers unilaterally in juvenile and adult mice, and comparing the protein network states in the deprived vs control whisker barrel cortex.

Results: We identified unique protein interaction network patterns associated with each type of stimulation. We also identified specific changes in the way the protein network responded to each type of stimulation in the mutant animals. For example, Fragile X animals showed a normal response to NMDA but no response to DHPG, and appeared DHPG-stimulated at baseline, consistent with the mGluR hypothesis. $Shank3B^{-/-}$ mice, in contrast, also showed a normal response to NMDA, appeared normal at baseline, but showed a non-typical response to mGluR stimulation. $Homer1^{-/-}$ mice showed very few changes in response to any type of stimulaiton, indicating a generalized reduction in the capacity for synaptic plasticity.

Conclusions: Our approach enables us to quantify, on the level of protein interactions, how autism-linked mutations affect molecular information-processing pathways at the synapse. We find that different ASD-linked mutations disrupt a consistent set of molecular calculations, but each mutation affects network states in distinct ways. We will discuss how an understanding of protein network signaling bridges the gap between our knowledge of specific gene disruptions, and how those disruption affect cellular-level processes during development and synaptic plasticity events.

317.002 *(Oral)* Return of Individual Genetic Results in the Largest Recontactable Cohort of People with Autism

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Background: SPARK — the largest recontactable cohort of people with autism spectrum disorder (ASD) — seeks to engage at least 50,000 individuals with autism and their family members in research. A tenet of the study is to form a partnership with participants and return research results to them — including any genetic variants believed to be a major contributing risk factor to their ASD. A pilot study of nearly 500 families affected by ASD found such genetic variants in 10 percent of affected individuals.

Objectives: More than 20,000 families are currently enrolled in SPARK, making it the largest autism study to return genetic results to families. SPARK is rapidly increasing the number of families receiving genetic results and has identified several challenges in returning individual research results at this scale.

Methods: SPARK returns genetic findings associated with ASD that meet American College of Medical Genetics (ACMG) criteria for likely pathogenic (LP) and pathogenic (P) variants. Currently, SPARK is returning LP/P variants within a predefined list of 176 high-confidence ASD genes or CNVs. All variants are confirmed in a Clinical Laboratory Improvement Amendments (CLIA) laboratory. At the time of enrollment, each participant can set preferences to accept or decline to receive genetic results related to autism; a parent consents for children and dependent adults. Participants may receive their result from a genetic counselor (at no cost to them) or from their own provider. SPARK provides gene-specific guidebooks to providers, genetic counselors and participants that explain the features associated with the individual's genetic result.

Results: SPARK has identified nearly 400 returnable genetic results to date from 5,242 simplex and 1,119 multiplex families that include at least one child with autism. Participants with a returnable result include 261 males and 105 females (a ratio of 2.5:1, compared with an overall ratio of 4:1). As expected, SPARK identified returnable genetic results in individuals with intellectual disability (ID) and/or seizures. 58.5 percent of people with a result had intellectual disability ID or developmental delay (DD) and 11.4 percent endorsed seizures, compared to 41.7 percent with ID/DD and 5.2 percent with seizures in all sequenced participants. SPARK has notified 191 participants of their ASD-related genetic results, and 118 have received their results. Of these 118 families, 97 received the result from a SPARK-provided genetic counselor or investigator and 21 chose their own medical provider. 94% of confirmed returnable results occurred *de novo* in the individual with autism, and 6% were inherited from a parent, some of whom do not have an ASD diagnosis. Genetic results inherited from parents take more time to return than *de novo* variants.

Conclusions: Large-scale return of genetic results is feasible but requires constant adjustment as no one protocol can account for all situations. A commitment to the return of genetic results is an important goal for all genetic research projects. SPARK's experiences can inform the process for other genomic research studies.

317.003 *(Oral)* Hematopoietic Stem Cell Rescue of Angelman Syndrome Phenotypes Using Preclinical Models

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Background: AS is a rare neurodevelopmental disorder characterized by developmental delay, impaired communication skills, ataxia, motor and balance deficits, intellectual disabilities, microcephaly, and seizures. The genetic cause of AS is loss of expression in the brain of UBE3A (ubiquitin-protein ligase E6-AP), due typically to a 4-Mb de novo deletion of the maternal 15q11-q13 region. Due to brain-specific imprinting, the paternal allele is silenced, thus loss of the maternal allele causes UBE3A deficiency throughout the brain. Novel strategies to treat Angelman Syndrome are critical as there is no cure or corrective therapy available to patients. A novel approach being developed by our laboratories is the use of hematopoietic stem cells (HSC), which offer a promising approach for life-long delivery of functioning UBE3A to affected cells, i.e., neurons.

Objectives: To assess in vivo efficacy of HSC therapy in a single gene disorder, AS, a platform for single gene ASDs.

Methods: We created and modified a lentiviral vector expressing secretable UBE3A, engrafted of the modified/transplanted HSC to have the ability to systemically secrete the enzyme thus providing functional UBE3A through a process called “cross-correction”. The studies tested N=10-15 of each of two genotypes (AS and WT) and three treatment (treated with transduced cells, treated with non transduced cells, non transplanted AS and WT mice) yielding 5 groups. Data suggested that immune deficient AS mice, capable of human cell engraftment, have numerous behavioral AS phenotypes attributed solely to the *Ube3a* deletion and not an artifact of immune alteration.

Results: Immunodeficient AS mice transplanted with human CD34+ HSC transduced with the Ube3a lentiviral vector displayed a significant improvement in motor and cognitive behavioral assays including open field, rotarod, beam walking, and novel object recognition as compared to nontransplanted AS mice and those transplanted with unmodified human CD34+ HSC. Gait analyses also demonstrated improvement in mice transplanted with the Ube3a lentiviral vector transduced cells and were similar to the wild type control cohort. High delta power in EEG was normalized with HSC treatment. A normal hematopoietic profile was observed in the blood, spleen, thymus, and bone marrow upon detection of human T cells, B cells, macrophages, and CD34+ cells. A lack of tumorigenicity was also observed with the Ube3a vector transduced cells as demonstrated in an in vitro immortalization assay.

Conclusions: This data demonstrates strong evidence for the use of this therapy to treat Angelman Syndrome. We are currently assembling a pre-IND package to submit to the FDA for a future clinical trial for Angelman Syndrome.

317.004 *(Oral)* Prospective Phenotyping in DDX3X Syndrome, a Significant Contributor to Autism in Females

D. Grice[1]*, J. Buxbaum*[2]*, Y. Frank*[1]*, I. Giserman-Kiss*[3]*, D. Halpern*[4]*, A. Kolevzon*[4]*, P. M. Siper*[4]*, L. Tang*[4] *and J. Zweifach*[4]*, (1)Icahn School of Medicine at Mount Sinai, New York, NY, (2)Department of Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY, (3)University of Massachusetts Boston, Brookline, MA, (4)Seaver Autism Center, Department of Psychiatry, Icahn School of Medicine at Mount Sinai Hospital, New York, NY*

Background: Five recent studies in autism spectrum disorder (ASD) have shown that mutations in the X-linked DDX3X gene are significantly associated with ASD, particularly in females. Moreover, review of phenotypes of individuals ascertained for DDX3X mutations demonstrate high rates of ASD and ASD traits in DDX3X mutation carriers. In broader studies, mutations in the DDX3X gene are emerging as one of the most common molecular findings in ASD, developmental delay (DD) and intellectual disability (ID) in females, accounting for 1-3% of unexplained DD/ID in females. Participants with DDX3X mutations present with a variable constellation of phenotypes, including ASD, mild to profound ID, nonverbal to verbal language abilities, and the presence or absence of brain structural defects; however, prospective assessments of the syndrome are lacking. In addition, evidence indicates that there are 3 distinct subclasses of DDX3X syndrome-associated mutations: DDX3X syndrome associated with either (i) loss of function (LoF; i.e., amorphic) alleles, (ii) hypomorphic missense alleles, or (iii) dominant-negative (DN; i.e., antimorphic) missense alleles. To date, only a single study has examined genotype-phenotype correlations in the syndrome.

Objectives: To carry out extensive, prospective assessment of individuals with DDX3X syndrome, and to carry out genotype-phenotype correlations to understand how DDX3X mutations exert their effects on behavioral phenotypes.

Methods: Ten participants (ages 3-16) have undergone comprehensive phenotyping at the Seaver Autism Center at Mount Sinai, using arefined assessment protocol developed based on prior approaches and preliminary data in DDX3X syndrome. A multidisciplinary team of expert clinicians (psychiatry, psychology, neurology, clinical genetics) are involved in aspects of the evaluation. All available medical records are obtained and reviewed with a particular focus on behavioral and neuroimaging results. Genetic reports are reviewed by a certified genetic counselor. Assessments include neuropsychiatric and medical examinations, standardized diagnostic, cognitive, language, and motor assessments, and caregiver report questionnaires.

Results: We have carried out detailed phenotyping in 10 DDX3X participants. Our results show that ASD (60%), ID (70%), language delay (100%), and structural brain defects (33%) are prominent. Seizures were reported in 2 girls (20%). We observed a broad range of cognitive function with 2 individuals showing FSIQ in the low average or borderline range, 2 individuals with moderate ID and 6 individuals with severe or profound ID. Receptive and expressive language varies broadly in these individuals. Six (6) participants were minimally verbal or nonverbal, 2 used phrase speech or simple sentences, and 2 were verbally fluent.

Conclusions: We confirm high rates of ASD in DDX3X syndrome. In addition, we observe a broad range of functioning. All DDX3X mutations we studied to date are in females, as are almost all prior reports. This is because the DDX3X gene is located in a short region in Xp11.4 that escapes X-inactivation, and females are thus functionally heterozygous for the mutation. We will continue to define the phenotype of DDX3X syndrome, and we are beginning to use in vitro methods to classify mutations as LoF, hypomorphic or DN, for future genotype-phenotype correlations. DDX3X syndrome provides a unique window into ASD in females.

Immunology

POSTER SESSION — **IMMUNOLOGY**
425 - Immunology Posters

425.001 *(Poster)* Activation of Microglia Mediates ASD like Phenotype in Mice Following in Utero Exposure to Anti-Caspr2 Antibodies.

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Background: The concept that the in utero environment, and specifically maternal antibodies, can contribute to the development of Autism spectrum disorders (ASD) has been entertained for over a decade. We have identified antibodies targeting the protein Caspr2 to be present in high frequency in mothers with an ASD child. A single exposure in utero to a monoclonal anti-Caspr2 antibody, derived from a mother of an ASD child, can lead to an ASD like phenotype in mice offspring. We have generated a new model in which anti-Caspr2 antibodies are present during gestation in mice immunized with the extracellular portion of Caspr2 to better mimic the human condition, and to allow us to ascertain the role of microglia and its inhibition as a potential therapeutic,

Objectives: To examine microglial activation in ASD and to assess microglia as targets for potential therapeutic strategies.

Methods: C57BL/6 female mice from Jackson Laboratories are immunized with the extracellular region of human Caspr2 purified from supernatant of transfected, glycosylation-deficient HEK293T GnTI− cells . Control female mice are immunized with adjuvant only. Titers to Caspr2 are determined by a cell based assay against both human and mouse Caspr2 . Since Caspr2 is considered to be expressed almost exclusively in the CNS and is sequestered by the BBB, anti-Caspr2 antibody are not pathogenic in the immunized mice which have no compromise to the BBB.

Results: We have generated a new model in which anti-Caspr2 antibodies are present during gestation in mice immunized with the extracellular portion of Caspr2. Male and not female mice of dams harboring polyclonal anti-Caspr2 antibodies showed abnormal cortical development, decreased dendritic complexity of excitatory neurons and reduced numbers of inhibitory neurons in the hippocampus, as well as repetitive behaviors and impairments in novelty interest in the social preference test. Since microglial-dependent pruning is one mechanism that may account for the diminished dendritic arborization, we assessed microglia in these mice. They have a higher activation score and reduced ramifications based on colocalization of CD68 with Iba1a, cell shape and Scholl analysis compared with control mice. Importantly, in a pilot study, a diet containing colony stimulating factor 1 receptor (CSF1R) inhibitor, PLX 3397, begun when the mice were 12 weeks of age, led to a 90% loss of microglia, normalized repetitive behavior, and increased dendritic arborization in these mice.

Conclusions: The data suggest the potential pathogenicity of anti-Caspr2 antibodies, and is consistent with the concept that anti-brain antibodies present in women during gestation can alter fetal brain development and may result in ASD in a subset of offspring. Our new model can be utilized to assess microglia as targets for potential therapeutic strategies.

425.002 *(Poster)* Acute Peripheral Immune Activation Alters Cytokine Expression and Glial Activation in the Early Postnatal Rat Brain

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Background: An acute peripheral immune response can be widely systemic, affecting a variety of tissues and organ systems, although the tissue-specific response may vary greatly. For example, peripheral immune stimulation has been shown to influence neuroinflammatory responses in the central nervous system (CNS). Specific effects seen in the brain following peripheral immune challenge include global changes in expression of interferon response genes as well as alterations in cell-specific transcriptional programming, particularly in microglia. These transcriptional alterations of neuroimmune signaling in early life are hypothesized to result in developmental priming, potentially leading to enduring consequences in response to later life exposures.

Objectives: The influence of an acute peripheral immune challenge on neuroinflammatory responses in the early postnatal brain in the context of genetic background and sex is not well characterized. To address this gap in knowledge, we evaluated the peripheral and central nervous system (CNS) immune responses to a mixed immune challenge in early postnatal rats of varying strains and sex.

Methods: On postnatal day 10 (P10), male and female Lewis and Brown Norway rats were injected intramuscularly with either a mix of bacterial and viral components in adjuvant, adjuvant only, or saline. Immune responses were evaluated at 2, and 5 days post-challenge. Cytokine and chemokine levels were evaluated in serum and in multiple brain regions using a Luminex multiplex assay. Multi-factor ANOVAs were used to compare analyte levels across treatment groups within strain, sex, and day of sample collection. Numbers and activation status of astrocytes and microglia were also analyzed in the cortex and hippocampus by quantifying immunoreactivity for GFAP, IBA-1, and CD68 in fixed brain slices. Immunohistochemical data were analyzed using a mixed-model regression analysis.

Results: Acute peripheral immune challenge differentially altered cytokine and chemokine levels in the serum versus the brain. Within the brain, the cytokine and chemokine response varied between strains, sexes, and days post-challenge. Main findings included differences in T-helper (Th) type cytokine responses in various brain regions, particularly the cortex, with respect to IL-4, IL-10, and IL-17 levels. Additionally, peripheral immune challenge altered GFAP and IBA-1 immunoreactivity in the brain in a strain- and sex-dependent manner.

Conclusions: These findings indicate that genetic background and sex influence the CNS response to an acute peripheral immune challenge during early postnatal development. Additionally, these data reinforce that the developmental time point during which the challenge occurs has a distinct effect on activation of CNS-resident cells.

425.003 *(Poster)* Cytokine Alterations on Clinical Characteristics in Chinese Children with Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder in which genetics, together with environmental risk factor play a key aetiological role. Multiple evidence indicates a link between immune dysfunction and ASD. However, few data showed the relationships between cytokine level and clinical characteristics of Chinese ASD patients.

Objectives: To investigate cytokines alterations in Chinese ASD children with regression and allergy.

Methods: We reanalyzed our previously published data for case-control study. ASD children who were diagnosed and qualified for the inclusion criteria were recruited in the research as experimental group, typically developing children from a Kindergarten and early childhood education center as control group. Research method: 11 cytokines plasma levels were measured according to Miliplex BMS protocol. The clinical characteristics of ASD group: We recorded the medical history including regression and allergy, medical assessments including Autism Diagnostic Observation Schedule, second edition (ADOS-2) and Griffiths Mental Development Scales (GMDS).

Results: The cohort included 65(55 male) ASD children and 42(28 male) TD children, aged 19 to 79 months.

1) The results of plasma cytokine levels showed: Plasma TNFa and Eotaxin levels were significantly higher in ASD group (TNFa: median 16.26, range 6.89–28.45pg/mL, P =0.045; Eotaxin: 72.18, 23.87–490.69pg/mL, P=0.016) than in TD group(TNFa: 14.19, range 7.40–25.21pg/mL; Eotaxin:55.72, 19.24-170.94pg/mL). There was a trend for Plasma TGF-β1(ASD: 5337.0, 931.67–34107.0pg/mL; TD: 2680.0, 574.08–18194.0pg/mL, P = 0.066). TGF-β1 was significantly increased in ASD male group than TD group (ASD: 5411.0, 931.67–34107.0pg/mL; TD: 2681.0, 838.28–16695.0pg/mL, P = 0.033).

2) The average ADOS total score is 21.17±9.88（SA:16.97±2.40; RRB:2.36±1.54） of 65 ASD children. The average GMDS DQ is 55.03±14.65 (Locomotor: 67.42±12.89; Personal-social：52.07±14.95；Hearing and Speech: 52.07±20.93; Eye and Hand: 55.34±17.01；Performance: 60.10±21.79)。

3) 17 of 65 ASD children had regression. Compared with ASD children with no regression(ASDnr) and TD children, ASD children who had regression(ASDr) had higher trend for plasma TGF-β1 (ASDr:7359.0, 1164.0–24649.0pg/mL; ASDnr:3413.0, 931.67–34107.0pg/mL; TD:2680.0, 574.08– 18194.0pg/mL, P=0.070) and Eotaxin (ASDr:72.42, 23.87–490.69pg/mL; ASDnr:71.0, 23.87–192.31pg/mL; TD: 55.72, 19.24-170.94pg/mL, P=0.056). For male, the increase of TGF-β1 was most significant in ASDr, almost three-fold higher than TD (ASDr:7359.0, 1164.0–24649.0pg/mL; ASDnr:4452.0, 931.67–34107.0pg/mL; TD: 2681.0, 838.28– 16695.0pg/mL, P=0.039).

4) Since we did not have data of TD children for allergic history, we compared cytokines of ASD children with allergy (ASDa: 29/65) and non-allergy (ASDna: 36/65). Compared to ASDna, ASDa showed higher TNFa level (ASDa: 17.14, 6.89–26.60pg/mL; ASDna: 15.6, 7.93–28.45pg/mL, P =0.038).

Conclusions: The pilot findings showed that TGF-β1, TNFa and Eotaxin may have associations with neurodevelopment progression of children, especially in boys. TGF-β1 and TNFa may have potential role in the mechanism of regression and allergy in ASD in Chinese population.

425.004 *(Poster)* Dysregulated Immune Gene Expression in Monocytes in Children with Autism Spectrum Disorders.

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Background: Immune dysfunction is a common co-morbidity seen in autism spectrum disorders (ASD), with innate immune dysfunction seen both in the brain and periphery. Evidence of this dysfunction includes altered numbers and activity of circulating monocytes as well as their counterparts in the brain, the microglia. Previous work has identified significant differences in the cytokine responses of peripheral blood monocyte cytokine after *ex vivo* Toll-like receptor (TLR) stimulation. However, an unbiased transcriptomic analysis of the response of ASD monocytes to different TLR agonists has not been examined. As early innate immune activation is largely driven by signaling through TLRs, we hypothesized that activation of different TLRs would impact gene expression in ASD monocytes compared to monocytes from typically developing (TD) controls.

Objectives: We aimed to identify gene expression profiles in TLR stimulated monocytes from ASD children compared to TD controls.

Methods: We isolated peripheral blood monocytes from 27 children with ASD and 23 TD children and treated them with either lipoteichoic acid (LTA) or lipopolysaccharide (LPS) to activate TLR-2 or 4 respectively. Following 24 hours of stimulation, we processed cells for RNA sequencing to profile mRNA expression between non-treated (NT), LTA and LPS treated samples for each diagnosis (TD or ASD).

Results: We identified differentially expressed genes in non-treated compared to stimulated cells for both TD and ASD samples. Both LPS and LTA induced expression of immune genes, with a subset that were differentially regulated in ASD compared to TD samples. In response to LPS treatment, monocyte cultures from ASD children showed a unique increase in genes within the KEGG pathway for Pathogenic *E. Coli* infection, a pathway that was not enriched in the controls. This pathway included elevated expression of key immune regulator genes such as FAS cell surface death receptor (FAS), nuclear factor kappa B (NFKB1), Interleukin Receptor Type1 (IL1R1), and TGF beta Kinase 3 (TAB3) in ASD. Notably, TD monocytes showed a consistent decrease in expression of genes associated with translation and rRNA metabolism in response to both LTA and LPS. A comparable decrease was not observed in the ASD monocytes, suggesting a failure to properly regulate a prolonged immune response.

Conclusions: We demonstrated that activation of TLR-2/4 in ASD monocytes led to differential gene expression compared to monocytes from TD controls, with enrichment for genes involved in inflammatory responses. Additionally, ASD monocytes did not significantly down-regulate genes involved in translation compared to controls, suggesting deficits in translational regulation. As monocytes are involved in early orchestration of the immune response, our findings will help elucidate the mechanisms regulating immune dysfunction in ASD and provide novel targets for future therapeutic development.

425.005 *(Poster)* Investigating the Causal Relationship between Inflammation Biomarkers and Autism Spectrum Disorder: A Two-Sample Mendelian Randomization Study

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Background: Previous studies have presented surging evidence which supports a close, potentially causal link between inflammation biomarkers and autism spectrum disorder (ASD). Investigating whether there exists genetic causality might shed light on underlying pathophysiology and provide further insights into therapeutic effects of attenuating inflammation.

Objectives: To identify whether increased inflammation levels of C-reactive protein (CRP) and interleukin-6 (IL-6) contributed genetically to higher risk of ASD.

Methods: We conducted a two-sample Mendelian randomization study using genome-wide significant SNPs correlated with CRP in 204,402 European individuals and IL-6 in 8,189 European participants from CHARGE Inflammation Working Group and I Young Finns Study, respectively. Summary statistics of ASD were retrieved from a recent published study involving 18,381 cases and 27,969 controls by iPSYCH and PGC. The inverse-variance weighted method, weighted median method, and MR-Egger were incorporated in our analysis using R version 3.4.2 and TwoSample MR R package.

Results: Totally, 46 and 5 SNPs were validated as instrumental variables for CRP and IL-6 to estimate the causative effect of inflammation exposureles on ASD. We failed to find a statistically significant causality between CRP and ASD (effect size = 0.016, se = 0.053, P = 0.763, per), neither between IL-6 and ASD (effect size = -0.023, se = 0.067, P = 0.736). The MR-Egger intercept was compatible with no unbalanced pleiotropy (P = 0.48 and P = 0.24, respectively).

Conclusions: Mendelian randomization analyses using current GWAS summary results did not suggest a causal link between CRP or IL-6 and ASD.

425.006 *(Poster)* Maternal Asthma and Infection during Pregnancy May be a Risk Factor for Neuropsychiatric Problems in Offspring throughout Childhood and Adolescence.

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Background: Emerging research suggests that maternal immune activation during pregnancy, caused by acute infection or chronic immune conditions, may increase risk of neurodevelopmental and neuropsychiatric disorders in offspring. MIA has been linked to increased risk of Autism Spectrum Disorder, schizophrenia, anxiety and depression in offspring. No studies have investigated whether MIA confers a risk for broad neuropsychiatric symptoms in children across childhood and adolescence.

Objectives: Using data from the Western Australia Pregnancy Cohort (Raine) Study, we investigated whether maternal immune conditions during pregnancy was associated with increased behavioral and emotional problems in offspring longitudinally across development. We also examined whether exposure to more than one maternal immune condition conferred greater risk to offspring outcomes than single exposures.

Methods: Mothers (Generation 1; N=1905) were classified into the following immune categories: AAAE (Asthma/Allergy/Atopy/Eczema; N=1267); infection (during pregnancy; N=1082); no AAAE or infection (N=301). The Child Behavior Checklist (CBCL) was administered for offspring (Generation 2; 921 females, 984 males) at ages 5, 8, 10, 14 and 17 years. The CBCL produces three T scores: Total behavior, Externalizing behavior, Internalizing behavior. We also analysed CBCL 'morbidity' (T scores above 60), which is an established threshold of clinically significant level of concern. Generalized estimating equations were used to investigate the effect of maternal immune status on CBCL scores.

Results: All AAAE conditions (one or more) were associated with significant increases in CBCL scores (β ranging 1.54 to 2.49) and morbidity (OR ranging 1.34 to 1.58) on the Total, Externalizing, and Internalizing scales. A single AAAE condition was associated with significant increases in scores (β ranging 1.20 to 2.04) and morbidity (OR ranging 1.33 to 1.54) on all three scales. Two or more AAAE conditions were associated with larger increases in scores (β ranging 1.84 to 2.93) and morbidity (OR ranging 1.35 to 1.68) on all three scales. All infection conditions (one or more) were associated with significant increases in CBCL scores (β ranging 0.76 to 1.27) on all three scales and morbidity on the Total and Externalizing scales (OR 1.19 and 1.16, respectively). A single infection condition was associated with increases in Total and Externalizing scores (β 0.71 and 0.67, respectively), but no significant increases in morbidity. Two or more infection conditions were associated with larger increases in scores (β ranging 2.22 to 2.83) and morbidity (OR ranging 1.53 to 1.73) on all three scales. For those whose mothers reported both AAAE and infection (at least one of each condition), larger increases in CBCL scores (β ranging 1.97 to 2.59) and morbidity (OR ranging 1.44 to 1.53) were observed across all three scales.

Conclusions: MIA was associated with a small increase in behavioral and emotional problems in offspring throughout childhood and adolescence. MIA may confer risk to neurodevelopment in a cumulative manner; exposure to more than one AAAE and/or infection condition was associated with greater elevation in CBCL scores than single exposures. These results highlight the need to understand MIA, fetal development, and long-term outcomes, with potential to advance early identification and intervention strategies.

International and Cross-Cultural Perspectives

PANEL SESSION — **INTERNATIONAL AND CROSS-CULTURAL PERSPECTIVES**

213 - From Clinic to Community: The Role of Sports, Dance, and Education in Improving Developmental Outcomes for Children with Autism Spectrum Disorder Globally

Panel Chair: David Austin, *School of Psychology, Deakin University, Burwood, VIC, Australia*

Discussant: James Charles, *Deakin University, Burwood, VIC, Australia*

Community-based interventions for children with Autism Spectrum Disorders (ASD) complement and enhance best practice clinical care, improving social connectedness, mental health and motor functioning, increasing physical activity and reducing risk for poor physical health outcomes later in life. Community-based interventions are 'strengths-based' and provide real opportunities for children and families to thrive. This panel is centred around a global perspective describing how we can develop the necessary 'evidence-based bridge' from clinic to community to enable sports, dance and educational sectors to work together to improve developmental outcomes of children with ASD. This will include a special focus on best-practice approaches to community-based interventions in indigenous communities, where in Australia, for example, there are limited clinical services available. Latest evidence on the benefits of participation in organised physical activity for children with ASD and parent reported barriers and facilitators will be presented. The panel will overview critical gaps in advocacy and measurement of community-based interventions and introduce the AllPlay™ program as one type of evidence-based platform to fill these gaps.

213.001 *(Panel)* Get Moving: The Importance of Accessibility of and Advocating for Physical Activity Programs for Individuals with Autism Spectrum Disorder (ASD)

R. B. Wilson[1], *S. Jeste*[2], *C. Lord*[2], *C. Giza*[1], *J. Goldman*[1], *M. Choe*[1], *S. Freeman*[3], *T. Paparella*[4], *D. W. Austin*[5], *J. McGillivray*[6] *and N. Rinehart*[6], *(1)UCLA Medical Center, Los Angeles, CA, (2)University of California, Los Angeles, Los Angeles, CA, (3)Child Psychiatry, UCLA Medical Center, Los Angeles, CA, (4)University of California Los Angeles, Los Angeles, CA, (5)School of Psychology, Deakin University, Burwood, VIC, Australia, (6)Deakin University, Burwood, VIC, Australia*

Background: Motor impairments are prominent in individuals with autism spectrum disorder (ASD), and these impairments often impact the individual's ability to engage in organized physical activity programs [OPA] (McCoy et al, 2016). Given the benefits of physical activity on health outcomes, social development, and improvement of motor impairments, there is a need for evidence-based OPA for individuals with ASD (Howells et al, 2019; Wilson, RB et al 2018). However, there remains a paucity in the literature regarding the outcomes associated with OPA for individuals with ASD.

Objectives: Identify opportunities to improve accessibility of and advocacy for OPA for individuals with ASD.

Methods: First, a systematic review of the field and literature was conducted and revealed that physical activity for children has important developmental benefits, but few studies are focused on outcome measurement of OPA in ASD. Second, three gaps were identified that should be addressed to improve accessibility of and advocate for OPA for individuals with ASD: (1) measuring and demonstrating positive outcomes of participation in OPA, (2) scalability of OPA for large populations of individuals with diverse ASD symptomatology, and (3) building partnerships with academic institutions to aid in gaps 1 and 2. Thought leaders in the field of neurology, neurodevelopmental disorders, sports medicine, psychology, child development, and large OPA serving individuals with ASD convened to discuss how to address these gaps.

Results: In review of the gaps, it was concluded that the following items should be addressed to improve access to and advocacy for evidence-based OPA for individuals with ASD: (1) Outcome measurement should focus on health and wellness, motor skills, social and behavioral, quality of life (QOL), and academic achievement. QOL measures should also be included for caregivers. (2) To build scalable programs there is a need to show the economic benefits of OPA. Specifically, improved physical health and decreased poor health outcomes. Outcome measures that are easily used by families and participants such as smartphone applications should be considered for large scale data collection. Lastly, accreditation and reliability of program delivery is needed in order to ensure individuals with diverse ASD symptomatology are being adequately served. (3). Partnerships with academic programs can improve outcome measurement by guiding OPA toward validated measures of brain and behavior. Partnerships with academic programs can also lead to creation and validation of measures that can be utilized broadly across OPA. Funding of community research partners can be established with academic institutions to guide physical activity organizations in accurate data collection.

Conclusions: Evidence-based OPA for individuals with ASD have the potential to improve health and wellness, social and behavioral outcomes, motor skills, and overall QOL. To improve access to and advocacy for these programs it is imperative that validated outcome measures of brain and behavior be systematically utilized to build the evidence base for OPA. These measures can guide the development of successful large scale OPA. Partnerships with academic institutions can support these goals by providing community-based OPA the guidance needed to measure outcomes and serve diverse populations of individuals with ASD.

213.002 *(Panel)* Introducing the Allplay Program: Building an Evidence-Based Approach to the Inclusion of Australian and Aboriginal and Torres Strait Islander in Organised Physical Activity

N. Rinehart*, J. Charles, C. Sivaratnam, K. Howells, J. McGillivray, A. Mantilla and N. Papadopoulos, Deakin University, Burwood, VIC, Australia*

Background: Many children with Autism Spectrum Disorders (ASD) are excluded from participating in organised physical activity, such as sport and dance; and when they do participate it can be a negative experience. In Australia, Aboriginal and Torres Strait Islander children with disabilities encounter further access barriers due to their Aboriginality (Dew et al., 2018). A unified novel platform called AllPlay™ has been developed by Deakin University researchers to promote the inclusion of all children in sport, dance and education using evidence-based strategies and programs.

Objectives: The objective of this paper is to provide an overview of the methodology used for building the AllPlay program, highlighting key preliminary findings from systematic reviews, surveys, and feasibility and pilot studies for our AllPlay sports program.

Methods: AllPlay has four programs with strengths- and evidence-based strategies and resources that help ensure children with disabilities are given the same opportunities to engage in sports, dance and education as their typically developing peers. These are: AllPlay™ Footy, AllPlay™ Aboriginal and Torres Strait Islander, AllPlay™ Learn and AllPlay™ Dance. AllPlay™ uses a co-design participatory design method in which all critical stakeholders were engaged in a collaborative process to i) understand and clearly identify needs and foci for each program, ii) design and develop the programs and iii) test the programs throughout different stages of development. The data informing the development of the four programs was generated using mixed methods which generally included conducting scoping and systematic reviews, surveys, focus groups, pilot program studies, community consultations, and leading industry groups and rapid response teams.

Results: Our systematic reviews demonstrated the positive effects on physical, mental and social functioning for children with ASD when engaging in OPA programs (May et al, 2019, Howells et al, 2019, May et al, in press). Data from these reviews informed the development of culturally sensitive pilot programs in community settings that reduce children's anxiety levels and promote inclusion in OPA. Our pilot AllPlay Footy programs show that children with ASD (5-12 years of age) who participated in OPA have a significant decrease in total scores on DSM oriented anxiety and social problems, with no change in those who did not (Intervention n =19, Comparison n=20). A 'dose effect' on the number of OPA sessions a child attended and reduction in social problems was found. Australian data on the barriers and facilitators to inclusion in OPA from 1,529 parents of children with and without disabilities will also be presented.

Aboriginal and Torres Strait Islander community consultations showed transportation, costs and location are the most frequently reported barriers across all communities, followed by lack of knowledge about sports programs available. The most important goals for Aboriginal and Torres Strait Islander children in non-remote locations participating in footy included increasing their involvement in OPA, as well as learning social skills (e.g. teamwork and respect) and footy skills.

Conclusions: There is emerging literature to show the physical, mental and social benefits of participation in OPA for children with autism and neurodevelopmental disorders more broadly.

213.003 *(Panel)* Allplay Dance: Participating in the Social, Physical and Creative Activities of Dance for Children with ASD

***O. Millard**, N. Rinehart, E. Lindor, N. Papadopoulos and J. McGillivray, Deakin University, Burwood, VIC, Australia*

Background: AllPlay Dance is founded on a collaborative approach to research between the disciplines of Psychology and the Creative Arts. This genuine cross-disciplinary partnership brings a rigorous scientific methodology to an investigation of the benefits of dance for children with ASD, supported by responsive work in the development of dance programs. As well as directly measuring the benefits of the program for the participating population, the study acts a step in the continuing development of inclusive dance programs for children with a range of disabilities.

Objectives: This paper will discuss the benefits for children with ASD of participating in a dance program using quantitative and qualitative measures such as social functioning, cognitive skills, emotional and behavioural wellbeing, and movement abilities.

Methods: The AllPlay Dance program for children with ASD is a waitlist-controlled pilot which gives children agency in their own inclusion in a series of dance classes, culminating in an informal performance. The dance program was developed to include a variety of dance activities such as learning movement material, dance improvisation and supported group movement generation (choreography). Rudolph Laban's Movement Principles within the framework of *Body, Space, Energy and Time* were employed as a structure for dance teaching and choreography, in order to develop a transferable and scale able program. Through the principle of intersubjectivity, described by cognitive science philosopher, Hanne De Jaegher, as "participation in the investigation of how experience transforms when examining it together" (2016, 393), dance is considered to be a social practice as well as a situation in which one participates physically and creatively. Crucial to the development and the success of the program was the participation of "buddies" who were older and had an existing level of dance experience. Buddies partnered with children with ASD through the classes and in performance.

Results: We will present the preliminary findings of the project, including the social, cognitive, and motor outcomes of the waitlist control trial. We will also include a discussion about the successes and emerging understandings of a project that is scientifically underpinned while equally valuing the embodied and experiential understandings gained through a creative arts approach. The discussion will be based on the following topics: working across disciplines to research dance for children with ASD; the buddy system – older more experienced, dancing partners; dance as a social practice; questioning conventional dance values - from spectacle to experience.

Conclusions: While undertaking the work of a pilot in which the benefit of participating in dance activities for children with ASD was measured, the program was also undertaken with the long-term aims of developing inclusive approaches to dance classes that challenge ablist notions of dance- as -spectacle and enable children with ASD to benefit from participating in dance in their communities.

213.004 *(Panel)* Allplay Learn: Co-Designing with Early Childhood Educators and School Teachers to Help Create Inclusive Education Environments for Children with Disabilities and Developmental Challenges

***A. Mantilla**[1], N. Rinehart[1], J. McGillivray[1], R. B. Wilson[2] and B. Devenish[1], (1)Deakin University, Burwood, VIC, Australia, (2)UCLA Medical Center, Los Angeles, CA*

Background: The AllPlay™ Learn website and online professional learning courses for early childhood educators and school teachers was launched in August 2019 in Victoria, Australia. AllPlay Learn was developed in partnership with the Victorian Department of Education and Training. It was co-designed with early childhood educators, school teachers, families, education and health experts, government and peak-body organisations.

Objectives: AllPlay Learn aims to support the inclusion of children in early childhood education and care settings, mainstream and special education primary and secondary schools. The program developed provides strengths- and evidence-based strategies and resources for teaching the 1 in 5 Australian children with disabilities and/or developmental challenges at early childhood education and care settings and schools. This paper shows how co-design was used as a participatory design method in which all critical stakeholders engaged in a collaborative process to understand and identify the objectives of the program, as well as to design, re-design and test the program throughout its development.

Methods: Scoping and systematic reviews were conducted to identify children's strengths and a comprehensive range of evidence-based strategies for ASD and ADHD, and also other disabilities and developmental challenges including ODD, cerebral palsy and communication disorders. A specific systematic review on the shared strengths, capabilities and competencies of children with ASD was also conducted. A total of six focus groups (n= 46 participants) at two different time points (i.e. development and trial phase) and one survey (n= 338 respondents) were completed during a total period of 9 months with a mix of early childhood education and care educators and professionals, teachers, wellbeing officers, education support staff, assistant principals and principals from government schools and teachers from three ASD special schools. An additional focus group with parents or caregivers of primary school aged children with ASD was also conducted.

Results: Our analysis of the focus groups transcripts highlighted several challenges faced by educators, teachers and education staff including lack of knowledge and preparation, lack of funding and support in their classrooms, difficulties with heightened emotions and behaviour, and additional pressure and stress. A variety of strategies used by teachers, education staff and schools and critical moments for additional support (e.g. transitions) were also identified. Findings suggested the teachers' need for evidence-based strategies; a consolidated website with high-quality content knowledge and resources; the importance of collegial, family and school level support; and, a strong interest for professional learning on ASD (and other specific disabilities) to strengthen their competence, confidence and inclusive teaching practices.

Conclusions: AllPlay Learn has received strong and positive support from the education sector and wider community. Co-design will continue playing a key role in improving the program and assessing the efficacy of AllPlay Learn in increasing educators' competence and confidence teaching children with ASD, and the resulting impact these practices may have on children's learning, emotional regulation, conduct, attention, peer relations and pro-social skills.

ORAL SESSION — INTERNATIONAL AND CROSS-CULTURAL PERSPECTIVES
318 - Interventions and Outcomes across Cultures

318.001 *(Oral)* Better Sooner Than Later. Child, Family and System Predictors of Later ASD Diagnosis

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Background: Early diagnosis of ASD facilitates early access to intervention and promotes better developmental outcomes in young children. In general, results suggest that Latino children are diagnosed with autism spectrum disorder (ASD) later in life; usually with more severe symptoms, lower IQs, and more health conditions, compared with non-Latino children. Lack of knowledge about best practices for both early identification and intervention in Latin American Countries and Caribbean countries as in many other low resource settings has been influenced by parental health belief, maternal education, low literacy skills, symptoms severity and the scarcity of trained professionals working with those diagnosed with ASD. It is highly important to identify which variables have an impact on the age of diagnosis, and lead to earlier diagnosis.

Objectives: This study aimed to examine the association between child, family, and system factors and the age of the first diagnosis. Furthermore, the study addressed the contribution of each category of variables that might predict the age of ASD diagnosis

Methods: This study includes data of 2817 caregivers from Argentina, Brazil, Chile, Dominican Republic, Uruguay, and Venezuela. The survey was completed through an online platform in the participant countries. It requested information about family demographics, affected individual characteristics, service encounters, and parent/caregiver perceptions. Age of parental recognition and description of first signs were ascertained through the direct questions of the survey.

Results: Age range from 2 to 63 years of age (x=4.80;SD= 12.3. The mean age of first concern was 24.91 months (SD 20.60), and the mean age of diagnosis was 61.16 months (SD 53.51). Optimal linear combination of child factors (diagnosis, gender, comorbid medical disorders, language level, symptoms severity, intellectual functioning, and challenging behaviors) accounted for 8.9% of the variance in age of diagnosis [adjusted R^2=0.089 F=19.707, p<.001]. Diagnosis (Asperger's), Medical comorbidities (Epilepsy & Down Syndrome), Gender (Females), and Language Level (Complex Sentences) all independently predicted a later age of diagnosis. On the contrary, family factors (caregiver's educational level, stigma variables, and another member with ASD) only accounted for 1.5% of the variance [adjusted R^2=0.015 F=4.040, p<.001]. Later age of diagnosis was predicted by lower primary caregiver's educational level and higher stigma. Although, system factors (country of residence, insurance coverage and diagnostician person) do not contribute to the variance of the age of diagnosis [adjusted R^2=0.004 F=4.790, p<.001]; country of residence (Chile & Brazil) independently predicted later age of diagnosis

Conclusions: Caregivers were concerned about their child development by 25 months. However, the diagnosis came 36 months later, which corresponds to the start of formal schooling; similar to other studies conducted in Latin American Countries and Caribbean. Child factors (Asperger's diagnosis, medical comorbidities, being female and good language level) and a primary caregiver with an education level below high school diploma, and higher perception of stigma predicted a later diagnosis. A better understanding of cultural influences in the diagnosis would likely translate to the timelier identification and diagnosis independent of ethnicity.

318.002 *(Oral)* Stress and Resilience in Parents of Children with Autism: A Cross-Cultural Evaluation of Double ABCX Model Using Structural Equation Modelling

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Background: The causes of stress for parents of children with autism and improving resilience are key research areas concerned with the well-being and quality of life.There is a global acceptance of diagnostic criteria for ASD; however, cultural differences in values to what is considered normal development may influence the diagnosis despite the biological cause. Raising a child with Autism Spectrum Disorder (ASD) involves unique challenges, and specific cultural challenges are often not considered in research (Freeth et al., 2014).Cultural factors may influence how autism is experienced, recognised and explained in diverse communities. For example, information that might be helpful for one parent may be too complicated or even unclear for another parent due to cultural beliefs and values, socioeconomic status, religion and stigma.

Objectives: The present study is a cross-cultural comparison of the factors associated with stress and resilience among the parents of children with autism, between UK and India, based on the double ABCX model.

Methods: An online survey was conducted with 120 parents from the UK (Age M=38; SD= 5.9) and 120 parents from India (Age M= 40; SD=6.7) who have children with ASD aged between 3-16 years. The mental health of the parents and child adaptive behaviour (factor aA); Perceived social support and perceived emotional support (factor bB); Parental attitude (factor cC) and Parenting stress and resilience were considered as factor xX. A new factor, affiliate-stigma, has been included as a cultural factor that enhances stress. The measures used were parenting stress index (PSI-SF), brief resilience scale (BRS), mental health continuum (MHC-SF), Vineland adaptive behaviour scale (VABS), multidimensional scale of perceived social support (MSPSS), perceived emotional support scale (PES), family impact questionnaire (FIQ), and affiliate stigma scale (ASS).

Results: Parents in India reported higher levels of stress and lower levels of resilience than their UK counterparts. Path analysis showed that both in the UK and India, perceived social support, perceived emotional support, child adaptive behaviour inversely, and affiliate stigma directly contributes to parental stress. Apart from these, in the UK, Mental health inversely, and in India, the parental attitude directly adds parental stress. Mental health is a strong positive, and affiliate stigma a weak negative predictor of resilience in both groups. Perceived emotional support and child adaptive behaviour are negative predictors of resilience among the UK participants, whereas parental attitude is a negative predictor in India.

Conclusions: The findings indicate that the factors that contribute to elevated stress among Indian and UK parents included their lower level of child's adaptive level, perceived social and emotional support and higher affiliate stigma. The data collected will be used to develop a culturally specific model of stress and resilience. This research will help to develop new, culturally specific strategies to provide interventions that will help parents overcome stress and enhance resilience. This research may also help to increase clinician's awareness and cultural responsiveness in order to support UK and Indian parents.

318.003 *(Oral)* The World Health Organisation Caregiver Skills Training Intervention for Families of Children with Autism Spectrum Disorder: A Focus on Implementation Strategies in Resource-Limited South African Settings

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Background: Implementing and scaling-up evidence-based early interventions into real-world settings is complex and challenging, and even more so in resource-limited contexts in low- and middle-income countries. Various barriers and facilitators across multiple contextual levels influence the success of getting interventions into practice.*Implementation strategies* are the techniques used to overcome the barriers and enhance the facilitators to increase the uptake of evidence-based interventions within service delivery systems. It is essential to track and report these strategies with sufficient detail in order to build a stronger evidence base for implementation strategies.

Objectives: The purpose of this naturalistic, observational study was to identify and describe the implementation strategies used to put the World Health Organisation Caregiver Skills Training (WHO CST) intervention into practice in real-life, resource-limited settings in South Africa.

Methods: We used the strategy tracking approach developed by Bunger and colleagues to generate detailed information about the types of strategies used during the different phases of implementation. This approach allowed us to gather retrospective and prospective data from a variety of project personnel. This presentation focuses on the retrospective data collected during the earlier planning and exploration phases of the project. This process entailed the recall and review of project calendars, project progress reports, meeting minutes and project files during the planning and preparation months. Data regarding the implementation strategies were extracted and included in an activity log that recorded all the implementation activities (actions, methods, events, or efforts to promote adoption and facilitation of the intervention, including the purpose, estimated length of time, and individuals involved). Data were then coded to identify distinct strategies. Using a consensus approach, two coders categorised each activity according to the ERIC taxonomy of implementation strategies.

Results: Our systematic documentation and classification of implementation strategies was useful for capturing and specifying a broad range of formal and 'behind the scenes' strategies that can be replicated in research and practice. The key actions identified during the planning and preparation phases included: (1) the development of stakeholder interrelationships, (2) the training and education of stakeholders, and (3) adapting and tailoring to the local context. As an applied example, we report on the type of strategy used, the action, actor, target, temporality, dosage (participants and hours of effort), outcome, and justification for each of the three main categories identified in this study.

Conclusions: The use and tracking of implementation strategies are particularly important in resource-limited settings, where a lack of resources with which to implement public health programmes necessitates that the project leadership and implementation teams utilise existing resources thoughtfully. Studying and documenting strategies used during the planning and preparation phases of implementing the WHO CST intervention in South African settings allowed us to capture strategies that may be extremely important, yet less observable and unique to resource-limited environments. Furthermore, it provides a more nuanced understanding of what it takes to implement interventions in resource-limited settings.

318.004 *(Oral)* Does Gender Matter for Intervention and Personalized Support? the Perspective of Francophone Autistic Women in Quebec

***I. Courcy**, Sociology, University of Quebec in Montreal, Montreal, QC, Canada*

Background: There has been a growing interest in the reality autistic women in recent years. The intersectional approach is proposed in social research in order to reveal the specific barriers faced by autistic women according to the intersection of their multiple social identities (Saxe 2017). Many suggest that interventions and formal support should be tailored to the specific experiences of these women. But what do *they* think about that?

Objectives: This exploratory research aims to present the perspective of Francophone autistic women on the interventions and supports offered to them in Quebec.

Methods: Participants (n=16) were recruited through a call for research posted on university bulletin boards and on social media. The participants are between 19 and 51 years old and live in Quebec (Canada). They have been diagnosed with ASD or Asperger's syndrome. Two interviews (in person or online) were conducted in French with each of the participants. The phenomenological analysis of the data (van Manen 1990) provided their perspective on the support services offered to them as they experience it as an autistic woman.

Results: Participants talked about gender as a social performance and convention and several gender inequalities were raised. The majority of them critiqued the predominantly "masculine" social representations of autism. Many regretted that girls and women are poorly represented in research and cultural productions.

They shared a vision of themselves that went against what they identified as attributes related to the traditional diagnostic categories based on the "male profile". For example, some said they were very empathetic, had an interest in helping relationships, and had “no interest in trains or mathematics”. Some participants felt that being a girl had contributed to their late diagnosis, obtained as a result of hospitalization for a mental health problem. Based on their personal experiences, some felt that autistic women are more at risk of abuse, exploitation or violence in relationships and jobs.

Many disagreed with behavioural interventions because they aim to “normalize” and “conform” them. Other forms of specialized support were perceived as "enclosing" them in the diagnostic category. Another criticism was the massive investment in genetic research at the expense of finding concrete solutions for people's everyday lives. Finally, participants said they wanted to seek professional training to help others. They explained the added value of their experience to better understand, intervene and support autistic people.

Conclusions: The results show an overall perceived mismatch between the needs of autistic women and the measures of support generally offered. The professionalization of some to intervene in the field of autism appears as a self-determining initiative in the autistic community. The results illustrate the interaction between the social identities of being women and being autistic. Other research is necessary to continue this exploration by integrating other social identities (e.g. ethnicity, social class, sexual orientation). Taking into account people's point of view from their own interpretation scheme is an ethical and relevant way to advance knowledge about the social experience of autism.

POSTER SESSION — INTERNATIONAL AND CROSS-CULTURAL PERSPECTIVES
426 - International and Cross-Cultural Perspectives Posters

426.001 *(Poster)* A Country Profile: Bulgarian Children with ASD

***M. Barokova** and H. Tager-Flusberg, Department of Psychological and Brain Sciences, Boston University, Boston, MA*

Background: Bulgaria has a population of 7 million, out of which 670,000 are children between 0 and 9 years. Currently, there are no official statistics on the number of ASD diagnoses. However, the increasing number of conferences for clinicians, and workshops for parents, combined with the establishment of treatment/intervention centers around the country suggests that there is a growing awareness and demand for ASD services. Yet, little is known about the unique country/culture/language-specific characteristics of Bulgarian children with ASD, and these need to be considered in the choice and design of treatment/intervention services.

Objectives: I. To characterize an urban Bulgarian sample of children with ASD in terms of demographics, symptom severity, non-verbal IQ, and expressive vocabulary. **II.**To examine change in those characteristics one year later as a measure of effectiveness of already utilized treatments.

Methods: Thirty-eight children (9females) between the ages of 2;7 and 8;10 (*M*age=5;9) were recruited from local resource centers. All children had a community diagnosis of ASD or PDD based on ICD-10 criteria. In this study, diagnoses were confirmed with the ADOS. Participants were administered the MSEL Fine Motor (FM) and Visual Reception (VR) subscales to obtain a measure of non-verbal IQ. Participants’ parents filled out a demographic questionnaire, and the Bulgarian adaptation of the MCDI: Words and Sentences to obtain a total raw score of number of words the child uses. There were two data collection waves: N=20 in summer 2018, and N=18 in 2019. Twelve children from 2018 were re-tested in 2019 following the same procedure.

Results: I.Profile: There was a wide range of symptom severity, non-verbal IQ, and language ability in our sample (Table.1). The majority of parents had a college degree and average income (Table.1). Children’s MCDI raw scores were negatively correlated with their ADOS total scores ($r(35)=-.576$, $p<.01$), and positively correlated with their MSEL FM ($r(28)=.779$, $p<.01$) and VR raw scores ($r(25)=.748$, $p<.01$).

II.Assessment of Change: For the 12 (2 F) re-tested participants, there was a significant increase in MCDI scores (Z=-2.134, p<.05), MSEL FM (t(9) =-2.58, p<.05) and VR scores (t(8)=-2.32, p<.05), but no change in ADOS scores. Children's MCDI scores at T2 were correlated with their MCDI scores (rs(10)=.874, p<.01), MSEL FM (rs(8)=.879, p<.01), VR scores (rs(8)=.827, p<.01) at T1.

Conclusions: Our urban Bulgarian sample was marked by heterogeneity in all examined characteristics consistent with the literature on children with ASD from other countries. Even though all participants' native language was Bulgarian, more than half were exposed to English. Parents revealed that exposure came from educational videos, and that their children used many English words. This warrants further investigation of the nature of the exposure, and how it relates to children's language. Nevertheless, children's vocabulary in Bulgarian was associated with their symptom severity, and non-verbal IQ as reported in the literature, and similar associations were found across time. It remains to be determined whether the reported changes in ability across time are the result of development or of the increasing number and quality of services becoming available in Bulgaria, like ABA, ESDM, and OT.

426.002 *(Poster)* A Qualitative Look at the Autism Diagnostic Interview-Revised Spanish

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Background: Autism diagnostic instruments, such as the Spain-based rendition of the Autism Diagnostic Interview-Revised (ADI-R; Lord, 1994) may not match the cultural and linguistic needs of Latin American families, both in the U.S. and in Latin America. Both the wording of the translations and the cultural context of the respondents may impact the culture-based construct validity of the instrument.

Objectives: The purpose of this study was to qualitatively assess the culture-based construct validity of select ADI-R items for use among Spanish-speaking populations, including Latina mothers of children with Autism in Guatemala and the U.S.

Methods: There are two unique phases of this study. First, we conducted a qualitative analysis of how U.S.-based Latina mothers responded to select ADI-R items. We drew from a sample of 50 Spanish speaking mothers from a sample of 50 previously recorded and de-identified administrations of the ADI-R Spanish (Magana, 2017). Phase one participants were recruited from clinics and parent support groups in two Midwestern U.S. cities (Magana, 2017). In this phase, we used inductive analysis to explore theories of cultural mismatch of the items and deductive analysis to generate themes that characterize how mothers are reporting symptoms. In the second phase, we conducted cognitive interviews with 7 mothers of children with Autism living in Guatemala. Mothers were probed on ten specific ADI-R items (selected by analyzing the results from the U.S.-based sample) to discuss how they perceived the questions. Inductive and deductive analysis was conducted by a primary and secondary coder to develop a thematic codebook.

Results: We identified various themes, including terminology and concept mismatch, respondent-introduced vocabulary, child-caretaker language mismatch concerns. Terminology was a common issue. For example, "*pronunciación* (pronunciation)" versus "*articulación* (articulation)" caused some confusion. There were also some conceptual mismatches, such as with the phrases "*frases raras* (weird phrases)" as well as, "small talk" and "hobby". Respondent-introduced vocabulary for child behaviors, particularly related to speech, social communication, and socially inappropriate behaviors. For example, mothers used the terms "*mochos*" and "*chipilón*" to describe their child's speech production. Lastly, analysis of the responses revealed that some U.S.-based Latina mothers may feel they cannot adequately judge their child's communication abilities due to language differences in the parent-child dyad.

In the Guatemalan sample, impressions and reactions to the ADI-R Spanish were overall positive as mothers valued the utility of the instrument in helping researchers, clinicians and families better understand Autism and their child's development. Mothers found the ADI-R Spanish tends to be wordy and would prefer questions be asked using more direct language. There was one item which some mothers pointed out as offensive and inappropriate due to the terminology used to describe a child with autism.

Conclusions: Latina mothers recognize the importance of measures like the ADI-R Spanish; yet cultural challenges are apparent. Themes were consistent across two samples and two qualitative methods. Results obtained will inform our future exploration of the cultural appropriateness of the ADI-R items and their use in research and clinical work with families of children with autism from Latinx backgrounds.

426.003 *(Poster)* Autism Services in Taiwan: Examining How Parents of Children with Autism Spectrum Disorder Perceive and Select Intervention Options

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Background: Although there currently does not exist a cure for ASD, an overwhelming number of interventions exist, with only a small subset of these interventions grounded in research. For parents, the selection of interventions for their child is one of the first decisions they must make following their child's diagnosis and, despite their best efforts, studies have shown that some parents engage in interventions that are ineffective, lack evidence, or are even harmful (Green, Pituch, Itchon, Choi, O'Reilly, & Sigafoos, 2006). Much of the literature related to decision-making is based within a Western cultural context, and less is known about how parents from other cultural backgrounds (e.g., Chinese) make these complex decisions.

Objectives: This study will expand on the limited knowledge on what types of interventions parents in Taiwan have used, are currently using, and would like to use. Specifically, this study will examine parents' knowledge of and attitudes towards ASD and various ASD interventions, and will identify factors that contribute to parents selecting or rejecting certain interventions for their child.

Methods: Framed within the Health Belief Model, a questionnaire was developed to examine parent knowledge, attitudes, and practices related to ASD and ASD interventions. Parents were asked 10 true/false questions about their knowledge of ASD and 11 questions, on a Likert-type scale, on their attitudes about ASD. Parents were also asked about what types of ASD services they are using, would like to use, or have previously used. In total, 170 parents who have a child (2 to 18 years old) with ASD in Taiwan completed the survey.

Results: Preliminary analyses show that, overall, parents had a good knowledge of ASD. Although the majority (86.9%) of parents had positive attitudes about their child's life, most parents (83.4%) also reported feeling stress due to their child's diagnosis. When deciding on an ASD intervention, parents rated distance, cost, and recommendations from medical professionals as the most important factors they consider. In terms of which services parents felt were most beneficial to their child's outcome, parents rated occupational therapy (40.6%), followed by applied behaviour analysis (13.7%), and parent training (12.6%) as the top services.

Conclusions: Preliminary results suggest that, although parents have a good understanding about ASD, there are still many barriers that exist for service utilization. In further analyses, we will examine what factors influence parental decision-making in selecting ASD interventions. A better understanding of how parents in Taiwan perceive ASD and ASD treatments may help inform future public health policy to address barriers that exist for parents.

426.004 *(Poster)* Barriers to Access Health Care Among Brazilian Children and Adolescents with Autism Spectrum Disorders

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Background: Most people with autism spectrum disorder (ASD) from low-middle income countries face major barriers to receive satisfactory treatments from the health care systems. Lack of infrastructure is usually one of the main obstacles to access care, but sociodemographic factors can play a role in the process. Identifying such factors could help promote better assistance for the ASD population.

Objectives: to identify sociodemographic characteristics related to the received health treatments and barriers of access among Brazilian children/adolescents with ASD.

Methods: Study Design: Cross-sectional study. Sample: 927 families from all of five Brazilian regions who had children with ASD aged 3-17 years. Instrument: Brazilian version of the Caregivers Needs Survey questionnaire developed by Amy Daniels & Autism Speaks and completed online. Four multiple logistic regression analyses were used to identified predictors of the main health services received and the main barriers to access to treatment.

Results: The most commonly received treatments were behavioural intervention (32.4%) and drug treatments (28.1%). The main access barriers were structural: waiting lists (59.6%) and costs (38.7%). Health care received and barriers faced by individuals with ASD varied according to familial/individual sociodemographic characteristics: (1) families who exclusively used the public health service ($p < 0.01$) and whose parents/caregivers had lower education ($p < 0.01$) had a reduced chance of accessing **behavioural intervention**; (2) younger children (3-6 years old) received less **medication** than older children/adolescents ($p < 0.01$); (3) younger children (3-6 years old; $p < 0.01$); public health users ($p < 0.01$; 95%); children of less-educated parents/caregivers ($p = 0.04$); and those living in a state capital ($p = 0.04$) reported more problems with **waiting lists**; and (4) health insurance/private users ($p = 0.08$) faced more difficulties to access care than public health users, due to **cost of treatment**.

Conclusions: Brazilian families of children/adolescents with ASD face significant barriers to access to care that are influenced by children/adolescent's age, the region of residence, type of health care system used and the parents/ caregivers' education.

426.005 *(Poster)* Characteristics of AI/an Children and Families Referred for ASD Evaluation in Rural and Urban New Mexico

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Background: A limited amount of research is available about Autism Spectrum Disorder (ASD) in American Indian or Alaska Native (AI/AN) children in the United States. The most recent ADDM Network review gathered information about diagnosis and treatment in a population sample with less than 1% AI/AN children (Baio, Wiggins, Christensen, et al., 2018) and reported no statistics on age of diagnosis or disparities. Mandell et al. (2002, 2009) reported that AI/AN students among other minorities were less likely to be identified with ASD. Tincani, Travers, and Boutot (2009) hypothesized lack of access to adequate health care as a major barrier to AI/AN children obtaining an adequate diagnosis of ASD. New Mexico is a frontier state due to its low population and barriers to accessing resources. About 10% of its population is AI/AN with nineteen Pueblos, two Apache tribes, and the Navajo Nation. In light of the minimal amount of research, it is imperative to understand the characteristics of AI/AN children referred for a diagnostic evaluation for ASD in order to reduce barriers and provide adequate care.

Objectives: We compared referral sources, urban vs. rural area, age of diagnosis, and characteristics of ASD and neurodevelopment (i.e., language and cognitive abilities) between AI/AN and white children referred for clinical evaluation of ASD in New Mexico.

Methods: Analysis consisted of 68 AI/AN and 381 white children evaluated at UNM's Autism Spectrum Evaluation Clinic (ASEC) compiled data using information from clinical evaluations. Rural definition was based on the Office of Management and Budget (OMB) counties in New Mexico.

Results: Sixty-five percent of AI/AN children evaluated received a diagnosis of ASD in contrast with 57% of White children, which was not a significant group difference ($t = 1.15$, $p = 0.25$). Twenty-four percent of the AI/AN families were considered rural, the majority of referrals (43%) come from PCPs, and the average age of evaluation was 6 years old for AI/AN children, no group differences were found. Forty-six percent had received early intervention in contrast to White children (51%), and 19% had already received an educational eligibility of autism in contrast to 25% of White children. These differences did not reach statistical significance. Fifty percent of AI/AN who received a diagnosis of ASD also received a Language Disorder diagnosis, a significant difference to the 30% of White children, $t = 2.48$, $p = 0.014$. No significant group difference was found for children with ASD and a diagnosis of Intellectual Disability or Global Developmental Delay.

Conclusions: Our analysis provides a first step in understanding characteristics AI/NA referred for ASD evaluation. No significant group difference based on race (AI/AN vs. White) was found for referral sources, urban vs. rural area, age of diagnosis. A significant difference was found for children who receive diagnoses of ASD and Language Disorder. Future directions include clarifying the difference in language profiles of AI/AN children diagnosed with ASD and assess barriers and access to diagnostic evaluations.

426.006 *(Poster)* Combining Parents Taking Action and Pivotal Response Training to Support Latinx Mothers of Children with ASD

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Background: In 2018, approximately 59.9 million Latinx people resided in the United States, of which 18 million were children (Pew Research Center, 2018; 2019). Although the Latino population comprises the largest ethnic minority group in the US, there have been identified disparities in ASD diagnosis and treatment access. Few diagnostic tools and intervention programs have been designed and explored for use with Latino children with ASD and their families. Parents Taking Action (PTA), is a culturally informed intervention program for Latinx families. PTA has been effective to enhance parent outcomes and improve use of services for Latinx children with ASD (Lopez et al., 2019). However, PTA has traditionally been a didactic program. Previous participants have requested behavioral coaching with their children in order to enhance the impact of the didactic format of PTA. In this study, we supplemented PTA with pivotal response training (PRT) sessions with Latina mothers of children with ASD. PRT was selected as the behavioral coaching model, given the emphasis on using naturalistic opportunities to enhance children's functional skills and communication. By including PRT with PTA, this study provides insight into culturally informed intervention along with the utility of PRT with a culturally diverse sample.

Objectives: Explore the impact of a culturally informed program and pivotal response training support on Latina mothers' use of intervention strategies.

Methods: Ten Latina mothers of children diagnosed with ASD were recruited for participation. Due to the attrition of three mothers, this study includes data from the seven mothers who completed all study components. Children were aged 2 to 7 years (See Table 1). Mothers received 14 2-hour sessions of the PTA program in their homes, from two *promotoras* (community healthcare workers). PTA content covers general information about ASD, treatment services, advocacy, self-care, and strategies to enhance children's social communication. Mothers also received 4 one-hour sessions of pivotal response training (PRT) from bilingual/bicultural coaches. Mothers completed questionnaires regarding child, parent, and family outcomes pre-intervention, post-intervention, and follow-up. Ten minutes of parent-child interaction were audio-visual recorded at these time points, if mothers agreed to the taping. We conducted paired sample t-tests to assess for changes in mothers' efficacy in using the strategies and frequency of using the strategies. Ongoing coding of parent-child interactions is currently underway.

Results: Paired samples t-tests indicated that mothers' report of efficacy in using the strategies and frequency of using the strategies was significantly greater after completing the intervention program (see Table 2).

Conclusions: The results of our study indicate that Parents Taking Action and PRT coaching have a positive impact on Latina mothers efficacy in using intervention strategies with their children. The study offers a unique and culturally informed model of intervention that fills the gap in need Latinx families experience as they raise children with ASD. Given the growing number of Latinx children diagnosed with ASD, this culturally informed intervention program offers a solution to the lack of ASD interventions designed for Latinx families of children with ASD. Limitations and implications of this study will be discussed.

426.007 *(Poster)* Cross-Cultural Differences in Vaccine Hesitancy and Attributions for Autism in Parents of Children with Autism

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Background: Vaccine hesitancy refers to a continuum of concerns about vaccines, including acceptance of vaccines in light of questions about their safety, as well as delays/refusals of some or all vaccines. In a recent study of 225 parents of children with autism spectrum disorder (ASD), 29% of parents were vaccine hesitant; significantly higher proportions of parents of color (collectively, Asian, Black, Hispanic, Other, or Bi-/Multi-Racial; 49%) were vaccine hesitant compared to White parents (22%; $p<.001$), which suggests important differences in beliefs about a link between ASD and vaccines across cultures.

Objectives: To (a) calculate the prevalence of vaccine hesitant parents (VHPs) within the SPARK (Simons Foundation Powering Autism Research for Knowledge) cohort, specifically across racial/ethnic groups; (b) compare beliefs about causes of ASD between hesitant and non-hesitant parents and across racial/ethnic groups; and (c) examine beliefs in causes of ASD and sociodemographic factors (e.g., parents' race/ethnicity, education level, household income) as predictors of vaccine hesitancy.

Methods: 8,854 SPARK parents completed the *Parents Attitudes about Childhood Vaccines* questionnaire (PACV; measure of vaccine hesitance) and the *Revised Illness Perception Questionnaire-ASD* (IPQ-R-ASD; measure of attributions for child's ASD). Descriptive statistics were calculated to determine prevalence of VHPs across racial/ethnic groups and other sociodemographic factors. Chi-square analyses compared sociodemographic characteristics between hesitant and non-hesitant groups, as well as personal beliefs about causes of children's ASD (IPQ-R-ASD Cause scale) across racial/ethnic groups.

Results: 22% of parents (n=1,962) were vaccine hesitant (PACV score≥50). VHP were less likely to be White (p<.0001) and were more likely to be American Indian (p=.0016), Black (p<.0001), Other (p<.0001), or Hispanic (p<.0001). Regarding causes, VHPs were more likely to attribute accident/injury (32% vs. 21%; p<.0001), alcohol consumption (31% vs. 22%; p=.0033), deterioration of child's immunity (57% vs. 17%; p<.0001), diet (40% vs 18%; p<.0001), environmental pollution (34% vs. 16%; p<.0001), worries about ASD (35% vs. 21%; p<.0001), general stress (27% vs. 20%; p<.0001), germ/virus (44% vs. 19%; p<.0001), in utero stress/accident (24% vs. 21%, p=.0003), negative attitudes (33% vs 22%; p<.0001), own decisions (30% vs. 21%; p<.0001), own emotional state (25% vs. 22%; p=.0035), poor medical care (50% vs. 20%; p<.0001), stress at birth (30% vs. 19%; p<.0001), and toxins in vaccines (78% vs. 10%; p<.0001) as causes of their child's ASD. In contrast, VHP were less likely to endorse chance (16% vs. 24%; p<.0001), parental age (19% vs. 23%; p=.0006), child's brain structure (17% vs. 31%; p<.0001), and genetics (18% vs. 35%; p<.0001) as causes. Further analyses examining racial/ethnic differences in endorsement of causes and predictors of vaccine hesitancy are forthcoming.

Conclusions: VHPs were less likely to endorse known causes of ASD (e.g., age, brain structure, and genetics) as causes of their child's ASD. Given similarities in this cohort compared to earlier work, it is expected that there will be different patterns of agreement with causes of ASD as a function of race by hesitancy status. This information may inform the design of targeted, preemptive educational information about vaccine safety that may need to be tailored to different cultural groups.

426.008 *(Poster)* Cross-Linguistic Evaluations of Language and Communication Among Bilingual (English/Spanish), Latino Children with Autism Spectrum Disorders

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Background: Latino children are affected by significant disparities in the diagnosis and treatment due to a number of cultural and linguistic factors (Zuckerman et al., 2014). A primary concern among Latino parents in the U.S. is whether bilingual exposure will result in further delays in their child's language and communication development. Emerging research on bilingual children with ASD finds little to no differences on early language milestones/development (e.g., vocabulary knowledge; Hambly & Fombonne, 2012; Petersen, Marinova-Todd, & Mirenda, 2012). However, most studies are based on retrospective review of clinical and educational records and parent's recall of child's early development. It is also unclear whether language profiles of bilingual children can be adequately measured by a single instrument and whether clinical and cognitive factors contribute to the development of both languages among bilingual children with ASD.

Objectives: The objective of this research is to compare English and Spanish profiles of bilingual, Latino children with ASD across multiple language measures and to examine underlying clinical and cognitive factors.

Methods: Latino children were eligible to participate if they had a prior ASD diagnosis, were between 6 and 14 years of age, and used verbal language to communicate in English and Spanish. Parents completed a battery of demographic and research questions, including the Language Background and Experience Questionnaire, the Social Communication Questionnaire, and the Behavior Rating Inventory of Executive Function (BRIEF). Children completed the Raven's Standard Progressive Matrices, core language and word association subtests from the Clinical Evaluation of Language Fundamentals-4th version, and two narratives based on the Frog, where are you? series by Mercer Mayer. Children completed all language measures in both English and Spanish, with each language assessed in separate sessions. To date, 13 children with ASD have participated in the research study, recruitment is ongoing.

Results: For the majority of the children (92%), Spanish was the first language learned, with most children learning their second language at 4.5 years of age. No significant differences were found across CELF-4 English and CELF-4 Spanish subtests (all p's > .05). Additional analyses found that BRIEF Global Executive Composite scores were negatively associated with CELF-4 English Core Language scores, $r(9) = - 0.827$, $p = .006$, CELF-4 English Expressive Language scores, $r(9) = -.718$, $p = .029$, and the CELF-4 English Word Association scores, $r(11) = -.615$, $p = .044$. Additionally, SCQ total score was positively associated with CELF-4 Spanish Word Association scores, $r(11) = -.653$, $p = .029$. Further analyses will explore these associations in a larger sample and will examine children's linguistic profiles in a narrative task administered in English and Spanish.

Conclusions: The preliminary analyses suggest that clinical and cognitive symptoms may function in a distinct manner in bilingual, Latino children with ASD. Executive functioning was found to be related to English language skills; whereas ASD symptoms were related to more efficient retrieval of semantic information in Spanish. The results of this can be used to inform culturally-sensitive interventions and therapies that can support the development of bilingual children with ASD.

426.009 *(Poster)* Determining Future Directions for Parent Education & Training Programmes in Autism Spectrum Disorder

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Background: The World Health Organization has recognised Autism Spectrum Disorder (ASD) as a public health concern and have recommended access to appropriate assessment and interventions. Psychoeducation and parent support soon after diagnosis are considered global best practice. Parent Education & Training (PET) programmes provide education, skills and support to parents. Despite the high need for PET there has been limited research in this field and few programmes are available, particularly in low- and middle-income countries (LMIC).

Objectives: To determine future directions for Parent Education & Training programmes in low-resource environments by 1) evaluating the broader evidence-base of PET; 2) conducting a comparative feasibility study of two PET programme in South Africa.

Methods: A scoping review of all peer-reviewed publications outside the USA was conducted. Two reviewers independently searched seven key databases for titles and abstracts. Four reviewers extracted data with a focus on descriptive characteristics of PET programmes, research methodologies and implementation factors. A mixed-methods quality appraisal of publications was performed. A comparative feasibility study of two PET programmes in a low resource setting was also conducted. EarlyBird/EarlyBird Plus (EB/EBP), a UK developed 12-week programme was compared to Autism Cares (AC), a locally developed 5-day programme. A mixed method, quasi-experimental design was used to collect pre, post, and 3-month follow-up data. Measures included standardised and custom-designed quantitative outcome measures and qualitative semi-structured interview data. A multi-stakeholder group used an ASD PET evaluation framework to compare the programmes.

Results: A total of 37 publications were found in the scoping review. These described a highly diverse range of PET programmes across 20 countries. Programmes varied significantly in their goals, modalities and length. A broad range of outcomes measures were used. Quality appraisal rated only 27% of studies to have met all the methodological quality criteria. Factors relevant to implementation such as manualisation, fidelity and cost were commented on infrequently.

In the comparative feasibility study eighteen parents participated in the EB/EBP programmes and eleven in Autism Cares. Strong parental acceptability for both programmes was found along with the need for some adaptations to the local context. Limited efficacy testing showed positive changes for parental stress, knowledge of ASD and changes in child, more so for EB/EBP. The multi-stakeholder group judged EB/EBP as most suitable for next-step research citing factors relating to implementation including scalability and sustainability.

Conclusions: Our findings contributed to the limited evidence-base for ASD PET in low-resource environments and highlighted the need for global collaboration in this area. We propose the following five recommendations for future directions of PET programmes: 1) expansion of local PET research in different settings; 2) creation of standardised outcomes for PET through involvement of global stakeholders; 3) dissemination of PET findings and lobbying of potential funders; 4) setting up of a global PET network; 5) caution around implementation of PET programme without a robust evidence-base that includes intervention outcomes as well as implementation outcome data.

426.010 *(Poster)* Diagnostic Patterns and School Placement Outcomes in Children with Autism Spectrum Disorder in Singapore

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Background: Early identification of children with Autism Spectrum Disorder (ASD) leads to early access to intervention and better outcomes. The estimated prevalence in Singapore is 1%, although there are no national prevalence data. KK Women's and Children's Hospital (KKH) is the larger of two national Child Development Programme (CDP) assessment centres focusing on preschool diagnosis and intervention. KKH sees approximately 70% of national CDP referrals and utilises an ASD-specific interview and the Autism Diagnostic Observation Schedule (ADOS),with reference to the DSM criteria for diagnostic confirmation. Children who meet DSM criteria but whose parents declined the ADOS would be given a clinical diagnosis of ASD.

Objectives: This study aimed to examine diagnostic patterns (e.g. age of presentation with ASD, diagnostic trends) and school placement outcomes in children with ASD at a tertiary level child development centre in Singapore.

Methods: A retrospective review of clinical records was conducted from 2017 to 2019, for children who were born in years 2008, 2009, 2010 or 2011, and who received a diagnosis of ASD or who were referred to the ASD Clinic.

Results: Data were collected from 2577 children (82.7% males, 66% Chinese). 1859 (72.1%) underwent an ADOS and 1805 (97.1%) were confirmed to have ASD. On longitudinal follow-up, 2205 continued to have an ADOS or clinical diagnosis of ASD.

Of these 2205, although 1643 (74.5%) had an initial clinical diagnosis of ASD, a further 241 (10.9%) were initially diagnosed with Developmental Language Disorder and 240 (10.9%) with Global Developmental Delay.

There was a significant effect of birth-cohort on the age of presentation (Welch's $F(3,1182)=13.2$, $p<0.001$). Children with ASD born in 2011 presented at higher numbers and an earlier age ($n=607$, *M(SD)*=3.07(0.90) years), than those born in 2010 ($n=582$, *M(SD)*=3.27(1.04) years), 2009 ($n=567$, *M(SD)*=3.25(1.04) years) and 2008 ($n=449$, *M(SD)*=3.45(1.05) years).

There was also a significant effect of race on the age of presentation ($t=5.8$, $p<0.001$). Chinese children with ASD presented at an earlier age ($n=1447$, *M(SD)*=3.16(1.00) years), than those of other races (Malay, Indian, Eurasian and Others) ($n=757$, *M(SD)*=3.42(1.03) years).

There was no significant effect of gender on the age of presentation.

School placement outcomes were available for 1428 of the 2205 with a final diagnosis of ASD. 685 (48.0%) went to mainstream primary schools, 321 (22.5%) went to a specialised ASD school offering mainstream curriculum, 297 (20.8%) went to specialised ASD programmes offering functional curriculums, and 125 (8.8%) went to specialised schools for intellectual disability. Of the 685 children in mainstream, 240 (35.0%) were originally recommended specialised school placement following formal psychological school readiness assessments.

Conclusions: The age at which children with ASD first present to child development services has shown a decrease across the years. The effect of race warrants more investigation as to whether this is due to social inequalities, or differing cultural awareness of ASD. Having data on school placement outcomes will also guide resource allocation to tailoring appropriate mainstream or specialised school support where it is most needed.

426.011 *(Poster)* Disparities in Access to Autism Services Funding By Aboriginal Status Among Children in British Columbia, Canada

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Background: Although rates of disability among Aboriginal children are twice that of all Canadian children (Di Pietro & Illes, 2016), the exact prevalence of Autism Spectrum Disorder (ASD) among Aboriginal children in Canada remains unknown. Government data suggest that the rates among Aboriginal children and non-Aboriginal children are similar, but that Aboriginal children may receive experience delays in ASD diagnosis.

Objectives: Given early access to ASD services has been shown to improve outcomes for children with ASD and their families (Bhopti, Brown, & Lentin, 2016), and the importance of equitable representation of children of all backgrounds in research (Di Pietro & Illes, 2014); the goals of this project were to: 1) assess differences in average age of ASD diagnosis between Aboriginal and non-Aboriginal children in British Columbia (BC) and, 2) depict the dispersion of registered autism service professionals, as a potential means of understanding disparities in access to autism services.

Methods: The ministry that oversees ASD service funding in BC shared data (December 2014 – August 2017) with the second author on the average age ASD funding case opened, and number of children receiving ASD funding, by aboriginal status, funding age category (under age 6, 6 - 18 years), and service delivery area (SDA). Descriptive analyses were conducted to compare the average age of ASD diagnosis, and proportion of Aboriginal and non-Aboriginal children receiving ASD funding in each age category and SDA, as well as in BC overall, and to identify the number of registered autism service providers in each SDA. Age disparities and dispersion of registered autism professionals will be depicted visually via a map of BC.

Results: Preliminary results suggest Aboriginal children comprise 9.98% of the population of all children in BC under age six, but receive only 7.18% of the ASD funding. For children six to 18 years, Aboriginal children represent 9.93% of the population and receive 6.71% of ASD funding. With regard to age disparities, Aboriginal children in BC receive ASD funding 4.08 months later than non-Aboriginal children in the under age 6 program, and, 6.40 months later, in the 6 –18 program. In two of the 13 SDAs, there are fewer than 10 registered autism providers, however, these do not coincide with SDAs with the greatest age disparities.

Conclusions: Aboriginal children in Canada face significant health disparities and underrepresentation in research. However, little remains known regarding ASD among Aboriginal children in Canada and internationally. Research on specific health disparities represents a critical step in addressing this inequity. Preliminary analyses suggest Aboriginal children may be less likely to access and/or experience delays in accessing early intervention services compared to non-Aboriginal children, and these disparities do not appear to be due to limited access to registered autism professionals in rural and remote locations. The project findings have the potential to increase awareness of disparities in research and service provision among Aboriginal children, and serve as a catalyst for developing public policies and services that address the specific needs of Aboriginal children with ASD in Canada.

426.012 *(Poster)* Disparities in Reported T-Scores of the 65-Item SRS and 16-Item SRS By Social Demographic Characteristics

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Background: The Social Responsiveness Scale (SRS) is an instrument that characterizes quantitative impairments in social reciprocity that define Autism Spectrum Disorder (ASD). This tool is able to assess autistic traits in large population-based studies because it quantifies dimensional impairments of ASD, and can be used in different settings against different norms and subgroups such as gender, age, or racial/ethnical background. Nevertheless, the 65-item SRS includes many items that are sensitive to (and can be influenced by) multiple factors, such as expressive language, global developmental level, behavior problems, age, and gender, according to previous studies. Therefore, a 16-item short form has been developed to only include items that are not significantly affected by those factors in the measurement of ASD symptoms.

Objectives: To compare internal consistency of the 65-item SRS (i.e. full form) and 16-item SRS (i.e. short form), and to examine disparities in reported T-scores of the full form and short form by child sex and social demographic characteristics in a community population of children aged 6-8 years.

Methods: The SRS data were collected by an epidemiologic autism study conducted in Pingtung, Taiwan. A total of 2917 caregivers completed the SRS for 1401 male and 1516 female children. Cronbach's alpha was calculated to evaluate the internal consistency. T-scores of both forms are standardized by the whole population.

Results: The short form demonstrates good internal consistencies with Cronbach's alpha values of 0.8 or above for both sexes and combined group. The T-scores of the full and short forms are almost identical with similar distribution patterns across all the social demographic characteristics such as child's birth order, mother's education, father's education, and respondent's education. Male children have higher SRS T-scores than female children. As for the respondents, other relatives reported the highest scores and teachers reported the lowest scores. In addition, biological fathers reported higher scores than did biological mothers. Furthermore, children whose parents have a higher education level were more likely to be rated with lower SRS T-scores. When categorized by respondent's education level, the pattern of SRS T-scores was consistent with the parents' education level. The above-mentioned results are true for both full and short form T-scores.

Conclusions: As expected, Cronbach's alpha is lower for the short form than the full form; however, the short form still has good internal consistency. T-score distributions of both forms are almost identical. Reported T-scores in both forms have the same patterns by social demographic characteristics. That is, the disparity of reported SRS scores remains the same even in the short form, which was designed to remove potential biases due to multiple child factors. Since the reported patterns and T-score distributions are almost identical in the full and short forms, our findings support considering the use of the 16-item SRS short form as a substitute for the 65-item SRS to save time from administering the longer tool. This consideration is particularly important for a large-scale population-based study to make implementation more feasible.

426.013 *(Poster)* Early Identification for Developmental Delays and Autism in Vietnam: Roles of Care-Givers and Health Providers

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Background: Early detection and early intervention of autism and other developmental disorders plays a crucial role in maximizing the development of children with these conditions. In Vietnam, child's development monitoring is not included within routine health check-ups and is not well aware by parents. Thus, many children at risk of developmental disorders are not detected early enough leading to missed opportunities for interventions at the most effective time. This paper describes a pilot for two screening models for developmental disorders, using an on-line platform, A365.vn, available in Vietnam. These models are; 1) integrating screening into primary health-care for children, 2) enabling caregivers to undertake screening for their children. The screening tools: CDC Milestones Tracker, Age and Stage Questionnaire (ASQ)-3, Modified Checklist for Autism in Toddlers revised (M-CHAT-R; for caregivers) and M-CHAT-R with follow up (M-CHAT-R/F (for health workers)) were used in the pilot.

Objectives: To describe the implementation process and results of piloting these screening models.

Methods: In Model 1, healthcare workers are trained to use and integrate the CDC, ASQ-3 and M-CHAT-R/F tools into routine child-health care activities, in particular immunization. This model was piloted in one district in Vietnam from 2015 – 2016, and is currently being piloted in two other districts. In Model 2 awareness of developmental disorders and the need for screening was raised nationwide, mainly through social media. Caregivers were encouraged to conduct screening tests at home using the guidance and tools available on a365.vn

Quantitative data for both models, including registered users' demographics and the screening test results, were collected from the back-end of a365.vn between October 2015 to October 2019. Unfinished test result data due to system errors was excluded. Data was analyzed using Excel and SPSS software.

Results: A total of 31,135 screening tests were completed between October 2015 and October 2019. The children screened were between the ages of 1 - 66 months. The average age of children screened and identified at risk of developmental disorders was 27 months. This is consistent with another study conducted in Vietnam in 2018. This showed the average age when parents first take their child for a developmental delay diagnosis is 27.47 months.

The number of tests completed by caregivers was 6.5 times higher than those completed by health workers. The number of children identified at risk of developmental disorders by caregivers was also higher than those identified by health professionals. Tests done by health professionals were mostly undertaken with financial support from the project.

Conclusions: For Model 1, if developmental screening for young children is to become a routine part of regular health check-ups then greater involvement of the health-sector is required. There must be training and financial support for grass-roots health workers to enable them to provide this activity as part of routine primary health care. For Model 2, communication is vital in raising awareness about the importance of early screening for developmental risks, amongst parents and other caregivers, and to provide them with information and tools to undertake screening for their children.

426.014 *(Poster)* Early Recognition of Autism, Comprehensive Management, Novel Research Initiatives, Empowering Health Professionals and Health Care Providers in a Tertiary Care Center: Experience over Last Two Decades

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Background: Our division has been actively involved in innovative research, training of physicians, empowering parents and holistic management of children with Autism Spectrum Disorder

Objectives: To provide an overview of results of 26 clinical studies in children with autism in last eighteen years in Child Neurology Division, Department of Pediatrics, AIIMS, New Delhi.

Methods: Around 4,000 autistic children have been managed in last 2 decades. Over 1000 children have been enrolled in 26 studies involving diagnosis(early signs of autism screening tool, AIIMS modified INDT ASD Diagnostic tool(mobile app), oxidative biomarkers, eye tracking), pathogenesis(clinical/whole exome sequencing , chromosomal microarray, vitamin D, other micronutrients, blood heavy metals, quantitative EEG, functional MRI brain, gut microbiota dysbiosis, advanced paternal age affecting sperm epigenome), co-morbidities(epilepsy, sleep disturbance, executive function, quality of life-QoL, parenting stress, coping strategy, depression in mothers) and management of autism(predictors of response to Applied Behavior Analysis-ABA, Gluten Free Casein Free Diet, probiotics, music therapy, communication based parental intervention, weighed compression vest-WCV), Alternative and Augmentative communication. Ongoing studies are exploring virtual reality and artificial intelligence for intervention. Association of molecular, genetics and environmental markers in ASD are being studied. Training of about 350 physicians in four national workshops, disability certification of 300 children and have been accomplished in last 4 years. Tele-consultation services have been initiated

Results: AIIMS modified INDT Diagnostic tool (age 1-14 yrs) and early signs of autism screening tool (1-18 months) tool have good psychometric properties. About 11% children with autism were found to have some genetic etiology. Autistic children were found to have higher blood lead levels ($p=0.01$), abnormalities in quantitative EEG and executive function ($p<0.0001$). 78% autistic children had sleep disturbances, 21% had epilepsy. 76% mothers had depression. Caregivers of autistic children with hyperactivity and epilepsy had more impaired QoL. WCV was found to reduce hyperactivity, inattention and withdrawn behavior ($p=0.02$, 0.03, 0.04 respectively).Younger age, higher education of parents, absence of epilepsy or hyperactivity and longer duration of ABA is associated with favorable response.

Conclusions: Innovative research exploring biomarkers, targeting novel diagnostics and therapeutics are imperative for improving care of children with Autistic Spectrum Disorder

426.015 *(Poster)* Examining Sociodemographic Disparities in Amount and Type of Intervention Use

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Background: Research suggests that intervention for children with Autism Spectrum Disorder (ASD) in the preschool years plays a particularly vital role in beneficial outcomes (Zwaigenbaum et al., 2015). Unfortunately, many children do not receive intervention as early as they should for a myriad of reasons. Children from sociodemographic minority groups in the United States are at a particular disadvantage for receiving early interventions (Nguyen, Krakowiak, Hansen, Hertz-Picciotto, & Angkustsiri, 2016). Although there is emerging evidence documenting disparities for some sociodemographic groups in ASD treatment use, previous research has focused on a limited dichotomous variable of treatment receipt and typically examines a narrow definition of treatment types.

Objectives: To better understand the nature of treatment use disparities, the current study conducted a closer examination of how the specific number of weekly hours of multiple different intervention types differed between sociodemographic groups.

Methods: This study examined data collected from 2856 participants enrolled in the Simons Simplex Collection (SSC), a genetic and phenotypic database of individuals diagnosed with ASD (Fischbach & Lord, 2010). We examined the specific number of weekly hours of therapy in five different domains: Speech Therapy, Occupational Therapy, Intensive Therapy, Biomedical Therapy, and Classroom Intervention. Importantly this study looked at service utilization for the classically studied under five-year-old group as well as for children ages five and older. We looked to see if either age group differed on amount of weekly therapy based on sociodemographic variables including, mother and father education, annual household income, and family structure.

Results: Amount of occupational therapy (OT) for children under 5 years old was significantly related to mother, $F(7,167) = 3.89$, $p = .001$ and father, $F(8,167) = 3.45$, $p = .001$, education. Post hoc analyses revealed children whose father had an associate degree had significantly more weekly hours of OT ($M = 3.49$ hours) than those with a father that did not complete high school ($M = 0.27$ hours), $p = .005$. Similarly, follow-up analyses showed children with mothers who completed only some high school received significantly less OT hours than mothers with additional education: GED ($p = .000$), some college ($p = .000$), associates ($p = .000$), or bachelor's ($p = .000$). Amount of OT was not significantly related to any of the other examined sociodemographic variables. We did not find significant sociodemographic differences in any of the other four types of therapy examined for either age group.

Conclusions: In alignment with disparity reduction models that call for a better understanding of the inequities (Kilbourne, 2006), this research helps to demonstrate the extent of the problem by quantifying what types of treatment demonstrate the greatest disparities and by how much, through an examination of group differences in total numbers of weekly treatment. We found that parent education specifically impacted number of weekly hours of OT. Additional analyses will examine therapy use patterns among children 13 to 17-years-old and will also examine several additional sociodemographic factors such as child race and ethnicity.

426.016 *(Poster)* Examining the Association between Early-Life Language Exposure and Social Visual Engagement in Toddlers with and without Autism

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Background: Infants preferentially attend to areas of the face that support their developmental goals. Attention to the eyes of others supports social development, while attention to the mouths of talking faces varies depending upon the mouth's adaptive value for early language learning (Lewkowicz & Hansen-Tift, 2012). For example, when first learning to make speech sounds, attention to mouths increases; while once these skills become more advanced, it decreases. Relatedly, trajectories of preferential looking to eyes and mouths vary by early-life language exposure: as compared to monolingual infants, bilingual infants preferentially attend to talking mouths for a protracted developmental period (Pons, Bosch & Lewkowicz, 2015). These processes, however, have not been extensively studied in children exposed to multiple languages who also have either autism spectrum disorder (ASD) or other non-autistic developmental disabilities. Here we investigate how early-life language exposure affects attention to faces in a clinical sample of toddlers with ASD or with other non-ASD developmental disabilities.

Objectives: To examine the degree to which early-life language exposure is related to social visual engagement in toddlers with ASD or with other non-ASD developmental disabilities.

Methods: Parent-reported language exposure in the home and eye-tracking data were collected from N=74 toddlers (*Mage(SD)*=25.09(6.54) mos.); all had some degree of English and non-English language exposure. For language-exposure level, those reporting <40% non-English were labeled "partially bilingual" (n=48), while those reporting between 40-70% non-English were labeled "fully bilingual" (n=26). Each group was individually-matched to a comparison monolingual sample on chronological age, non-verbal cognitive function (age equivalence on the *Mullen* visual reception domain), sex, and diagnosis (ASD or non-ASD). All children received a comprehensive developmental assessment using standardized instruments (*ADOS*, *Mullen*). Eye-tracking data were collected while watching video scenes of children in daycare settings and were quantified by measuring percentage of visual fixation to eyes, mouths, bodies, and objects. Between-group differences in visual fixation were tested by ANOVA.

Results: Analyses revealed no main effect of language-exposure on fixation time (all $p>0.05$). Analyses also revealed no interaction between diagnosis and language-exposure (all $p>0.05$). Analyses did show a significant main effect of diagnosis on fixation to ROIs: toddlers with ASD fixated on eyes and mouths significantly less than toddlers without ASD and significantly more on bodies and objects (all $p<0.05$).

Conclusions: In a clinical sample of toddlers with and without ASD, early-life language exposure did not significantly affect visual fixation to eyes and mouths. Instead, although toddlers in this sample without ASD had other intellectual, developmental, and language disabilities, their levels of fixations to eyes and mouth were greater than children with ASD, regardless of language-exposure. These results show promise for the use of eye-tracking-based measures to identify children with ASD, regardless of language exposure. Future work will examine how accurately performance-based, eye-tracking measures of social visual engagement can match diagnostic outcomes established by expert clinicians in children with varying levels of non-English early-life language exposure.

426.017 *(Poster)* Experiences of African Parents of Children with ASD: Implication for Research and Practice

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Background: Autism is a neurodevelopmental disability that is characterized by difficulties in social communication, restrictive and repetitive behaviors and interests. Signs of ASD appears early in the child's early development.

Objectives: While autism is said to occur uniformly across cultures, little is known regarding the experiences of caregivers in the African region who generally lack proper assessment, diagnosis and intervention. This study sought to explore experiences of caregivers of ASD parents and their help-seeking behaviors.

Methods: An online survey was launched and distributed to African parents who were part of Pan African Congress on Autism. The survey was shared on 3 FB pages that are made up of parents of children with ASD. Participants came from 18 different African countries. The survey contained 21 questions and 155 parents/caregivers from 18 African countries. The purpose of the study was to understand the experiences of African caregivers of children with autism from the point they notice the first signs to diagnosis, intervention and education. The study also sought to understand help-seeking behaviors and struggles faced by caregivers.

Results: The participants included 125 boys and 31 girls. Age range of ASD individuals ranged from 18 months to 30 years of age. Out of 155 caregivers, 96% of caregivers noticed the early signs when their children were between ages 18 months-23 months; 24% noticed first signs between 24 months-35 months, 28% noticed between 0 and 35 months.

Of the 46% of the sample, caregivers noticed red flags before 24 months and 25% by age 3. When asked about early symptoms, 61% reported lack of communication as the first sign, 16%, repetitive and restricted interests, 9% sensory issues, and 14% other delayed milestones such as walking. Also, 47% of the children in the sample were nonverbal. When asked who they went to upon realizing that their child had a problem, 45% talked to a pediatrician, 31% talked to family members, 9% faith healers, 5.8% internet, 6% psychologist, 1.9% religious Leaders, and 1.2% psychiatrists.

Conclusions: In this pilot study, it is evident that African parents are recognizing the early signs early and are getting diagnosis early. The question however, remains, why does the prognosis remain poor? Although caregivers recognized early signs and received diagnosis, there were no available early intervention services. Worse still, although public education is free for primary age children in Africa, it is not free for children with Autism and families have to make arrangements for private school, provide an aide to accompany the child to public school or homeschool their child. While this is changing is some African countries, we are far from celebrating. As a results, parent and professional education in basic evidence based strategies would be beneficial for families. This will give them tools and strategies they need to help their children. Also, since over half of the parents went to pediatricians, providing pediatricians with information about autism, red flags and activities that parents can work on with their children at each developmental milestone would be helpful.

426.018 *(Poster)* Film and Television Representations of ASD: It's Not Just about Hollywood

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Background: Recent years have seen a surge of new films and TV shows about ASD (Rohr, 2015; Veltman, 2009). These portrayals of ASD can be useful, because despite of the increased prevalence, many people still have not had direct substantive contact or personal experience with individuals with ASD. Many people form personal perceptions of ASD based on the characters they observe on the screen (Nordahl-Hansen, Øien, & Fletcher-Watson, 2018). Yet, misrepresentations may inadvertently shape misperceptions about individuals with ASD(Berger, 2017). Many characters with ASD, for example, are white young-adult males with savant skills (Singer, 2017); and this narrow scope may be less relatable to cross cultural audiences. Research is needed to examine existing empirical studies about media portrayals of ASD and to call attention to diverse film and television portrayals of ASD.

Objectives: This is a systematic review of research focusing on ASD-representations in film and television. Here we examine (1) the current state of research on ASD in film and television; (2) the extent two which media portrayals of ASD are culturally diverse, and (3) the academic and cultural diversity of the researchers studying ASD representations.

Methods: Data bases covering publications from various disciplines were used to ensure a comprehensive search. These include; PubMed, PsycINFO, ERIC, JSTOR, MLA, Project Muse, and Communication and Mass Media Complete. Articles were screened using the following criteria: (a) studies must have been published in scientific journals, (b) articles focused on film or television portrayals of ASD, and (c) the focus character with ASD was played by an actor. The initial search included 45 articles. Both authors screened these articles separately (Inter-rater reliability ICC= .85) ending with a total of 24 articles, which were read and coded by both authors and included in this study.

Results: Seventy-seven movies and television shows were discussed across the 24 articles. One hundred and thirty seven characters with autism across the life span and spectrum were represented. Television and film production primarily originated in the United States (62%), followed by UK (9%), Canada (5%), India (3%), Australia (3%), Sweden (2%); and Argentina, China, Finland, France, Indonesia, New Zeland, and Venezuala each produced one film or television show with a character with ASD. Researchers studying ASD representations were also from diverse backgrounds. Countries of origin included Australia, Canada, Germany, India, Norway, Spain, The Netherlands, Turkey, UK, and USA. Academic areas included; American Studies, Asian Diaspora, Education, Emergency Medicine, English, Mass Communication, Journalism, Psychology, Psychiatry, Sociology, and Spanish.

Conclusions: Compared to peer reviewed research studies, movies and television shows are able to extend ASD awareness by reaching an audience that far exceeds academic journals. While a majority of film and television representations of ASD originated in the USA, a notable number of characters with ASD have been developed in other countries. Likewise, researchers studying this topic are also academically and culturally diverse.The study of media portrayals of ASD is cross cultural and extends beyond traditional ASD-research areas of scholarship.

426.019 *(Poster)* Interventions for Individuals with Autism Spectrum Disorders in Low-and-Middle-Income Countries: A Systematic Review

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Background: A proliferation of autism interventions targeting young children and adolescents with autism was documented in high-income countries (HICs). Despite some interventions being disseminated to low-and-middle-income countries (LMICs), it cannot be assumed that interventions validated as effective in HICs are equally effective in LMICs. A meta-analysis of community-based early interventions conducted in industrialized economies showed mixed region-specific effect sizes across child outcome measures. It is thus imperative to examine current autism interventions in LMICs.

Objectives: The study's purpose was to systematically review interventions for individuals with autism in LMICs and to answer the questions: (a) What autism interventions have been reported in LMICs? (b) How are those interventions replicated or adapted to local contexts?

Methods: Following the PRISMA guidelines, studies of interventions for individuals with autism in LMICs were searched across major databases and online first publications of autism-related journals. Studies meeting predetermined inclusion criteria were retained. Eighteen intervention studies were included for review.

Results: Twelve of 18 interventions were originally reported from HICs. Nine are parent/caregiver-implemented and the other half was delivered by professionals. Nine interventions were delivered at home and eight were in schools or clinics. The interventions focused on social communication/interaction, behavioral management, AAC, alternative therapies, and auditory integration. Of parent/caregiver-implemented interventions that reported the gender of implementers, 93.4% were delivered by mothers or female family members. Varying intervention duration was conventionally reported ranging between 10 days and an average of 19.5 months.

Interventions were delivered in countries in Africa, Asia, and Eastern Europe. Adaptions to HIC interventions were reported in the areas of (a) content (materials translated to local languages and adapted to local beliefs; intervention components added to ongoing routine care; increased intensity and duration); (b) context (age range of participants broadened due to late diagnosis; simplification of intervention language; interventions delivered in caregivers' preferred languages; task-sharing among local lay health workers); and (c) assessment (outcome assessments conducted in local language and cultural validation of standardized instruments [e.g. ADOS-2, ADI-R, CARS, etc.]).

Conclusions: Autism interventions in LMICs have burgeoned in recent years. Current intervention options presented recognizable patterns similar to those in HICs concerning the dominance of mothers' involvement in parent-implemented interventions, a preponderance of social communication and behavioral interventions, and the use of prevalent standardized measures from HICs. However, that twelve interventions were imported from HICs may speak to LMICs' limited access to locally initiated autism interventions among LMICs included in this review. Of note, intervention intensity reported across studies appeared to be low relative to NRC's recommendations, which could be explained by the unaffordability of intensive interventions. The unaffordability may be attributable to limited access to autism resources, local poorly coordinated service delivery and shortage of trained professionals.

Future efforts in capacity building of autism intervention practices in LMICs may include (a) considering including components amenable to adaptions; (b) to circumvent a shortage of trained professionals, empowering parents to support child learning in natural settings to breed more contextually relevant interventions from within.

426.020 *(Poster)* Outcomes of the Special Interest Group on the Topic of "Autism and Related Disorders in the Context of Humanitarian Emergencies"

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Background: UN figures estimate 48 million children are impacted by humanitarian emergencies, including armed conflict and natural disasters. Within this population, children with autism and related disorders are at further risk for poor outcomes related to health, mental health, physical injury and maltreatment. Little is known about these children and best practices to identify and support them.

Objectives: With the aim to launch a platform for communication and collaboration between researchers and key stakeholders in the humanitarian setting, an INSAR Special Interest Group (SIG) was formed in 2019 titled 'Autism and Related Disorders in the Context of Humanitarian Emergencies.' The objective of the SIG is to promote research and answer essential questions regarding the care and support of children with autism in the humanitarian context.

Methods: Forty participants from various backgrounds including post-graduate students, trainees, researchers, clinicians, medical doctors, interventionists, community organization officers, members of the autism community and advocates participated in the SIG. Following background presentations by professionals with expertise in the humanitarian setting, participants engaged in roundtable discussions addressing the following domains: clinical care, research, capacity building and advocacy. Participants were asked to consider challenges, gaps and potential action plans. Discussions were recorded by a note taker in each group and analyzed using a thematic analysis to identify domain specific and cross-over themes.

Results: Challenges and gaps identified were domain-specific and included: (1) the lack of epidemiological data (e.g., prevalence, comorbidity and impact of trauma); (2) limited understanding of cultural and contextual factors that impact presentation, identification and access to services; (3) limited evidence-base for interventions in the humanitarian setting; (4) limited resources (e.g., funding, trained professionals, infrastructure) for research and clinical care; (5) the low priority and limited voice of those with autism and related disorders in this setting.

Potential solutions by domains included: (1) empowering and engaging local professionals and possibly at-risk individuals/caregivers in capturing new and existing data; (2) involving local partners in capacity building (increasing knowledge and skills), including advanced crisis planning; (3) expanding research initiatives to low-resource humanitarian settings (e.g., WHO Caregiver Skills Training Programme); and (4) effective use of technology to improve training communication, coaching and supervision of local partners. In addition, there was some solutions that was mentioned across the various groups which resulted in the following cross-over themes: (5) multidisciplinary collaboration among stakeholders to improve implementation approaches; and (6) sustained, targeted advocacy and coalition building within the autism community, professional societies, and governmental, nongovernmental, intergovernmental and humanitarian organizations.

Conclusions: At the conclusion of the first meeting of this new INSAR SIG, participants outlined key gaps, challenges and potential solutions to address the needs of individuals with autism and related disorders facing humanitarian emergencies. Overall, there was a call for a cohesive and multidisciplinary approach in developing and/or adapting interventions that enhance the wellbeing of children and caregivers across all developmental disorders. Future directions will build on the themes identified in the SIG to support further systematic data collection on needs, barriers, and solutions in humanitarian contexts.

426.021 *(Poster)* Participation in Genetic Research Amongst Underrepresented Communities of Color

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Background: It is well documented that communities of color are underrepresented in health research (Heiat et al., 2002, Kelly et al., 2005). Disparities are also prevalent in Autism Spectrum Disorder (ASD) research participation (Hilton et al., 2019). The Simons Foundation Powering Autism Research for Knowledge (SPARK) study, a nationwide autism genetic study, recognizes participation gaps amongst communities of color and have reported that 79% of SPARK participants are white. In an effort to understand participation barriers in genetic studies, focus groups were conducted with parents of individuals with ASD and other community stakeholders. The overarching goal is to improve the impact of targeted recruitment strategies to increase participation of traditionally underrepresented families in genetic research.

Objectives: To understand the disparities in genetic research participation, specifically in the SPARK genetic study, amongst ethnically and racially diverse individuals who have children with ASD and ASD community members. Moreover, the study aims to assess sensitive and culturally appropriate recruitment efforts to increase participation amongst underrepresented communities.

Methods: IRB approval was obtained to run three focus groups: two at UCLA (one for self-identified Asian parents of children with ASD and another for self-identified African American parents) and one at CHOP comprised of parents, self-advocates, and community members. Asian participants had an average income range of $99,285-$125,999 and African-American participants had an average income range of $64,000-$94,999. Group discussions were audio recorded, transcribed and coded for major conceptual models. Qualitative analysis was conducted using a modified grounded theory approach.

Results: Findings from all focus groups presented similar conclusions. All groups expressed the importance of explicit communication regarding the use of their genetic information. Asian immigrant parents discussed the importance of having the study available in different languages and felt that learning about genetics research directly from health professionals, specifically physicians, was important to their decision to participate. CHOP participants emphasized the influence of timing and understanding where a family is in their “autism journey” as important participation factors. They also stressed the need for varied recruitment materials (i.e. pictorial brochures and “Did you know?” ASD and SPARK fact bracelets) to broaden accessibility for families with different levels of educational attainment.

African-American parents expressed their distrust of genetic research due to the history of unethical research studies on African-Americans. Additionally, they described the impact of daily and long-term stressors as being in “survival mode.” Thus, participating in research does not take precedence over caring for their children. However, African-American parents revealed they are more willing to participate in research that addresses the systemic disparities on the availability of autism resources and treatment.

All participants discussed a desire to be directly connected to age appropriate resources, information for their child with autism and having a continuous relationship with the research institution.

Conclusions: The key to increasing participation is clearly communicating how genetic information will be used and making resources readily available and accessible. Understanding participants’ concerns may facilitate the development and implementation of a national strategy for reducing disparities in genetic autism research.

426.022 *(Poster)* Pilot Study of Citas: Communication Interaction Training on Autism for Spanish-Speaking Caregivers

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Background: Descriptive research has documented that Latino children have less access, lower levels of utilization, and worse quality of health care when compared with white children (Liptak et al. 2008; Partish el al. 2012; Siller, Reyes, Hotez, Hutman, & Sigman, 2014)). Magaña, Lopez, & Machalicek, (2017) identified a lack of information in the community as important factor in the lack of service use for Latino families of children with ASD. Increasing ASD-related knowledge and provider trust are two strategies for decreasing disparities in the diagnosis and treatment of ASD among Latinos in the US (Zuckerman et al., 2017).

Objectives: The purpose of this study was to test the feasibility and acceptability of Communication Interaction Training on Autism for Spanish-Speaking Caregivers (CITAS), a 6-month parent intervention designed for Latino families and delivered within the context of a monthly parent support group.

Methods: Eleven Latino mothers of children diagnosed with ASD were recruited to participate in this research. Participants ranged in age from 27 to 30 years (M = 29.1, SD = 1.2) and their children had a median age of 54.5 months (IQR = 43-74). Caregivers reporting being of Mexican (n=10) and Guatemalan (n=1) descent. Annual household income ranged from <$25K (30%) to $26K-50K (70%). All caregivers participated in one of two CITAS cohorts. CITAS is a manualized 6-month, low-intensity group-delivered intervention aimed at caregiver increasing knowledge of autism and child development, sense of competence, quality of life, and decreasing parent stress. Two waves of data collection (pre and post CITAS participation) included a battery of caregiver report measures focusing on caregiver knowledge and caregiver self-efficacy. During the intervention, participation and attendance was tracked. Additionally, caregiver satisfaction surveys were collected at study exit.

Results: A mixed models analysis revealed no significant effects however medium and large effect sizes indicate that a lack of significance may be due to small sample sizes. Results revealed that caregivers participating in CITAS showed medium effect sizes for one subtest of the Parenting Stress Index (d=.37) and the Parenting Sense of Competence (d=.49). Large effect sizes were obtained for the Concepts of Development Questionnaire (d=.60) and for the Social Relationships subtest of the WHOQOL-BREF (d=.74). Participant survey results indicated high levels of satisfaction with CITAS participation with ‘agree’ and ‘strongly agree’ responses reported at a rate of 90%.

Conclusions: The results of this study indicate the promise of a brief, low-intensity treatment to significantly improve caregivers’ knowledge of child development, sense of parenting competence, and aspects of quality of life for Latino caregivers of children with ASD. These findings will be presented in terms of clinical implications and future research directions.

426.023 *(Poster)* Professionals’ Experiences of Gender Differences in Autism: A Qualitative Study Utilizing a Cross-Cultural and Cross-Professional Sample

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Background: Autism is associated with reductions in functioning and research indicates gender differences in functional outcomes for autistic people. Gender-related aspects of the environment, including gender expectations and socialization, likely interact with individual factors in causing different challenges for autistic females and males. Accordingly, gender expectations and potential biases among professionals working with autistic individuals might influence if an individual is identified and will receive relevant support. Gender differences in autism have largely been studied in relation to symptoms and in high-income countries, while there is a paucity of studies providing a cross-cultural and functional perspective.

Objectives: We aimed to gain insights in gender differences in functioning in autism by exploring the experiences of an international group of professionals working with people with autism.

Methods: Professionals’ experiences of gender differences in functioning among autistic individuals were explored using an open survey question. An invitation to participate was sent to an international group of autism experts and to be included professionals were required to have a minimum of five years of experience working with autistic people. The professions of the experts (n=102, 77% females) included occupational therapist, physician, psychologist, speech language pathologist and special education teacher. The experts represented 31 countries, and all six World Health Organization (WHO)-regions. The written responses were analyzed using inductive content analysis, aiming to explore recurring patterns across the data set.

Results: The content analysis yielded three main categories: i) *Matching the clinical conceptualization of autism* encompassing professionals experiencing autistic presentation among females as matching diagnostic manuals and the conception of autism less than male presentations. ii) *Co-existing problems* includes references where professionals expressed that autistic males display more conspicuous problems, including externalizing behavior and deficits in language production, while females display more internalizing problems such as anxiety. iii) *Navigating the social environment* encompasses professionals’ experiences of differences in how autistic males and females interact with their social surroundings. Professionals experienced that autistic females, compared to autistic males, displayed higher social motivation with more interest in social relationships, received more support from their female peers, and more often masked or camouflaged their difficulties, e.g. by imitating peers or following set patterns in conversation. Social motivation among autistic females was also described as posing a risk for more frequent social failures. While both autistic females and males were described as struggling to meet gender expectations, for females this regarded social expectations, and for males concerning physical performance in activities. Categories and sub-categories are presented in Figure 1.

Conclusions: Responses underline areas pertaining to functioning among autistic females and males respectively, with females being experienced as more difficult to identify due to behavior presentation that did not correspond to the conceptualization in diagnostic manuals. Females were also experienced as displaying less conspicuous co-existing problems and to camouflage their difficulties more, compared to autistic males. The higher social motivation among autistic females may contribute to detrimental outcomes for autistic females given a risk for more frequent social failures.

426.024 *(Poster)* Sensory Processing Difficulties and Food Selectivity in Children with Autism Spectrum Disorders: Evidence from a Developing Country

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Background:

There are number of comorbidities and aberrant behaviors associated with autism spectrum disorders (ASD) in children and one of the significant challenging behaviors is atypical feeding. Not much research has been done in the developing countries to understand the correlates of feeding problems in children with ASD.

Objectives: To examine food selectivity, mealtime behaviors, and sensory processing problems of children with ASD and to compare the profile with two control groups: healthy age matched typically developing children and siblings of children with ASD.

Methods: Fifty children (4-10 years) with a diagnosis of ASD (DSM 5) were recruited from the pediatric psychology and neurodevelopment clinics of a tertiary care center in India. The Brief Assessment of Mealtime Behavior in Children (BAMBIC) was used to assess the mealtime behavior of children. The BAMBIC consists of 10 items and these items assess 3 domains of mealtime behaviors including food refusal, limited variety of food intake, and disruptive mealtime behaviors. The Short Sensory Profile (SSP) was used to measure sensory processing problems in 7 domains. In addition, parents were interviewed about their child's dietary intake using a 3 day dietary recall including two non-consecutive weekdays and one weekend day. Two control groups were also recruited for comparison: healthy age matched controls and siblings of children with ASD. The study was cleared by the ethical review board of the institute and written informed consent was obtained from the parents.

Results:

As compared to the control groups, children with ASD had significantly higher problems on sub scales of food refusal (F=12.05, P=.0001) and displayed more disruptive behaviors during mealtimes (F=17.62, P=.0001) and total score on the BAMBIC scale (F=11.98, P=.0001). Children with ASD had significantly lower scores as compared to other two control groups in all the sub scales of SSP, except one, including tactile sensitivity (F=34.17, P=.0001), taste sensitivity (F=14.75, P=.0001), movement sensitivity (F=16.80, P=.0001), under-responsive (F=31.87, P=.0001), auditory filtering (F=29.15, P=.0001), and visual/auditory sensitivity (F=13.41, P=.0001). No significant differences were found between the groups on daily intake of calories and proteins. However, vitamin D (F=3.04, P=.05), folate (F=75.91, P=.0001), sodium (M=7.08mg, SD=1.15) and zinc (M=257mg, SD=100) were less likely to be consumed by the ASD children as compared to the controls. In addition, low levels of vitamin A, calcium and sodium were found in ASD children with food selectivity. Significant negative correlation was found between total BAMBIC scores and Vitamin A (r=-.35, P=.05), Calcium (r=-.28, P=.05), and sodium levels (r=-.29, p=.05) suggesting that low levels of Vitamin A, calcium and sodium are found more in children with ASD who are picky eaters and refuse more foods.

Conclusions:

Children with ASD have several feeding problems and these are associated with sensory processing sensitivities and nutritional deficiencies which may not lead to stunting or wasting in the short run. The study underscores the need for detailed evaluation of feeding problems and sensory processing problems in children with ASD in order to provide parents clear management guidelines to counter some of these problems.

426.025 *(Poster)* Severity of Autism in Relation to Socio-Demographic and Clinical Characteristics and Psychiatric Co-Morbidity of Autistic Children.

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Background: Autism is a neurodevelopmental disorder with unclear identified psychopathology. Studies from Egypt and the Middle East regarding autism are rare.

Objectives: Current Study aims to study the severity of autism in relation to socio-demographic characteristics and developmental condition of children, Clinical condition of mothers during pregnancy and labor, and Psychiatric co-morbidity among autistic children.

Methods: A descriptive study was utilized with a random sample of (84) children diagnosed with ASD by a consultant psychiatrist at child psychiatric department, Port-Said mental health hospital. Data collected using three tools; first for assessing socio-demographic and developmental characteristics of children, and clinical condition of mothers during pregnancy, the second for assessing the severity of autistic symptoms using Gilliam Autism Rating Scale (GARS), and the third for assessing co-morbid psychiatric disorders using Mini International Neuropsychiatric Interview for children (MINI-Kid).

Results: presented that 71.4% with moderate autism severity. Sibling gender, age of mother during pregnancy, mother co-morbid physical disease during pregnancy, child age of walking and child exposure to media related significantly to autism severity. More than two thirds (67.9%) of autistic children comorbid with psychiatric disorders. Anxiety is the most common (35.7%) followed by ADHD (32.1%). Numbers of co-morbid disorders related significantly to autism severity.

Conclusions: Severity of autism related significantly to Socio-demographic Characteristics and Psychiatric Co-morbidity.

426.026 *(Poster)* The Role of Indian Cultural Perceptions in Autism Spectrum Disorder: A Qualitative Study

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Background: Autism Spectrum Disorder (ASD) is a neurological disorder that impedes the social and communication development of a child. According to the Centers for Disease Control and Prevention, 1/59 children were diagnosed with ASD based on 2014 data of 8-year-old children. Although numerous studies indicate the benefits of early interventions for children at risk for ASD, many families access these services after the child has surpassed key developmental milestones. ASD impacts all racial/ethnic groups equally; however, few studies assess on the implication of culture regarding the familial experience of ASD. Due to stigma in some cultural communities, some families are less likely to share their concerns with others to avoid shame and humiliation. Limited studies assess the influence of culture on Asian families of ASD in the United States (U.S.), but numerous findings indicate the prevalence of stigma on mental illness in many Asian communities. Furthermore, a paucity of literature exists regarding the implications of culture in the process of acceptance and day-to-day life of Asian Indian families in the U.S. affected by ASD.

Objectives: This study aims to explore the impacts of cultural perceptions on Asian Indian mothers' acceptance of child's diagnosis, lifestyle choices, and relationship with cultural community.

Methods: Semi-structured Qualitative interviews were conducted with Asian Indian mothers who have ASD-diagnosed children (N= 20). Interview domains focused on mothers' experience of receiving an ASD diagnosis, process of acceptance, day-to-day life experiences, family/community members perception of ASD, experience with Indian culture, and resiliency/healing process. All audio-recorded interviews were transcribed verbatim to implement a thematic analysis via MaxQDA software.

Results: Several themes emerged from the data. During the initial stages of receiving a diagnosis, participants discussed their experiences of interacting with healthcare providers. Overall, participants' self-efficacy partially determined their lifestyle choices with their child of ASD. Regarding culture, participants discussed the lack of awareness about ASD in the Asian Indian community. Although many participants noted differences in their interactions with the Indian community living in the U.S. versus in India, some participants stated that stigma of ASD exists in both communities. However, family members and close social support systems served as protective factors in these respondents' ASD journey. Additionally, many participants defined ASD as their culture.

Conclusions: These findings support the need to further expand current outreach models to incorporate cultural context to spread awareness of ASD in various cultural communities. Future research can assess the indication of cultural perceptions and stigma in the choices of families from multicultural communities in the U.S. who are affected by ASD.

426.027 *(Poster)* Transcultural Adaptation of Autism Classification System of Functioning: Social Communication (ACSF:SC) for Use in Brazil

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Background: The Autism Classification System of Functioning: Social Communication (ACSF: SC) was created by Canadian researchers to provide a common language for classifying social communication among preschool-age ASD children, focusing on their specific strengths and support needs. Unlike other existing instruments that focus on the deficits and symptoms of children with ASD, ACSF: SC emphasizes the child's capabilities.

Objectives: Accomplish the cross-cultural adaptation of the Autism Classification System of Functioning instrument: Social Communication (ACSF: SC) for use in Brazil.

Methods: Methodological study of cross-cultural adaptation of the ACSF: SC instrument. Are fulfilled the recommendations for cross-cultural adaptation of health protocols, which included secure permission, translation, back translation, proofreading and expert panel. In the second phase, the verification of the measurement properties of the instrument through a study of 30 fathers and mothers of children with ASD, ages between 3 and 5 years and 11 months. The sample was recruited from the Sensory Integration Laboratory (LAIS), Federal University of Minas Gerais (UFMG) and other university services, as well as private clinics. Initially, the inter rater reliability was assessed using the intraclass correlation index (ICC). Children were also evaluated with the Childhood Autism Rating Scale (CARS). To verify the correlation between the CARS and ACSF: SC, we used the Pearson correlation with level of significance of 0,05. All participants signed an informed consent form.

Results: The experts' evaluation showed that the translated version of the ACSF: SC instrument was well understood conceptually and culturally appropriate, with 48 sentences with higher agreement 90% for conceptual and cultural equivalence. Phrases that did not exhibit adequate levels of agreement was revised as suggested by the experts. The ICC result among examiners was 0.85. The average age was 52.54 ± 9.05 months, and 23.1% female and 76.8% male. The result of CARS pointed out that 80.8% had autism mild-moderate and 19.2% severe autism. The result of ACSF: SC pointed out that 11.5% of children had capacity and 3.8% typical performance level I, 15.4% capacity and the typical performance level II, 46.2% and 30.8% capacity performance in typical Level III, 23.1% capacity and 38.5% typical performance at level IV and 3.8% capacity and 11.5% typical performance at level V. Pearson correlation analysis between the CARS and ACSF: SC Typical Performance pointed $r = 0.419$ ($P < 0.05$) and ACSF: SC capacity was $r = 0.580$ ($p < 0.01$). Between ACSF: SC - Typical Performance and ACSF: SC–Capacity was $r = 0.876$ ($p < 0.01$).

Conclusions: The process of cross-cultural adaptation was rigorously performed. The equivalence between the original versions and translation of the ACSF: SC instrument is guaranteed, obtaining above agreement 90%. The instrument is easy to apply and may be useful in Brazil. However, this study has a limitations on sample size and profile and therefore future studies should include samples larger and several states.

426.028 *(Poster)* Voices from a Low-Resource Setting: Perceptions of Stakeholders of ASD in Mongolia

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Background: Hardships of families of children with autism are exacerbated in low-resource settings (LRS) where little resources are available. While many nations attempt to ensure the rights of these families within the constraints of available resources, their success is heavily dependent on factors such as the governments' level of commitment, available infrastructure, and cultural views and stigmatization on disabilities. The gap in research of these LRS is concerning, and it may further marginalize these parts of the world in both research and practice. Among many LRS in the world, Mongolia may be a viable representative of an LRS as a post-communist, middle income country that is landlocked in Central and East Asia. In addition to its cultural and geographical advantages, Mongolia may also serve as an exemplar to other LRS due to its unique support system of nongovernmental organizations (NGO) that are consisted of parents of children with autism, various international development agencies, and the Mongolian government. However, there is no prior research conducted to examine the perceptions of Mongolian families of children with autism.

Objectives: This exploratory study examined the experiences and needs of parents of children with autism in Mongolia.

Methods: The qualitative inquiry included five focus group interviews with 30 Mongolian parents of children with autism and 15 individual interviews with various professionals who work with children with autism. The data were collected in Mongolia in summer of 2019, with logistical assistance from a local NGO of parents of children with autism. Data were analyzed using constant comparative method that involved open coding, generating codes and categories, and theme identification.

Results: Results from this study indicate that parents are facing both individual and systemic barriers for raising a child with autism in Mongolia. Parents reported severely limited availability of resources for diagnosis of and treatment for autism. These barriers included the scarcity of qualified providers, high-quality resources, support from their own government, and educational options for their children. Furthermore, parents reported difficulties in enrolling their children in public schools, often having to send their children to private schools or therapies that are costly. Parents also reported high level of stigmatization of disabilities, which results in isolation and embarrassment even from their own families. Interviews with the professionals also indicated difficulties of educating children with autism due to lack of resources both in pre-service training and professional development.

Conclusions: Based on the stakeholders' reported experiences and barriers, there is a clear need to develop a system of support for families of children with autism in Mongolia. The findings from this study have implications for both practice and policy. Firstly, due to high cost and very limited availability of professional services, researchers need to examine the potential of nonspecialist delivery of intervention (e.g., parent-mediated interventions). Secondly, as there are many other LRS that share similar characteristics with Mongolia, an intervention model could be developed in Mongolia, and its generalizability needs to be examined for application in other LRS.

426.029 *(Poster)* What Knowledge Regarding Autism Is Needed? - Stakeholder Priorities from the Netherlands

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Background: To ensure that resources reach where they are most needed and can make the most impact, all stakeholders from the autism community need to be involved in priority setting for autism innovation, research and implementation projects. Therefore, in the Netherlands, all autism stakeholders joint efforts to formulate an integrated Autism Knowledge Agenda.

Objectives: To formulate an integrated Autism Knowledge Agenda, based on the perspectives from a wide range of autism stakeholders from the Netherlands.

Methods: Based on previous inventarisations, 20 overarching themes were formulated. By broadly distributing an online questionnaire, these themes were considered by stakeholders from various perspectives, i.e. autistic people themselves, their relatives/loved ones, (mental) health care professionals, educational professionals, researchers, and policy makers. Participants were asked to 1) provide a grade (0-10) to each theme, including the opportunity to add new themes, and 2) prioritise themes, by indicating their top-3 priorities. Within their top-3 priorities, participants were able to provide grades regarding sub-themes, and to give suggestions on how to approach projects on these themes. Subsequently, focus-groups and a panel-discussion were conducted to create an integrated ranking of prioritized themes.

Results: In total, 1162 people participated, of which 56% autistic persons, 54% relatives/loved ones, 42% (mental) health care professionals, 8% educational professionals, 5% researchers, and 4% policy makers. These percentages add up to more than 100%, because 413 (36%) of the participants indicated to represent more than one perspective. For this reason, grades per theme were calculated for the total sample. The highest grades (≥ 8) were provided on the themes 'Dealing with (ones own) autism', 'Image-forming and inclusion', 'Care, treatment and medication', 'Well-being & meaning of life', 'Knowledge & information', 'Sensory processing', and 'Communication & Contact'. Subsequently, participants were assigned to one primary category (perspective), to provide all participants with equal votes, when setting the priorities for separate stakeholders. The number one priority for each stakeholder-group was: 'Dealing with (ones own) autism'(for autistic persons), 'Education' (for relatives/loved ones & educational professionals), 'Care, treatment, medication' (for care professionals), and 'Image-forming and inclusion' (for researchers & policy-makers). The Top-5 ranking that resulted from the integrated panel-discussion was: 'Dealing with (ones own) autism', 'Image-forming and inclusion', 'Care, treatment and medication', 'Well-being & meaning of life', and 'Education'.

Conclusions: Although differences between stakeholders exist regarding the prioritized themes that need further knowledge development, similarities were mostly found, and synthesized into a shared Autism Knowlegde Agenda. Currently, projectgroups of mixed stakeholders are formulating projects plans to together improve knowledge (utilization) on the prioritized themes.

426.030 *(Poster)* "Avoiding Climate Breakdown Will Require Cathedral Thinking": Are Environmental Justice and Neurodiversity Advocates Facing a Common Foe?

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Background: Stigma reduces well-being among autistic people and their family members around the world (Grinker and Cho, 2013; Robertson, 2010). Goffman (1963) defined stigma as arising when attributes of an individual mark that individual as less than social norms, disqualifying that individual from full societal acceptance. Given that stigma arises when an individual "falls short" of culturally defined norms, it is not surprising that the degree to which autism is stigmatized varies across cultures (Obeid et al., 2015). A study examining predictors of differences in autism stigma among people in Lebanon and the US revealed that heightened acceptance of inequality, rather than collectivism, predicted stigma (Gillespie-Lynch et al., 2019). Subsequent research revealed that heightened autism stigma is associated with more generalized prejudice and social dominance orientation (SDO). These findings raise the possibility that stigma reflects a general desire to dominate others and that autism stigma (a lack of appreciation for neurodiversity) may be intertwined with a desire to dominate nature (a lack of appreciation for biodiversity). Indeed, the term neurodiversity was inspired by the desire to expand appreciation of biodiversity to include appreciation of neurological diversity (Blume, 1998; Singer 2017).

Objectives: The current study aimed to identify factors that contribute to differences in autism stigma in two multicultural countries: the US, a vast country with high levels of autism resources, and Lebanon, a small country with very limited autism resources. We hypothesized that reduced respect for biodiversity, empathy, and support for inclusion and heightened SDO and avoidance of uncertainty would predict stigma.

Methods: College students from Lebanon (n = 178; 31.5% male) and the US (n = 133; 33.1% male) participated in an online survey utilizing measures developed by autistic and non-autistic scholars. The survey assessed: demographics, explicit stigma (social distance scale; α=.87), autism knowledge (PAK-M; α =.80), respect for biodiversity (α=.73), SDO (α=.82), avoidance of uncertainty (α=.88), support for inclusive education (α=.73), and empathic concern (α=.34).

Results: A regression revealed that reduced respect for biodiversity (B = -.17, p = .003), autism knowledge (B = -.20, p < .001), and support for inclusive education (B = -.17, p = .001), heightened SDO (B = .24, p < .001) and uncertainty avoidance (B = .14, p = .006), and being male (B = .13, p = .008) and from Lebanon (B = -.18, p < .001) predicted heightened explicit stigma towards autism (R^2= .32). Empathic concern was unrelated to stigma (and exhibited low internal consistency).

Conclusions: These findings suggest that autism stigma and disrespect of biodiversity arise from a broader belief that those who are in power (e.g., "neurotypical humans" when compared to "neurodivergent" humans or humans in general when compared to other animals) deserve their privileges. By recognizing common causes shared by different social justice movements, we can work together to ameliorate stigma and combat environmental degradation by teaching the value of interdependence and respect for diverse ways of being. As Greta Thunberg noted, systems change requires "cathedral thinking" or a focus on the foundations of oppressive practices and attitudes.

Interventions - Non-pharmacologic - Infant, Toddler, and Preschool

POSTER SESSION — INTERVENTIONS - NON-PHARMACOLOGIC - INFANT, TODDLER, AND PRESCHOOL
427 - Interventions - Non-pharmacologic - Infant, Toddler, and Preschool Posters

427.001 *(Poster)* A Comparison of Parent Sensitivity and Responsivity across Parent Delivery of Different Intervention Approaches

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Background: Multiple intervention approaches that include parent participation have emerged as evidence-based practices in autism spectrum disorder (ASD; Schreibman et al., 2015). Structured behavioral interventions, such as Discrete Trial Training (DTT; Lovaas, 1987), are based on applied behavioral analysis (ABA). DTT emphasizes the provision of learning opportunities by utilizing antecedent and consequence strategies to enhance child learning with limited attention to the caregiver/child relationship. More recently, interventions such as the Early Start Denver Model (ESDM; Rogers & Dawson, 2010) blend the learning principles of ABA with relational strategies based on developmental science (e.g., developing sensitive and responsive interactions; Ingersoll et al., 2010). Developmental studies examining the effect of helping parents increase sensitive and responsive parenting behaviors that fit their child's learning needs have linked increases in these parenting behaviors to more positive outcomes for children with ASD (Gulsrud et al., 216; Rogers et al., 2014; Siller et al., 2013), but little attention has been paid to how these behaviors might vary as a function of intervention approach.

Objectives: Examine the role of parent coaching intervention in facilitating sensitive/responsive interactions

Methods: Data was collected as part of a larger randomized treatment study comparing DTT and ESDM intervention approaches. Participants in the parent study included toddlers with ASD and their primary caregivers. Over the year-long intervention, parents received coaching in parent ESDM (P-ESDM) or behavior management in the DTT condition. 83 children completed the study (42 DTT, 43 ESDM). Children were, on average, white (53%) males (75%), and 25 months old at entry (range 12-30). Video recordings of parent-child interaction during home toy play were collected monthly for 12 months. This study compares the quality of the parent-child interaction from months 1, 4, 8, and 12 using the Parenting Interactions with Children: Checklist of Observations Linked to Outcomes (PICCOLO; Roggman et al., 2013), a checklist of 29 observable developmentally supportive parenting behaviors in four domains—Affection, Responsiveness, Encouragement, and Teaching. Repeated measures, random effects models will be used to model change over time in parent sensitivity/responsivity. Secondary analyses will assess the four sub-domain scores as outcomes to probe specific areas that might explain any overall difference. With 83 parents, assuming a two-sided test and alpha = 0.05, we will have 80% power to detect a difference in slope as small as 0.25 standard deviations, assuming the correlation between the repeat assessments is at least 0.2.

Results: PICCOLO coding is underway (12% completed at submission) and will be completed by January 2020. Ten P-ESDM dyads and 11 DTT dyads have been coded. Preliminary analysis indicates no differences in overall performance on the PICCOLO between the P-ESDM dyads (M = 37.89, SD = 6.6) and the DTT dyads (M = 38.18, SD = 8.5) at study entry; $t(19)$= -0.08, p = 0.93.

Conclusions: Greater understanding of the effects of coaching in specific intervention strategies on parent-child interactions will lead to a greater understanding of how best to support parents of children with ASD. This information can be used to streamline parent coaching strategies.

427.002 *(Poster)* A Group-Based Approach to Parent-Mediated Intervention for Toddlers with ASD: Fostering Child Social Communication and Parental Self-Efficacy

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Background: Recent evidence from parent-mediated early intervention models for toddlers with ASD has demonstrated child- and parent-level gains following 3-12 months of intervention. Among this evidence is a cross-site RCT of Social ABCs™, a 12-week, in-home, parent-mediated intervention. In response to increasing demand for early intervention, we developed an abbreviated, group-based version of Social ABCs™, which takes place in clinic. This group model is being piloted to determine if similar gains occur when parents are taught the Social ABCs^{TM} strategies in a parent group format. Preliminary data (n=21), presented at INSAR 2019, demonstrated improvements in parents' use of the strategies, children's responsiveness, parent-reported number of words understood/spoken, and in parent stress levels.

Objectives: With additional participants and increased statistical power, this study aims to determine if any relationships have emerged between the parents' evaluation of self-efficacy, their stress levels, their use of the strategies, and their children's communication skills. The motivation for this work was to increase access to intervention at the earliest signs of concern.

Methods: Group Social ABCs^{TM} entails six weekly, group-based, didactic sessions for parents and nine one-on-one parent coaching sessions. Referrals were received from clinicians at a large pediatric rehabilitation hospital in Toronto, Canada. Data from 35 toddler-parent dyads (9 groups) were coded from video, and questionnaires were analyzed (see figures for demographics). Data from 51 dyads will be included for presentation at INSAR in May 2020.

Results: Feedback from parents led to program modifications following Groups 1 and 6, which have been maintained subsequently. Parents achieved implementation fidelity at a mean rate of 68.67% (SD=17.99) by the end of the program, increasing significantly from baseline, t = 11.89, p < .001. Toddler responsivity (% vocal responses to parent language opportunities) increased by 38.72% from baseline to week 6 (t=11.10, p < .001), at a pace commensurate with that reported in the RCT and a recent community implementation. Findings that are unique to the group model include decreased parent-reported ASD symptoms (Autism Parent Screen for Infants; p < .001) and increased words understood and spoken (MacArthur CDI; both p's < .001). Parents also reported increased self-efficacy over time (p = .011) and reduced parenting stress on all three domains of the Parenting Stress Index; p's < .05. The best predictor of toddler week-6 responsivity was parent week-6 implementation fidelity (R^2=.23, p = .003). Also, notably, parent self-efficacy significantly and strongly predicted (decreased) parental distress (R^2=.37, p < .001). The following demographic factors did not predict responsivity: Parent education level or ethnicity, parent baseline strategy use, child age or sex, child baseline language level. Parents and clinical staff have reported high levels of satisfaction with the program.

Conclusions: Group-based Social ABCs^{TM} is an efficacious way to enhance parent skills and toddler social-communication, with collateral effects of increasing parents' self-efficacy and reducing parenting stress. This is the first Social ABCs^{TM} study to show reduced parenting stress, which may be directly related to the group-based format, and to demonstrate an inverse relation between parent self-efficacy and stress.

427.003 *(Poster)* A Pivotal Response Treatment Package for Children with Autism Spectrum Disorder: An RCT Study

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Background: Pivotal Response Treatment (PRT) is a comprehensive service delivery model that uses both a developmental approach and ABA procedures that aim to provide opportunities for learning within the context of the child's natural environments (Koegel, Koegel, Harrower & Carter, 1999; Koegel, Koegel, Shoshan & McNerney, 1999). Many recent RCT studies have reported its efficacy in improving children's social communications (Gengoux, et al., 2019).

Objectives: Our aim was to conduct a randomized controlled trial to evaluate a pivotal response treatment package (PRT-P) on the communication skills of children with autism spectrum disorder.

Methods: Twenty children with autism spectrum disorder and significant language delay between 2 and 5 years old were randomly assigned to PRT-P (n = 20) or the delayed treatment group (n = 20) for 12 weeks. Autism Diagnosis Observation Scale (ADOS), Social Communication Questionnaire (SCQ) and Childhood Autism Rating Scale (CARS) were used evaluate social communication skills before and after 12 weeks of treatment.

Results: Analysis of child utterances during the structured laboratory observation revealed that, compared with the delayed treatment group, children in PRT-P demonstrated greater improvement in frequency of functional utterances. The PRT-P group had significant reductions in the total score and the scores on social communication in ADOS after 12 weeks of treatment ($P<0.05$) as well as a significant reduction in the total score of the SCQ and CARS ($P<0.05$). The PRT-P group had a significantly greater reduction in the score on social interaction subscale than the delayed group ($P<0.05$).

Conclusions: This is a 12-week randomized controlled trial in which community treatment is delivered. PRT-P was effective for improving child social communication skills. Additional research will be needed to understand the best combination of treatment settings, intensity, and duration.

427.004 *(Poster)* A Robot-Based Play-Drama Intervention May Improve the Joint Attention and Functional Play Behaviors of Chinese-Speaking Preschoolers with Autism Spectrum Disorder: A Pilot Study

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Background: Young children with Autism Spectrum Disorder (ASD) experience deficits in joint attention and play skills, which are typically developed within the first two years of life. Previous intervention studies have shown that explicitly and directly teaching children with ASD initiations of and responses to joint attention and play behaviors yields promising results (e.g., D'Ateno, 2003; Kasari et al., 2014). In contrast, Other studies have found that combining a play context with behavioral techniques, including prompting and reinforcement, may promote joint attention but not play behaviors (Baker, 2000; Kim et al., 2008). The present pilot study introduced a novel approach – a play-drama intervention protocol – to promote joint attention skills and play behaviors. Instead of using human beings as the actors in the dramas, we deployed social robots. Individuals with ASD show deficits in orienting themselves toward social stimuli, engaging with humans, and maintaining social relations (Social Motivation Theory of Autism; Chevallier et al., 2012). Besides, individuals with ASD have excessive reactivity and rapidly form memories of experiences possibly resulting in sensory and emotional overstimulation and distractions (Intense World Theory; Markham & Markham, 2010). Unlike human beings, robots operate within predictable and lawful systems, thus providing children with ASD with a highly structured learning environment and helping them to focus on the relevant stimuli.

Objectives: We examined whether a robot-based play-drama intervention would promote joint attention skills and play behaviors using randomized controlled trial design. If so, children in the intervention condition would have better joint attention and play skills than those in the wait-list control condition.

Methods: Chinese-speaking preschool children were randomly assigned to an intervention group (N = 12) and a waitlist control group (N = 11). Children in the intervention group watched three robot dramas and engaged in role-plays with both robots and human experimenters over the course of nine weeks. Both groups of children then took the Early Social-Communication Scales (ESCS; Mundy, Hogan, & Doelring, 1996) and the Structured Play Assessment (SPA; Ungerer & Sigman, 1981) in the pre- and post-tests. Parents completed the Social Responsiveness Scale (Gau et al., 2013).

Results: Our findings have shown that the robot-based play drama intervention promoted joint attention initiations and functional play behaviors, which were not directly and explicitly taught during training (See Figure 1 and Figure 2). The parents of the children in the intervention condition also rated their children as having less severe social impairments after the training. Both groups of parents gave high ratings on the social validity questionnaire.

Conclusions: A robot-based play-drama intervention can enhance the joint attention and play behaviors of children with ASD. In this protocol, children acted different characters and engaged in drama role-plays. Thus, they can discover the implications of their play behaviors and the impact of their responses on others. It may therefore motivate them to initiate joint attention with others and to understand how to respond to others' joint attention behaviors. Additionally, a play-drama intervention offers a structured approach to developing children's symbolic understanding and use of pretense.

427.005 *(Poster)* Adaptive Training for Community Intervention Deployment: Comparing Training Strategies for New Behavioural Interventionists

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Background: In order to bring known efficacious early intervention programs for children with autism and other complex communication needs into routine daily care, community clinicians require access to high quality professional development supports to grow the local capacity necessary to deliver complex behavioral interventions. This randomized controlled trial examines training tools to support the development of clinicians learning to deliver a social communication intervention within a provincial public health system in Canada.

Objectives: To examine strategies to support community interventionists' ability to deliver the Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER: Kasari et al., 2006) intervention with high implementation fidelity. Specifically, to compare the effect of (a) Peer Coaching: weekly feedback from a local interventionist who has achieved over 90% fidelity with (b) Intensive Refresher: a 12-hour training conducted by a local Senior Trainer (ST) on trainee interventionists' JASPER fidelity and children's social communication and play skills.

Methods: Thirty community interventionists (e.g., speech language pathologists, psychologists) training to deliver JASPER, served 43 boys and 5 girls with ASD (diagnosed through the local health system) age 2.0-6.9 years (M=4.66 years). Interventionists were supervised by 5 local JASPER STs.

Intervention and training occurred in two phrases. Phase 1 began with a 5-day introductory training. Interventionists then practiced weekly with one child for 12 weeks with feedback from their ST. After 12 weeks, implementation fidelity was assessed. Eight interventionists demonstrated 90%+ fidelity while 22 were below 90%. For Phase 2, those below 90% were randomized to receive Peer Coaching or Intensive Refresher. All interventionists were assigned new child cases for another 12 weeks.

Interventionists' JASPER implementation fidelity was measured by scoring ten-minute interventionist-child interactions at treatment exit. Each video was coded for 32 items rated on a Likert scale from 0 (low quality, accuracy) to 5 (high) strategy implementation.

Children received two play-based assessments at baseline and exit including: (a) Structured Play Assessment (SPA: Sigman & Ungerer, 1981) and (b) Early Social Communication Scales (ESCS: Mundy et al., 2003) All assessments were video recorded and delivered by community staff who were independent of the local treatment team and reliable (administration fidelity *M*=81.87% ESCS, *M*=93.05% SPA). Independent, reliable coders blinded to timepoint and condition coded (a) the number of spontaneous unique play acts across 16 play levels from the SPA and (b) the number and type of spontaneous initiations of joint attention and requesting from the ESCS.

Results: Interventionists receiving Peer Coaching made significantly greater gains in JASPER fidelity than those receiving the Intensive Refresher ($F(1,126)=4.23$, $p=0.042$), reaching means of 85.44% and 87.32% respectively by exit. Overall, children paired with interventionists in both groups made significant gains in initiations of joint attention and requesting ($F(1,25)=4.94$, $p=0.036$) and total play types ($F(1,23)=4.78$, $p=0.039$). However, there was no significant difference in children's gains between groups.

Conclusions: Altogether, community interventionists can demonstrate high quality implementation. Weekly peer discussions which do not require the specialists nor the condensed intensity of the intensive refresher offer a less costly and more efficient option to provide effective training supports.

427.006 *(Poster)* An Intervention to Teach Social Referencing to Children with Autism

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Background: Social referencing is characterized as a chain of behaviors which starts when an infant is confronted with an ambiguous object or event. In this ambiguous context, the infant may look toward another person, typically a parent or caregiver, who would then provide affective cues that serve as informational messages for either an approach or avoidance response. Although demonstrated by typically developing infants as young as 10 months of age, social referencing is absent or impaired in children with autism.

Objectives: The purpose of the present study is to evaluate the efficacy of an intervention to establish a social referencing repertoire in young children with autism using multiple exemplar training, prompting and contingent reinforcement.

Methods: The intervention was comprised of teaching trials involving multiple exemplars of standard and ambiguous task materials drawn from experimenter-defined categories of stimuli (e.g., food, art material, toys). Social referencing was taught as a two-step chain involving (a) a looking response, and (b) a discriminated response based on the facial expression of the caregiver. Each session comprised of 10 trials with ambiguous stimuli and data are reported as a percentage score for referencing responses. Measures of joint attention were collected pre- and post-training using the Early Social Communication Scale (ESCS; Mundy et al., 2003).

Results: Preliminary results were evaluated using a multiple baseline across participants design and show a systematic increase in referencing responses with the introduction of treatment for all three participants. On average, the participants exhibited 0% referencing responses in baseline, and this increased to 70% during the training. Measures of joint attention will be discussed in the context of the social referencing data obtained herein, and the interaction between these early social repertoires will be highlighted.

Conclusions: The intervention designed to teach social referencing to children with autism using operant learning procedures was effective. The empirical evidence in support of strategies for teaching early social repertoires will be discussed.

We will also present findings of an ongoing randomized control trial with 30 participants evaluating the intervention protocol.

427.007 *(Poster)* An Israeli Adaptation of the PEERS for Preschoolers Parent Mediated Social Skills Program - Preliminary Results of a Clinical Trial

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Background: The significant role of parental involvement in intervention programs for children with ASD was documented in early intervention programs, and in adolescent social-skills training. However, social-skills training programs for young children with ASD were mostly school-based, with minimal parental involvement.

PEERS for Preschoolers (P4P; Laugeson, Park, & Sanderson, 2008) is a 16-week manualized social skills intervention for high-functioning children with ASD aged 4-7, as an adaptation of the Program for the Education and Enrichment of Relational Skills (Laugeson & Frankel, 2010). Children are taught age-appropriate social-skills while parents are taught how to support the practicing of learned skills during everyday life. Preliminary findings from this intervention (Sanderson et al., 2009, 2010) reveal significant improvements in parent and teacher reported social skills. However, P4P has not been cross-culturally evaluated and its effects on parents have not been tested.

Objectives: (1) To culturally adapt P4P in Israel. (2) To evaluate the effect the adapted P4P has on the social skills of Israeli preschoolers with ASD and on stress and reflective functioning of parents in a preliminary clinical trial.

Methods: The original P4P protocol was translated and adapted by a team of psychologists, using culturally-appropriate social activities (songs and games). A short free-play break was added for each session, to give children some time for regulation. The P4P protocol was then administered to 51 Israeli children with ASD (eight girls) aged 4-7 and their parents in groups of 7-10 children each. Parents reported pre- and post-intervention on the Social Skills Improvement System (SSIS), the Social Responsiveness Scale (SRS-2), the Quality of Play Questionnaire (QPQ), the Parental Stress Index (PSI) and the Parental Reflective Functioning Questionnaire (PRFQ). Teachers reported on the SSIS and the SRS-2.

Results: Analyses indicated significant improvements in children's social skills, as reflected through parent reported SSIS Social Skills index ($p<.01$), and SSIS communication ($p<.05$), cooperation ($p<.05$), assertion ($p<.01$), responsibility ($p<.01$), engagement ($p<.05$), and self control ($p<.01$) subscales. Parents also reported on reduced scores (indicating better social functioning) on the SRS-2 total score, as well as its social-awareness and social-communication subscales ($p<.05$ for all). Parents' report on the QPQ indicated significant improvements on the number of playdates children had at their- ($p<.01$) and their peers'- ($p<.05$) homes. Finally, parents self-reported on improved certainty about their children's mental states ($p<.05$) on the PRFQ, and on fewer difficulties taking care of their child ($p<.01$) on the PSI.

Teachers' reports indicated significant improvement on the SSIS Social Skills index ($p<.01$) and the SRS-2 Social Communication Index ($p<.05$). Intervention-related improvement on the PRFQ-Parental certainty of child's mental states was correlated with parent reported reduced ASD symptoms on the SRS-2 ($r=-.34$, $p<.05$).

Conclusions: The Israeli adaptation of P4P could serve as an effective parent-mediated social-skills intervention, which enhances children's social skills and some elements of parental reflective functioning. The effectiveness of the P4P and the mediating and moderating roles of parental factors should be examined in a future RCT.

427.008 *(Poster)* Are Play-Based Interventions for Children with Autisms Spectrum Disorder Effective?

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Background: Play is crucial in becoming a mentally healthy adult. If children experience problems, play therapy is effective because it fits within their natural behaviour to develop novel skills. But some children, like children with ASD often show an aberrant play development. Whether play-based interventions are effective in children with ASD and their parents has not systematically been evaluated with a risk of bias (ROB)-assessment.

Objectives: Discovering if play-based interventions are effective in children with ASD and their parents, evaluated with a risk of bias (ROB)-assessment.

Methods: A systematic literature search according to the PRISMA guidelines on play-based interventions for children with ASD with and a Cochrane ROB-assessment.

Results: 76 records consisting of 22 RCT's evaluating 7* play-based interventions and 3 non-RCT's on 2** additional play-based interventions were identified. ROB-assessment classified 95% RCT's and all non-RCT's with high risk of bias. When heterogeneity, treatment duration/intensity and sample size were excluded from ROB-assessment, 76% of the studies classified as 'high risk of bias'. Social interaction, communication and parental behaviour are the most studied outcomes, presenting considerable effect sizes.

Conclusions: Whether play-based interventions for children with ASD are effective is unclear. This review shows that the majority of the evaluated studies have a high risk of bias. Future research should focus on improved study designs with less risk of bias to more clearly investigate the effect of play-based interventions on children with ASD.

* Joint Attention Symbolic Play Engagement Regulation (JASPER), Pivotal Response Treatment (PRT), Developmental, Individual-differences & Relationship-based model (DIR/Floortime), PLAY project, Early Start Denver Model (ESDM), Lego® therapy & 1-2-3 project.** Parent-Child Interaction Therapy (PCIT) & Theraplay.

427.009 *(Poster)* Beyond Intervention into Daily Life: A Systematic Review of Generalisation Following Social Communication Interventions for Young Children with Autism

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Background: Generalisation is the ability to apply learned behaviours in contexts other than the one in which it was initially acquired and may occur across people, settings, behaviours and/or time. Successful generalisation is necessary for an intervention to have the intended benefit on everyday life beyond the original learning environment. Researchers have generally considered autistic individuals to have difficulties generalising learned skills across novel contexts. However, there is no consensus on the extent or profile of generalisation following interventions for autistic individuals.

Objectives: Given the importance of generalisation, and the complexity of issues surrounding its assessment, this review aimed to explore generalisation in randomised controlled trials of early interventions for autistic children that target social communication skills. We aimed systematically to explore (i) the extent to which generalisation has been measured alongside a measure of initial target learning (see Figure 1), and (ii) the evidence for generalisation following intervention.

Methods: We conducted a systematic review of PsycInfo and PubMed. We screened 1117 abstracts and reviewed 82 full text articles. Inclusion criteria included that the study was a randomised controlled trial; all participants were aged below six years at baseline (i.e. age 0 to 5 years 11 months); intervention included a focus on the acquisition of social communication skills and included measures of child outcomes; and intervention and control groups each had a minimum of 10 children. It was also necessary that the RCT included a measure of initial target learning and generalisation.

Results: We identified nine RCTs (Table 1) that provided evidence of initial target learning and measured generalisation, of which eight demonstrated at least some successful generalisation across person, setting and/or activity. The findings did not support the widely reported generalisation 'difficulties' associated with autism. However, generalisation was not consistent across all skills within studies, and one study found no generalisation despite evidence for initial target learning within the intervention context. In general, there are few methodologically sound studies exploring generalisation in autism and no consensus on how it should be measured within trials. In particular, failure to demonstrate initial learning of target skills within the intervention setting and an absence of formal mediation analyses of the hypothesised mechanisms limit current research.

Conclusions: Despite frequent reference in the literature to problems of generalisation in autism, early intervention trials for autistic children provide evidence that generalisation can occur post-intervention. However, generalisation is neither consistent across skills, nor is it found in all studies. We outline proposals for future research, including a framework for measurement of generalisation that we hope will be useful for future studies. A more systematic and comprehensive approach to the measurement of generalisation, and how it can be enhanced, is now needed across the autism intervention literature.

427.010 *(Poster)* Can We Reach More Families Faster? a Community-Implemented, Parent-Mediated, Group Intervention for Autism and Disruptive Behavior

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Background: As many as 50-70% of children with autism exhibit disruptive behaviors (DBs) including tantrums, aggression, noncompliance, property destruction, and self-injurious behavior (Hartley, Sikora & McCoy, 2008; Kaat & Lecavalier, 2013). Beyond obvious challenges, DBs often contribute to additional difficulties, including interfering with adaptive functioning and increasing social isolation (Scahill et al., 2012). DBs also pose challenges to caregivers, including reducing family quality of life (Allik et al., 2006, Simonoff et al., 2008). Evidence points to a bidirectional relationship, with child behavior problems and parenting stress exacerbating one another over time (Hayes & Watson, 2013; Lecavalier et al., 2006; Zaidman-Zait et al., 2013). DBs unaddressed in childhood can have significant long-term negative consequences for children with autism and their families.

Parent-mediated interventions (PMI) engage parents as agents of change (Bearss et al., 2015). The use of PMIs for children with autism has a solid and growing evidence base (e.g. Pickles et al., 2016). The Research Units in Behavioral Intervention (RUBI) protocol is a manualized PMI for DBs, developed for children with autism (Bearss et al., 2015). Several studies in the US have shown that the RUBI protocol reduces DB in children with autism when conducted in a one-on-one, lab-based setting (e.g. Bearss et al., 2015b). The current study examine the efficacy of the RUBI protocol in a community-implemented, group format with Jewish and Arab parents in Israel.

Objectives: To examine the efficacy of the RUBI protocol delivered to groups of Arab and Jewish parents in the community. The study also seeks to examine changes in participating and non-participating parents' stress levels following the intervention.

Methods: Participants included 34 parents (17 Jewish, 17 Arab) of children between four and eight years old with a diagnosis of autism and at least one DB, ascertained by the Aberrant Behavior Checklist (ABC). The intervention included 11 sessions and one home visit. Ten groups of three to four participants were conducted according to the RUBI protocol. Outcome measures were administered at baseline, weeks 4, 8, and 12, including the parent and teacher-report ABC (Aman, Singh, Stewart, & Field, 1985a,b), the Home Situations Questionnaire (HSQ; Barkley and Murphy 1998), and the Parenting Stress Index-Short Version (PSI-SR; Abidin, 1990), administered to participating and non-participating parents.

Results: Results indicated significant reduction of DBs over the course of the protocol. This includes parent-report ABC-Irritability subscale ($p=0.011$) and ABC-TOTAL score ($p=0.001$), and teacher-report ABC-Irritability subscale ($p=0.003$) and ABC-TOTAL score ($p=0.003$). Improvement was also indicated by the HSQ-Total score ($p=0.001$). Participating parents reported decreased stress on the PSI ($p=0.002$), while non-participating parents indicated no reduction in stress.

Conclusions: This study provides initial evidence for a community-based delivery of the RUBI protocol in a group format. Findings indicate significant reduction in DB and support the use of RUBI with Jewish and Arab families in Israel. Reduction in participating parents' stress, together with no such change in non-participating parents demands further consideration. These findings are preliminary and further study is necessary in the form of a randomized controlled study and long-term follow-up.

427.011 *(Poster)* Caregiver Role in Assisting Child Social Skill Development: Examining Caregiver-Child Relationships in the PEERS® for Preschoolers Program

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Background: Social impairments characteristic of Autism Spectrum Disorder (ASD) are evident in early childhood and tend to worsen with development (Rao, Beidel, & Murray, 2008). Despite the emphasis on early intervention and caregiver training, few evidence-based interventions explicitly address social skills in preschool-aged children (DeRosier et al., 2011; Reichow & Volkmar, 2010) and none actively integrate caregivers (Reichow, Steiner, & Volkmar, 2012). Research indicates that generalization beyond a social skills group setting might occur by including caregivers (DeRosier et al., 2011). The PEERS® program is an evidence-based caregiver-assisted social skills program for adolescents and young adults (Laugeson & Frankel, 2010), recently extended for preschoolers with ASD. An initial randomized controlled trial indicated benefits from PEERS® for Preschoolers (P4P), but did not examine caregiver outcomes.

Objectives: This project tests the hypothesis that P4P will improve social skills in children with ASD, caregiver confidence, and parenting skills. Thus, this study will explore caregiver-child mechanisms of P4P and whether parent confidence and style improve with intervention, even if not directly targeted.

Methods: Fifteen caregiver/child dyads (11 boys; 66.7% Caucasian) ranging from 4 to 7-years-old ($M = 4.87$; $SD = 1.25$) participated in four P4P groups, consisting of 16 1.5 hour sessions twice per week. One hour included separate child/caregiver didactics while the last 30 minutes were for caregiver-coached play. Children were required to have an ASD diagnosis, meet ASD criteria on the ADOS-2, be fluent in English, have an IQ greater than 70, be toilet trained, and able to tolerate a group setting. Measures used included the Parenting Scale (PS; measuring parenting style), Quality of Play Questionnaire (QPQ; measuring peer conflict during play dates), and the Parental Self-Efficacy in the Management of Asperger Syndrome (PSEMAS; assessing parental self-efficacy), administered at entry, midpoint, exit, and 6-8 week follow-up.

Results: Paired samples t-test revealed a significant decrease in PS overreactivity (e.g., harsh, authoritarian, irritability, anger displays) from entry to exit, $t(8) = -4.007$, $p = .005$, but was not maintained at follow-up, $t(9) = -1.66$, $p = .132$. There were no significant changes in the other PS domains (e.g., total score, verbosity, laxness). There were significant decreases in total PS scores from entry to follow-up $t(10) = 2.663$, $p = .025$, suggesting improvements in overall parenting styles (*M*entry = 3.189 *SD* = .024; *M*follow-up = 2.88, *SD* = .53). Finally, QPQ, revealed a significant decrease in conflict from entry to follow-up $t(13) = 2.31$, $p = .02$. QPQ conflict score was also correlated with parent-efficacy (confidence in coaching child) at follow-up ($p = .046$).

Conclusions: Results suggest P4P may aid in some parenting skills, specifically in learning how to react appropriately to their child, confidence in coaching their child, and overall more beneficial parenting skills. Improvements in these domains may indicate that some changes in caregiver behaviors that were not specifically targeted warrant further research to examine if caregiver changes are mechanisms that explain child social skill gains. Further research could also look at overall family dynamics and examine behavioral interactions between caregiver and child.

427.012 *(Poster)* Caregiver Skills Training for Families of Children with ASD in Vietnam

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Background: In the context of low resource settings, where qualified early childhood interventionists and allied health therapists are lacking, a model developing the skills of caregivers to deliver interventions can be effective. Research evidence indicates that caregivers can work effectively with professionals to set intervention goals and can learn the necessary skills to deliver rehabilitation therapies for their children with Autism Spectrum Disorder (ASD). However, there are a number of challenges might prevent service providers and caregivers from actively engaging in caregivers training, and caregivers from applying their skills in daily care for their children. Since 2019, Center for Creative Initiatives in Health and Population (CCIHP) adapt and pilot the WHO Caregiver Skills Training (CST) Programme for families of children with ASD and other developmental disorders within health system in Vietnam.

Objectives:

- To present the process of adaptation and pilot the CST in health system in Vietnam
- To discuss challenges and lesson learnt for care-giver skills training

Methods: This pilot study employed mixed qualitative method with interviews, observation checklists and pre and post tests.

Results: Health providers were willing to learn and teach care-givers. However, clinical practice experiences of health providers might prevent them from obtain fidelity. In addition, workload at health facility is also a challenge for health providers to actively delivery care-giver training sessions and home visits.

Pre and posts showed improvement in knowledge of caregivers. Continuously encouragement and feedbacks motivated caregivers to employ knowledge into practice. In addition, online coaching (via Facebook groups) and online resources (video on a365.vn) were also recognized as good options. Home visits were highly appreciated, but sometimes it was challenging when people live in rural areas. However, further follow up and assessment will be needed.

Conclusions: The care-giver skills training is one potentially feasible solution for families with children with ASD in low resource settings. It is very important for researchers and clinical teams shared experiences and good lessons learnt in order to enhance its feasibility and acceptability in different social and cultural contexts.

427.013 *(Poster)* Classifying the Trajectory of Cognitive Development in Response to Early Intervention

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Background:

Early Intensive Behavioral Intervention (EIBI) can facilitate cognitive development for children with Autism Spectrum Disorder (Smith et al., 2000). Most children display behavioral improvements in response to EIBI, though there is wide variation in outcomes of treatment and in cognitive assessment scores. Prior investigations of individual differences in treatment response identified “rapid learners” (Eldevik et al., 2011) as children who demonstrated significant improvements in cognitive assessments, though others were identified as “moderate learners” (Sallows & Graupner, 2005) who acquire adaptive skills yet showed little change in cognitive scores.

Objectives:

A regression tree model classified the developmental trajectory of cognitive abilities in children with ASD undergoing community-implemented EIBI. Lasso regression is applied to identify ASD intake assessments which significantly contribute to cognitive trajectory classification.

Methods:

The trajectory of cognitive ability was operationalized by a child’s Mullen Composite Score (MCS) at baseline, year 1, and year. MCS trajectories were partitioned using an iterative, multivariate regression tree in R using the MVPART package. These classifications are confirmed using ANOVA and k-means clusters.

Results:

Participants included 62 children with ASD enrolled at age 24 months (M = 3.26, SD = 0.65),

who were classified by the model into four distinct groups of cognitive trajectories: Modest

Learners, Gradual Learners, Robust Learners and those with High-Functioning Autism. The MCS classifications were confirmed using ANOVAs. Modest Learners showed significant change in MCS from baseline to Year 1, $F(1,25) = 27.77$, $p=.00$, but not from Year 1 to Year 2, $F(1,25) = 0.382$, $p=.54$. Gradual Learners only made significant cognitive gains in the second year of treatment, $F(1,27) = 5.62$, $p=.03$. Robust Learners had significant increases in MCS both from baseline to Year 1, $F(1,47) = 70.92$, $p=.00$, and from Year 1 to Year 2, $F(1,47) = 11.29$, $p=.00$. Lastly, children classified as High-Functioning Autism exhibited only marginal changes in MCS were evident in baseline to Year 1, $F(1,47) = 4.37$, $p=.06$, and non-significant change during the second year.

A K-means cluster analysis confirmed the tree classifications, yielding four clusters of similar composition to the regression tree – the largest cluster contained 26 children, identical in composition to the Robust Learners decision tree classification plus one child formerly classified as a Gradual Learner. The remaining clusters were largely accurate as well, with the K-means cluster identifying 93.75% of Gradual Learners in the second cluster, 85.71% of Modest Learners in the third cluster, and the fourth cluster included 87.50% of children classified as High-Functioning Autism.

Variability in three ASD intake assessments predicted 79% of the variance captured by the cognitive trajectory classifiers: Response to Joint Attention (R2 =.46), Motor Imitation (R2 =.11), and Active but Odd behavior (R2 =.22), controlling for age, treatment site and treatment hours.

Conclusions: If applied to a larger sample, multivariate regression trees could provide a data-driven clinical tool to identify individual differences in cognitive trajectory following behavioral intervention in children with ASD.

427.014 *(Poster)* Communication and Behavior: How We Teach Parents to Support Each Domain in Their Young Children with Autism.

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Background: Children with autism frequently exhibit challenges not only in social communication, but also with disruptive behaviors. Parents play an important role in social communication development and in the prevention and intervention of disruptive behaviors. When parents respond to child interests with rich linguistic modeling (Leezenbaum, Campbell, Butler, & Iverson, 2014; McDuffie & Yoder, 2010), children have larger vocabularies and stronger receptive language skills (Perryman et al., 2013). Similarly, when parents learn behavior management strategies their children have fewer disruptive behaviors (Bearss, Johnson, Handen, Smith, & Scahill, 2013; Ginn, Clionsky, Eyberg, Warner-Metzger, & Abner, 2017; Postorino et al., 2017). Recent meta-analyses have highlighted the importance of parent interventions for disruptive behavior (Postorino et al., 2017) and social communication (Roberts, Curtis, Sone, & Hampton, 2019). Yet no study had examined the impact of sequencing interventions and the effect on parent implementation across domains and on child skills. It is critical to understand how we sequence, combine, and teach parents different sets of strategies in early intervention (social communication, disruptive behavior) to best reduce family burden and to increase efficiency and efficacy of each intervention.

Objectives: To initially evaluate the effect of positive behavior support parent instruction on parent use of behavior strategies following a parent-mediated social-communication intervention, and the simultaneous maintenance of social communication support strategies.

Methods: A Multiple-baseline across behaviors, single-case design, was employed to examine the effects of parent instruction on 4 categories of behavior support strategies. Participants included 3 mother-child dyads. Parents had recently completed a parent-mediated social communication intervention (Kaiser & Hampton, 2016), and subsequently received instruction in positive behavior supports to address challenging behaviors (Bearss et al., 2018). Parent use of positive behavior support strategies was the primary outcome, and maintenance of social communication strategies and child rate of disruptive behavior were secondary outcomes. Reliability was measured for 20% of all outcomes, with point-by-point agreement greater than 80%. Fidelity of parent instruction was measured for 20% of sessions and was greater than 90% implementation.

Results: All parents demonstrated improved behavior support strategy use as demonstrated by increase in level and trend following each of the four strategy introductions. However, some variability was observed. In particular, all parents required a booster with additional feedback following the third phase of intervention, indicating that the curriculum may require additional supports during this phase. All parents also demonstrated a decrease in social communication support strategies throughout the positive behavior support training, indicating that it may be difficult for parents to integrate multiple methods of engaging with their child without specific coaching to do so.

Conclusions: Parents can learn positive behavior support strategies with minimal instruction over 12 weeks, however additional support may be required to help parents integrate and maintain all strategies. These results are especially important in the landscape of early autism interventions which often include multiple disciplines coaching parents to implement strategies at home (e.g. speech pathologists, and behavior analysts). Implications for clinical practice of coaching and instructing parents and for future research will be discussed.

427.015 *(Poster)* Correlates of Play Skills in a Diverse Population of Young Children with Autism

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Background: Children with autism often display more rote, repetitive, and less diverse play compared to their typically developing peers (Jarrold et al., 1996). Play skills are important for children's development and have been associated with gains in other developmental domains (Mundy et al., 1987; Pierucci et al., 2015).

Objectives: This study will 1) examine whether changes in play skills are associated with changes in other developmental skills after participation in JASPER and 2) identify potential moderators of the effect of treatment on changes in play skills in a diverse sample of young children with autism.

Methods: Participants included 174 young children diagnosed with ASD (*M*= 46.72 months; *SD* =7.5 months) from four different studies. Eighty-six percent of the sample was male and 75% reported ethnic minority backgrounds.

Ninety-three children participated in a play-based social communication intervention, Joint Attention, Symbolic, Engagement, and Regulation (JASPER; Kasari et al., 2006) that took place in community settings in the greater Los Angeles area. Eighty-one children received treatment as usual.

The *Mullen Scales of Early Learning* (Mullen, 1989) was used to measure visual reception, fine motor, receptive language, and expressive language. Children's mental age scores were calculated by averaging the age equivalent scores of the four domains. The average mental age of the sample was 26.34 months (*SD* = 10.99 months) and ranged from 8 to 57 months.

Structured Play Assessment (Ungerer & Sigman, 1981) was used to measure children's spontaneous play acts. The frequency and the number of different play acts by level (simple, combination, pre-symbolic, and symbolic) were coded by blinded raters.

Early Social-Communication Scales (Mundy et al., 2003) was used to measure children's spontaneous initiations of joint attention (IJA) and behavior regulation (IBR).

Results: Regression analyses were conducted to examine the association of changes in play with mental age and IJA. Children's gains from baseline to exit in combination play (p=0.0127), pre-symbolic play (p=0.025), symbolic play (p=0.028) were associated with increases in mental age from baseline to exit. Children's gains in combination play (p=0.049) and symbolic play (p=0.007) were also associated with increases in expressive language from baseline to exit.

Moderation: Baseline IJA moderated the effect of treatment on changes in combination play (p=0.001) and symbolic play (p=0.002). Children with greater IJA had greater improvement in combination and symbolic play if they received JASPER. There was no significant moderation by IJA at baseline with treatment on pre-symbolic play.

Conclusions: The results demonstrated that within a diverse sample of children with autism, change in play skills is associated with cognitive and communication gains. Additionally, children with more IJA made more gains in play during intervention. Future research should examine those children who are not as responsive to treatment and explore adaptive treatment approaches.

427.016 *(Poster)* Effectiveness of Community-Based Behavioral Interventions for Young Children with Autism: A Meta-Analysis

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Background: Early intensive behavioral intervention (EIBI) is recommended for young children with autism as soon as autism is suspected. While EIBI is widely accepted due to empirical demonstrations of effectiveness in research settings, less is known about the effectiveness in community-based settings. Currently, disparities in access to services disproportionately impact young children of color and those on Medicaid. Improving our understanding of community-based services is needed to address these disparities.

Objectives: Conduct a systematic review and meta-analysis to examine the effectiveness of community-based behavioral interventions for children under age 6 years.

Methods: A literature search generated 725 possible papers, of which 16 met inclusion criteria (children diagnosed with autism, under six years of age, group design, behavioral intervention, delivered by a person in a community setting, and reported in English). Each study was evaluated for 1) methodological characteristics (use of a control group, randomization, fidelity measurement, sample size), 2) participant characteristics (age, sex, race/ethnicity, inclusion/exclusion criteria, study attrition) and 3) intervention characteristics (targeted versus comprehensive intervention, parental involvement, intervention length, intervention setting). Four outcome domains were common across three or more studies and were the focus of the meta-analysis; adaptive behavior, cognitive functioning, autism symptom severity, and joint attention. Effect sizes were calculated using Hedge's *g*.

Results: Evaluation of each of the 16 studies revealed 13 of 16 studies used a control group and only 5 of 16 utilized randomization. Sample sizes varied greatly, with a range of 16-306 participants (average of 92). Results from 9 studies indicated a moderate association between intervention and adaptive behavior with an effect size of 0.42, 95%CI [0.21, 0.63]. Results from 8 studies indicated a moderate association between intervention and cognitive development with an effect size of 0.46, 95% CI [0.08, 0.85]. Results from 3 studies indicated a large association between intervention and joint attention with an effect size of 0.95, 95% CI [0.26, 1.63]. With regard to autism symptom severity, negative effect size indicates an improvement. Results did not reach statistical significance, but a moderate association was found, with an effect size of -0.29, 95% CI [-0.67, 0.09].

Conclusions: Community-based studies provided evidence for the effectiveness of EIBI in community-based settings; findings consistent with those of highly controlled efficacy trials. However, results also revealed the need for more high-quality community-based trials of EIBI. Future community-based implementation trials should consider challenges of research to practice, challenges associated with randomization in community settings, and access to robust sample size. Community-research partnerships may help address such challenges and achieve interventions that are more aligned with cultural values. As more studies focused on effectiveness are conducted, meta-analytic techniques can be used to address issues related to small sample sizes and to increase confidence in the emerging evidence that community-based interventions can lead to improvements in functioning for young children with autism.

427.017 *(Poster)* Effectiveness of Structured Supports in Increasing Object Imitation in Toddlers with Autism Spectrum Disorder

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Background: Imitation skills are significantly impaired in children with autism spectrum disorders (ASD) and are linked to future deficits in other areas of development (e.g., social communication; Toth, Munson, Meltziff, & Dawson, 2006). Engaging in imitation during interactions with caregivers creates experiences that support development and learning in early childhood (Ingersoll & Schreibman, 2006). Thus, imitation is a critical intervention target. Naturalistic developmental behavioral interventions (NDBIs) elicit imitation in children with ASD but research is unclear whether structured supports, which are shown to facilitate on-task engagement in individuals with ASD, pair well with these interventions (Hume & Odom, 2007; Ingersoll & Schreibman, 2006).

Objectives: The present study assessed whether a NDBI, with the addition of structured supports, facilitates imitation in toddlers with ASD.

Methods: Three toddlers (ages 27-31 months) with a confirmed diagnosis of ASD and poor imitation skills (<25% on the Motor Imitation Scale; Stone, Ousley, & Littleford, 1997) participated in a multiple-baseline design across participants design study (Hersen, Barlow, & Kazdin, 1984). Toddlers participated in two 20-minute sessions twice weekly. Baseline sessions followed Ingersoll & Schreibman's (2006) reciprocal imitation training (RTI) protocol. Treatment utilized the same protocol in a structured environment, using physical structure (child sits at table facing adult), utilization of a left-to-right activity system, and material structure (finished component, limited materials, segmenting steps). Each participant completed two generalization sessions, (1) novel setting and (2) novel setting and materials. Imitation was scored as a percentage passed of all actions modeled. Interobserver agreement and treatment fidelity data were collected for 20% of sessions across participants and condition, and social validity data were collected from parents related to intervention feasibility and perceived outcomes. Visual analysis of level, trend, variability, and rapidity of change was conducted to examine the functional relationship between structured supports and object imitation. Mean changes across phase and the percentage of non-overlapping data points (PND; Scruggs & Mastropieri,1998) were calculated.

Results: Rapid level changes were evident for all participants, trending from decreasing/highly variable in baseline to increasing/stable in the intervention phase (Figure 1). All three participants demonstrated stable data in follow-up probes and generalized object imitation to novel settings and materials in generalization probes. Means increased across participants from an average of 28% of all actions modeled in the baseline phase to 84% in the intervention phase and maintained at 98% at the follow-up data collection point. Object imitation generalized across setting (93%) and materials (87%). PND were calculated at 91.8% across participants indicating a highly effective intervention per Scruggs & Mastropieri (1998). Treatment fidelity and social validity data indicated that the treatment was implemented with integrity (90% fidelity) and was deemed feasible and effective by caregivers.

Conclusions: Our results suggest that NDBIs paired with structured supports were effective in rapidly increasing object imitation learning in toddlers with ASD. Findings indicate that structured supports may allow for increased attention to bids for imitation. Future studies should compare rates of learning in NDBIs with and without structured supports.

427.019 *(Poster)* Evaluation of the Autism Distance Education Parent Training (ADEPT) Program in Boise, Idaho: An Update

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Background: Autism Spectrum Disorder (ASD) symptoms are mitigated when treatment starts early (Zweigenbaum, et al., 2015). An effective intervention for young children with ASD is Applied Behavioral Analysis (ABA) (Rogers and Vismara, 2008).

In Idaho, access to ABA treatment is improving but remains suboptimal. A semblance of ABA is provided by developmental disability agencies, but those providing treatment obtain less training and supervision in ABA compared to behavior therapists in other states. The quality and type of behavioral intervention offered by school districts is variable.

To address access issues, professionals at UC Davis MIND Institute designed the Autism Distance Education Parent Training (ADEPT) program for parents of young children with ASD. Parents review on-line modules demonstrating how to use ABA principles to improve functional skills and reduce problematic behaviors in their children. Parents then attend two, twelve hour, group parent training workshops led by treatment professionals to hone their ABA knowledge. Parents then have a home visit with two of the treatment professionals after each workshop. An unpublished pilot study at MIND showed an increase from pre to post training in parent-reported confidence in the ability to implement ABA principles and parent knowledge of ABA principles.

Providers at a children's hospital in Boise, Idaho implemented the ADEPT program with eight parents who had a child with ASD. Parent-reported confidence in the ability to implement ABA principles increased from pre to post training. Parent knowledge of ABA principles either remained the same or increased from pre to post training. These results were presented at a previous INSAR meeting.

Objectives: Providers in Idaho implemented the ADEPT program with more parents who had a child with ASD to continue to evaluate its benefit. Would a larger sample size show an increase in parent-reported confidence in the ability to implement ABA principles and parent knowledge of ABA principles from pre to post training? Would parenting sense of competence increase and autism-related parenting stress decrease from pre to post training? Positive outcomes would support continued implementation of the ADEPT program throughout Idaho.

Methods: Seven community-based providers (mental health providers, ABA therapists, occupational therapist) implemented the ADEPT program three separate times. Nineteen parents who had a child recently diagnosed with ASD (ages 2 to 8) participated.

Before and after training, parents completed the Autism Parenting Stress Index (Silva and Schalock, 2012), Parenting Sense of Competence Scale (Johnson and Mash, 1989), and surveys on parent-reported confidence in the ability to implement ABA principles and parent knowledge of ABA principles (unpublished).

Results: Consistent with previous results, parent-reported confidence in the ability to implement ABA principles increased from pre to post training. Parent knowledge of ABA principles remained the same or increased pre to post training. Autism-related parenting stress remained the same from pre to post training. Parenting sense of competence increased from pre to post training, which was a new finding.

Conclusions: Results support continued implementation of the ADEPT program. Investigating ways to increase parents' knowledge of ABA principles from pre to post training is warranted.

427.020 *(Poster)* Examining Parental Self-Efficacy in a Parent-Mediated Intervention for Children with Autism Spectrum Disorder

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Background: Parental self-efficacy is defined as an individual's beliefs in their ability to effectively manage the different tasks and situations of parenting (Gross & Rocissano, 1988). Parental self-efficacy has been shown to directly affect the quality of parental care provided to children (Sanders and Woolley, 2005; Teti & Gelfand 1991; Tucker et al. 1998). Although research suggests that parent-mediated intervention (PMI) for children with autism spectrum disorder (ASD) can improve parent self-efficacy (Ingersoll et al., 2016), little research has focused on the child, parent, or environmental factors that influence parents' self-efficacy in their implementation of PMIs for children with ASD.

Objectives: This mixed-methods study identified factors that relate to parent-reported self-efficacy when implementing a telehealth-based PMI. Exploratory research will also be conducted to identify certain parent, child, and environmental factors that relate to parent self-efficacy.

Methods: Fifty-one parents of children with ASD received access to a self-directed web-based tutorial as part of one of two research studies evaluating the efficacy of a telehealth-based PMI (Ingersoll et al., 2016). Seventeen participants went through the online program on their own (self-directed) and 24 participants went through the program with therapist assistance and coaching. Parents used a 5-item, 5-point likert-type scale adapted from the Parent Adherence to Treatment and Competence measure (a-PATC; Kasari et al., 2010) to rate their feelings of self-efficacy within intervention implementation per lesson. Parents also completed two to three short answer responses per lesson regarding their child's response to intervention implementation and which techniques the parent felt were most successful and difficult to implement from the lesson. Correlations were used to examine the relationship between group assignment, parent demographics, general parent self-efficacy using the Parenting Sense of Competence Scale (PSOC; Gibaud-Wallston & Wandersman, 1978) at intake, child IQ at intake, and average parent self-efficacy in the intervention (a-PATC). Inductive thematic analysis is being used to identify common themes in parent short answer responses.

Results: Cronbach's alphas for the a-PATC for each lesson were ≥ .67 suggesting adequate internal consistency. Bivariate Pearson's correlations found that general parent-reported self-efficacy at intake on the PSOC significantly and positively related to parent-reported self-efficacy within the intervention program on the a-PATC ($r = .308$, $p < .05$; Table 1). Group assignment, child age, parent education level, and child IQ were not related to a-PATC scores. A median split of the overall average a-PATC scores identified parents as having either higher self-efficacy (average ratings of 3.91 and above) or lower self-efficacy (average ratings below 3.91). The final analysis will utilize theme counts to identify common themes in parents with higher and lower self-efficacy in the intervention.

Conclusions: Parents' feelings of self-efficacy about general parenting were related to parents' feelings of self-efficacy within intervention implementation. Findings suggest that clinicians and researchers should consider general feelings of parent self-efficacy before treatment when gauging parent self-efficacy within the intervention. As a result of this study, we also hope to identify themes influencing parent self-efficacy in intervention implementation to inform additional supports and increase parent self-efficacy within intervention implementation.

427.021 *(Poster)* Factors Predicting Likelihood of ASD Diagnosis within a Multi-Stage Screening Protocol

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Background: Children from marginalized backgrounds are more likely to be neglected or missed during universal ASD screening in primary care (Guthrie et al., 2019), with Spanish-speaking families experiencing further boundaries to timely diagnosis and treatment (Zuckerman et al., 2017). Screening in Early Intervention (EI) may allow for quicker and more accurate identification of children at risk for ASD, especially for underdiagnosed groups.

Objectives: The aim of the present study is to determine how diagnostic rates for different demographic groups vary between a) EI sites participating in a targeted screening protocol and comparison EI sites and b) participating sites pre-implementation and post-implementation.

Methods: This study occurs within the context of a community-based, multi-stage screening and assessment protocol implemented in local Part C EI agencies. Children who screened positive on both stages of the screening process were referred for a diagnostic evaluation.

We utilize data obtained from the Department of Public Health to determine demographic, diagnostic, and service receipt information on children in local EI agencies. Participants were: a) enrolled in either a participating or comparison EI agency for at least 8 weeks during either the baseline period (January 2012-December 2013) or intervention period (July 2016-June 2018), b) between the ages of 14 and 34 months. Intervention sites were three agencies in Boston with high populations of Spanish-speaking (32.4%), racial/ethnic minority (75.6%), and low-income (70.0%) families. Three comparison sites, at which the screening protocol was not implemented, were examined during the same two-year time periods and were selected based on demographic similarity (23.7% Spanish-speaking, 64.9% minority and 71.5% low-income families).

Results: Logistic regressions predicting receipt of an ASD diagnosis based on site, demographic factors, and time suggested that across all sites, children of color were more likely to receive a diagnosis during the implementation period compared to baseline (p=.002). During the implementation period, Spanish-speaking children were more likely to receive a diagnosis at intervention sites than at comparison sites (p=.001). In fact, for intervention sites, diagnoses for Spanish-speaking children increased 71.6% from pre- to post-implementation, while rates for English-speaking children decreased by a non-significant 9.7%.

A two-way an interaction between site and language suggests that Spanish-speaking children were diagnosed later than English-speaking children only at comparison sites; diagnostic age did not differ by language status at intervention sites, $F(1, 947)=77.4$, p=.049.

Conclusions: Results suggest that implementing a community-based, EI-embedded, multi-stage screening and evaluation protocol, available in English and Spanish, a) increased the diagnostic rate for Spanish speaking families and b) decreased the disparity in age of diagnosis for Spanish-speaking families during the intervention period. The fact that financial status and race/ethnicity were not associated with intervention effects suggests that a lack of English language proficiency may be more of a barrier to timely diagnostic evaluations in the usual care context than other social determinants of health, at least among families already accessing EI. Future research should address whether Spanish-speaking families receiving a timely diagnosis are also able to connect to autism-specific services in a timely manner.

427.022 *(Poster)* Helping Optimize Language Acquisition (HOLA): Feasibility and Acceptability of Online Training Modules for Parents of Toddlers at Risk for ASD

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Background: Early access to evidence-based intervention (EBI) leads to best-case long-term outcomes for children with Autism Spectrum Disorder (ASD). Delay in the receipt of ASD-focused intervention has been associated with later autism severity, placement in segregated learning environments and lower scores on tests of student achievement. Parents from underserved communities often have less knowledge about ASD and are less likely to recognize ASD symptoms therefore, their children are less likely to receive early interventions for ASD. Additionally, underserved families may find interventions that require a significant time commitment or cause their child to react emotionally untenable due to cultural mismatch. The dissemination of brief, culturally competent parent-mediated intervention models can reduce the service-need discrepancy for underserved families.

Objectives: To this end, I developed and assessed a PRT training curriculum which includes 6 online training modules titled, Helping Optimize Language Acquisition (HOLA), based on the information, lessons and examples included in, "Using Pivotal Response Treatment to Teach First Words to Children with Autism" by Lynn Koegel. The 40 to 60-minute training modules provide parents of minimally verbal children with knowledge of child development, ASD symptomology, and teach them basic PRT strategies to improve their child's communication and social interaction in daily routines.

The research questions addressed in this study include; 1. Is HOLA feasible for diverse families with young children at risk for ASD? 2. Is HOLA acceptable to diverse families with young children at risk for ASD?

Methods: This project progressed in 4 stages: Development, refinement, recruitment and assessment of the HOLA online modules. Modules were developed using Canvas Studio and Camtasia software and refined according to feedback from a stakeholder advisory committee. 10 parents or caregivers of toddlers (16 to 48 months) who were minimally verbal and scored 6 or above on the MCHAT were recruited from an Early Intervention provider on the East Side of Los Angeles. Participants received a weekly link by email to complete the 6 online modules. Parent satisfaction was measured by a researcher developed likert scale, and feasibility was determined by recruitment rate and percentage of completion of modules and follow-up assessments. Additionally, the Maternal Autism Knowledge Questionnaire was given at both baseline and follow-up to assess the Impact of training on parent knowledge.

Results: This project will complete recruitment in March 2020.

Conclusions: HOLA has the potential provide parents who may have limited knowledge about ASD with information about their child's development as well as teach strategies to help their child communicate. This program has the potential to reduce disparities in underserved populations.

427.023 *(Poster)* Implementation of Video-Based Feedback Intervention within a Community Based Ndbi Program: Feasibility and Preliminary Results

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Background: The use of video-based feedback (VF) has been found to be effective in increasing parental sensitivity (Poslawksy et al., 2014) and responsiveness (Green et al., 2010) over the course of parent mediated interventions for young children with ASD. However, because VF interventions have not been implemented widely in community-based interventions yet, there is still a need to examine the feasibility of community implementation and treatment effects.

Objectives: We 1) demonstrate initial feasibility of a VF intervention implemented within an early intervention program; 2) examine preliminary treatment effects; and 3) identify predictors of treatment response.

Methods: Participants (15 toddlers with ASD and their caregivers) were drawn from a 6-month, community-based, stated-funded NDBI early intervention program consisting of group-based clinician-mediated intervention (6 hours/week) and individual parent-coaching sessions (3 hours/week). Children were randomized into the control group (n=7) which received "treatment as usual" and the treatment group (n=8) whose parents were instructed to record 30 minutes of interaction with their child at home to be reviewed by their therapists during individual coaching sessions. The Brief Observation of Social Communication Change (BOSCC, Grzadzinski et al., 2016) was used to measure child changes in social communication and the Measure of NBDI Strategy Implementation–Caregiver Change (MONSI-CC; Vibert et al., under review) was used to measure parents' interactive strategy use. Given the small sample size, both paired sample t-tests and Cohen's d as well as Reliable Change Index (RCI, Jacobson & Truax, 1991) scores were used to examine person-level changes. Pearson's r correlations between parent and child changes were examined.

Results: Out of 15, 10 families participated in the study for approximately 6 months, with 3 participants currently receiving treatment. Both groups demonstrated acceptable attrition rates ($M_{Treatment}$=25% (n=2); $M_{Control}$=0%). Parents recorded an average of 27.30 minutes/week (SD=5.79) of interaction at home for 6 months. Parent surveys for the treatment group (1-10, 10 indicating more positive feelings) indicated that parents felt that VF made the therapists' feedback easier to understand ($M_{Treatment}$=8.0, SD=1.40) and helped them learn new strategies ($M_{Treatment}$=8.36, SD=1.37). Parent feelings (1-10, 10 indicating increased negative feelings) of nervousness and stress of VF treatment were low ($M_{Treatment}$=2.2, SD=0.79; $M_{Treatment}$=4.2, SD=2.45). Children and parents in both groups showed reduction in symptoms and gains in interactive strategies with moderate to large effect size, with children in the treatment group showing a significant level of symptom reduction (BOSCC ASD Total Change; $M_{Treatment}$=7.4, SD=4.76, t(4)=3.50, p=0.03; Figure 1). In the treatment group, 60% of participants showed reliable reduction in autism symptoms (BOSCC), compared to 17% in the control group. Significant correlations were observed between child reduction in social communication symptoms (BOSCC) and improvements in parent strategy use (MONSI-CC; r=-0.70, p=.03).

Conclusions: Results demonstrate the initial feasibility of VF in community-based interventions; parents successfully incorporated the VF intervention into their routines and showed positive feelings towards the intervention. Preliminary findings also showed treatment effects for both children (core ASD symptom reduction) and parents (improvement in interactive strategies). Barriers to intervention implementation and sources of attrition will be explored further.

427.024 *(Poster)* Improvements in Family Empowerment Associated with Perceived Change in Social Ability: A Study of Preschoolers in Early Behavioral Intervention

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Background: A diagnosis of autism spectrum disorder (ASD) is typically followed by recommendations for intensive intervention, including early intensive behavioral intervention (EIBI). EIBI is well supported in the literature, with improved outcomes that span cognitive skills, social development, and adaptive functioning among others. Navigating service systems can be difficult for families unfamiliar with ASD, healthcare, or early behavioral intervention; thus, variables such as empowerment are of particular interest in parents of children with ASD.

Objectives: To conduct an exploratory study investigating whether and how changes in family empowerment and child skills correlate with one another in the context of EIBI services.

Methods: Data was collected from families of 31 children diagnosed with ASD who participated in EIBI (Age M=42.4 months, SD=11.2, Range = [19.3, 63.2]), provided at the outpatient clinic of a large children's hospital. All children were on Medicaid insurance and the majority were non-Caucasian in race/ethnicity. Naturalistic developmental behavioral intervention (NDBI) was delivered to the children 12 hours per week, for 12 weeks in a classroom setting; caregivers were also trained to deliver therapeutic techniques throughout the child's participation. Case management support was provided to assist families in accessing services following discharge from the program. Intervention services were delivered by board certified behavior analysts and behavior technicians and supervised by a licensed psychologist with extensive training and experience in the delivery of NDBI. Change in children's skills was measured by comparing baseline and post-treatment scores on the Adaptive Behavior Assessment System, Third Edition (ABAS-3). The changes in the ABAS-3 Global Adaptive Composite, Social, Conceptual, and Practical domains, and Communication subdomain, were all compared to change in family empowerment, measured by comparing baseline and post-treatment scores on the Family Empowerment Scale. All assessments were completed by children's primary caregivers.

Results: Correlational analyses were run to compare changes in assessment scores; an adjusted alpha was calculated using a Bonferroni correction. Both family empowerment (p=.026) and social skills (p=.022) were significantly improved from baseline to post-treatment. Correlation to change in family empowerment scores was not found to be significant for any ABAS-3 domain excepting the Social domain, r=0.513, p=0.016.

Conclusions: These results suggest a relationship between increased caregiver empowerment and improvement in children's adaptive social skills. While increases in other areas of the ABAS-3 were noted by caregivers, the Social domain was the only one to achieve significance when compared to changes in scores of family empowerment. Given the centrality of social deficits to the diagnosis, seeing an improvement in this core feature of ASD may lead families to feel more empowered. Additionally, feelings of disempowerment may be high at treatment onset, as early intervention tends to follow a new diagnosis of ASD, and families may encounter difficulties when attempting to access such a service. Following a successful treatment experience with a parent-training component, feelings of empowerment may then increase. Future research is needed to better understand the elements of early intervention programs that may correlate with increased reports of family empowerment.

427.025 *(Poster)* Increasing Early Social-Communication Skills of Preterm Children with Autism Spectrum Disorder through Focused Intervention Practices: Effects on Imitation, Joint Attention and Play.

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Background: The prevalence of autism spectrum disorders (ASD) reported in children born premature or/and with low weight is higher than in the general population. This fact has led to the increase of early detection studies to investigate the early signs of ASD in preterm children. The aim of early detection is to identify early signs of risk of ASD in the child's development, in order to initiate earlier treatment, even before the child receives a formal diagnosis. Thus, early detection only makes sense if there are early treatments available that have proven their efficacy. Focused intervention practices (FIPs) are widely used to improve social communication skills, as they are specifically aimed at enhancing skills identified as core deficits in children with ASD such as imitation, joint attention and play.

Objectives: The general aim of this study was to pilot social-communication FIPs on facilitating imitation, joint attention and play skills for children born premature who showed early signs of ASD (later diagnosed with ASD). Hence, it is important to identify practices that might reduce impairment in social communication skills from the very beginning, as it has been recognised as one of the key problems in children with ASD. The specific aim of the study is to evaluate if these children benefit from early intervention practices focused on socio-communicative skills.

Methods: Families from Salamanca and Zamora areas (northwest of Spain) participating in the national health developmental surveillance program for preterm children were asked to participate within the research study. Neurodevelopmental assessments at ages of 12, 18, 24 and 36 months were performed. Children that show red flags at 18 months were asked to collaborate with the early intervention study. Children in the treatment group received FIPs targeting object and gesture imitation, joint attention, and play. Intervention was administered one hour per day, two days per week during 15 weeks. Treatment was conducted in a small room with identical play materials. FIPs uses several naturalistic techniques to teach social and communication skills.

Results: 25 children have collaborated with the surveillance program, but only 3 children showed early sings of ASD and agreed to participate with the early intervention study. Participants increased their imitation, joint attention and play skills In addition, participants exhibited increases in other skills, including language, adaptative behaviour and cognitive developmental measures. Also, ASD symptomatology scores(measured with ADOS-2, module T) were lessened after intervention. Families reported less stress at the end of the program and positive perspectives about their children's abilities.

Conclusions: These preliminary results suggest that apply FIPs for teaching imitation, joint attention and play to preterm children with early signs of ASD showed improvements in the targeted skills of intervention. This fact support a new and potentially important practice option for children who exhibit early signs of impairment in social-communicative behaviours, before receiving a formal diagnosis of ASD. Nevertheless, this is a pilot study and further research and implementation of FIPs interventions targeting social-communication skills for preterm children with ASD is needed.

427.026 *(Poster)* Individual Differences in Developmental Gains across One Year of Early Intervention for Pre-Schoolers with Autism

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Background: Many children with autism benefit from intensive early intervention. However, individual responses vary, and little is known about the profile of skills associated with more favourable outcomes. Age at intake and amount of intervention received are commonly identified as contributing to positive outcomes, as are symptom severity and developmental level. However, these factors have rarely been examined together, and total scores are often used to measure child characteristics, which may mask information about specific behavioural predictors.

Objectives: We aimed to identify discrete behaviours associated with developmental gains across one year of intervention, and to further examine the role of intervention dose and child age at intake, in a large sample of preschool children with autism.

Methods: Participants comprised 122 children aged between 1 and 4.8 years at intake, who received approximately 1-year of Group-Early Start Denver Model (Vivanti et al., 2017) between 2015 and 2018. Individual differences in outcomes were examined by computing a Reliable Change Index (RCI), a standard score to quantify statistically robust change at the individual level. The Autism Diagnostic Observation Schedule (ADOS-2) was conducted at intake, and single items representing discrete behaviours were examined as potential predictors of outcome (e.g., Pointing, Response to Joint Attention, etc.). The primary outcome of interest was Verbal and Non-Verbal RCI scores calculated from Mullen Scales of Early Learning (MSEL) Age Equivalent Scores (V/NVAE) scores.

Results: Large variability was evident in developmental gains, with RCI scores suggesting approximately one third of the sample demonstrated no reliable change in V/NVAE, with the remaining two thirds demonstrating possible or significant improvement (*Figure 1*). Stepwise regressions were conducted to examine the unique role of potential predictors. Pointing, less Overactivity, Response to Name, and Pretend Play were significant unique predictors of Verbal RCI scores, while Pointing and Less Overactivity were significant unique predictors of Non-Verbal RCI. Intervention dose and younger child age at intake were not significant predictors of statistically reliable change in V/NVAE in this cohort.

Conclusions: Discrete behaviours identified as important in predicting developmental outcomes included (1) tuning in behaviours (e.g., Response to Name, Overactivity), and (2) behaviours to engage others (e.g., Pointing and Play). Identifying discrete behaviours associated with more favourable developmental outcomes may inform future individualised treatment decisions and provide more clinically useful information than baseline total scores. Identifying behaviours associated with developmental outcomes may inform proximal intervention targets or the identification of individuals who may benefit from more targeted supported; this is particularly important given that approximately one third of the sample made no reliable change in verbal and nonverbal cognition.

427.027 *(Poster)* Intensive Intervention for Children with ASD: How to Change the Developmental Profiles?

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Background: Research focused on the efficacy of intervention proved improvements in both cognitive and social abilities reporting promising results (Ospina et al., 2008; Smith &Iadarola, 2015, Tiede et al., 2019). Developmental interventions are planned to aim the core deficits of children with ASD. Furthermore, the involvement of parents in the intervention setting has been recently and widely highlighted (Green et al. 2010; Fava et al. 2011; Strauss et al. 2012; Kasari et al. 2014).Consequently, The recent literature emphasizes the importance of the presence of both parents and school educators during the intervention

Objectives: Our main aim was to explore how the cognitive profile and the social communication skills of children with ASD would change after receiving an early and intensive intervention, in line with the characteristics of the intervention according to the “Italian model of intervention” (Venuti, Scattoni et al. 2016) that included three contexts: the rehabilitation, the educational school and the family.

Methods: Participants were 26 children with ASD (chronological age 2-5 years; Mean=39,6 months, SD= 12,7; Mean mental age= 29,5 months, SD =12,5). The sample consists of 14 children with high functioning (Mean CA =40, 1months, SD= 15,6; Mean MA=32,4 months, SD =14) and 12 children with low functioning(Mean CA =38, 7 months, SD= 6; Mean MA=26,3 months, SD =10,2). Data concerning the cognitive profile were collected using the Griffith Mental Development Scales (GMDS-ER, Luiz et al., 2006) and the information regarding the social communication abilities were obtained from Autism Diagnostic Observation Schedule-2 (ADOS- 2, Lord et al., 2014). These tools were administered pre e post intervention (average period of intervention 13 months, SD=3,5).

Results: A significant improvement in the mean of General Quotient of the children were found between T1 and T2 (p=0.05), in particular regarding the Communication and Performance Scale. Moreover, the Social Affect domain showed a significant decrease between T1 and T2 (p=0.05). The results showed that children with high functioning obtain the higher progression compared to children with low functioning. In particular,regarding the language skills the results showed a significant difference (p=0.05) in the increase between children with high functioning (Mean Communication Quotient T1= 68,1; SD =22, T2 =94; SD=22) and children with low functioning (Mean Communication Quotient T1= 48,1; SD =27,1;, T2=52; SD=30,6).

Conclusions: These preliminary results underline how the characteristics of initial cognitive profile of children can differentiate the development trajectory after a period of intervention. Furthermore,all children following this intervention present greater skills in the use of social signals aimed at maintaining interaction with each other and general improvements in the development profile. Considering the differences between the improvements of high- and low-functioning children, it seems that cognitive functioning might characterize an intensive intervention in high-functioning children while for low-functioning children a continuous intervention might provide better outcomes

427.028 *(Poster)* Knowledge, Self-Efficacy, and Practices Among Part C Early Intervention Providers Who Work with Children at Risk for ASD

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Background: Children under age 3 with suspected or confirmed ASD should receive a mix of naturalistic and developmental interventions that actively involve their families and address core and associated symptoms as early as possible (Zwaigenbaum et al., 2015). Many children and families receive these early intervention services through the federally funded Part C program which mandates that early intervention is provided to children under 3 who have developmental delays. However, community agencies often do not have the accessibility to ASD-specific interventions and thus families are not recipients of these best practices (Hume et al., 2007, Stahmer et al., 2005, & Siller et al., 2013). Rather, providers often select intervention approaches that are available to them (Paynter et al., 2017).

Objectives:

To measure Early Intervention Providers' ASD knowledge and beliefs; 2. To assess Providers' self-efficacy related to working with children who have ASD; and 3. To assess Providers' current intervention practices for working with young children with ASD.

Methods: Ninety-three Early Intervention Providers were recruited through an ASD workshop series. Providers completed a professional and demographic survey and the ASD Knowledge and Self Efficacy Questionnaire (ASD-KS; Atun-Einy & Ben-Sasson, 2017). The professional survey asked about demographic and education and asked them to name three intervention strategies they use when ASD is suspected. Three scales from the ASD-KS were used: Knowledge and Beliefs, Early ASD Markers, and Clinical Self Efficacy. Respondents were asked to indicate the degree to which they agreed with statements across each scale using a four to six point Likert scale.

Results: Preliminary analyses were conducted. Bivariate correlations between demographic and outcome variables indicated that higher levels of education were significantly correlated with knowledge of early markers (r = .302; p = .005) and clinical self-efficacy (r = . 355; p = .001). Years of experience and number of children with ASD on their caseloads were not correlated with any measure of knowledge or efficacy. Using an inductive approach to content analysis, themes were identified to capture intervention strategies implemented when ASD was suspected. Of the 19 broad themes that emerged from the first data pass, 4 are considered established interventions according to the National Autism Center (2015). Those were behavioral interventions, language training, natural teaching strategies, and self-management. Sensory interventions and visual supports were endorsed more than any other themes. Accuracy of Early ASD Markers and ratings of Clinical Self-Efficacy were also examined by discipline. Speech-Language Pathologists had the highest accuracy of red flags and Social Workers had the lowest accuracy. SLPs, Occupational Therapists, and Physical Therapists reported the highest level of self-efficacy. Providers with a degree in Special Education reported the lowest levels of self-efficacy. Across all roles, the average ratings of perceived self-efficacy indicated that respondents had low to average confidence in their skills for working with children with ASD.

Conclusions:

This study is one of the first to examine ASD specific knowledge, self efficacy, and practices among Part C Providers. The results offer implications for targeted preservice and in-service training.

427.029 *(Poster)* Learning to Eat at Home: Delivery of Telehealth-Home Based Interventions to Address Food Selectivity in Autism Spectrum Disorder: A Feasibility Study.

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Background: The prevalence of food selectivity in autism spectrum disorder (ASD) is up to 89%. Gastrointestinal dysfunction, abnormal oral motor functioning, behavioural and sensory processing differences are contributing factors that drive food selectivity. Nutritional deficiencies, obesity, and stressful parent child relationships are negative health outcomes experienced in this population. A multidisciplinary team assessment is recommended to manage feeding challenges in ASD. Sensory or behavioural interventions are commonly used to address food selectivity, not taking into account other contributing factors driving food selectivity. Limited access to feeding clinics and intervention programs, geographic barriers and cost are some factors that impact the successful management of food selectivity in ASD.

Objectives: To determine whether a multidisciplinary team approach evaluating contributions from medical, oral motor, behavioral, sensory, and environment domains, coined the MOBS^{E}© framework, when paired with videoconferencing for delivery of therapy (telefeeding), can assess and guide the treatment of food selectivity in ASD.

Methods: 20 families with ASD and food selectivity are being recruited. A systematic multidisciplinary team assessment using the MOBS^{E}© framework is used to identify contributing factors of food selectivity. Families receive up to 12 one hour feeding intervention sessions to address a priori feeding intervention goals agreed upon. Outcome measures include; the Canadian Occupational Performance Measure (COPM), 24 hour food diary, and parent and therapist satisfaction questionnaires.

Results: Thus far 7 families have completed the intervention (we anticipate n=20 by INSAR 2020). Six of seven (86%) participants and five of seven (71%) participants showed a clinically significant change with respect to their performance and satisfaction respectively, of a priori goal determined by parent and clinician (Table 1). All participants explored new foods, though the total number of foods did not change over the study period. All participants were satisfied with the telefeeding intervention. All therapists involved with intervention delivery were satisfied with the telefeeding intervention. Parent child interactions around feeding were consistently identified as a challenge that contributed to feeding difficulties in all participants.

Conclusions: Our preliminary data suggests that the use of telefeeding is feasible and satisfactory to providers and parents for delivery of therapeutic feeding interventions. The multidisciplinary MOBS^{E}© framework approach facilitated identification of specific factors that contribute to the feeding challenges in ASD. Addressing parent child interactions around feeding were found to be integral in the management of food selectivity in ASD. This feasibility study is a novel multidisciplinary approach to deliver individualized care with telefeeding intervention to address food selectivity in children with ASD. This novel approach will address barriers to accessing specialized feeding intervention in this vulnerable population.

427.030 *(Poster)* Looking Back and Moving Forward: Scoping Review of Interventions Delivered By Speech-Language Pathologists to Preschool Children with Autism

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Background: One of the most important predictors of successful long-term outcomes in children with autism is language and social communication skills, and parents consistently identify these skills as treatment priorities for their children with autism. Because speech-language pathologists (SLPs) are trained to support a range of different skill areas (e.g. speech production, augmentative communication, language, social communication, play development, feeding and swallowing), they are well-positioned to tailor their selection of intervention strategies to the unique communication needs of each individual child with autism. This is critical given the heterogeneity of Autism Spectrum Disorder (ASD). However, to date, there has yet to be a comprehensive scientific review of the extent, range, nature, and outcomes of specific interventions delivered by SLPs to preschoolers with suspected or diagnosed ASD.

Objectives: In order to fill the gap in the existing literature and inform clinical practice development, we aimed to understand the extent, range, nature, and reported effectiveness of interventions used by SLPs with preschoolers diagnosed with or suspected to have ASD.

Methods: Adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols 2015 (PRISMA), we 1) identified relevant literature through librarian-assisted searches of 7 databases and by reviewing full text bibliographies; 2) conducted initial title and abstract screening, and planned aspects of data extraction; 3) iteratively developed the extraction form, and 4) collated and summarized results according to emergent understanding of the literature.

Results: The search yielded 19,796 records after removing duplicates; initial title and abstract screening yielded 1019 articles for full text review and 103 articles have met eligibility criteria. Final eligibility screening of full text is proceeding in parallel with iterative data extraction, which has yielded the preliminary findings reported here. At least three quarters of the articles published on SLP interventions for preschool children with autism have been published since 2000, with over half of those articles published within the last decade. Interventions provided by SLPs have covered a wide range of skill development areas including: social communication, augmentative and alternative communication, play development, imitation, speech production, pre-reading, receptive and expressive language, behaviour, feeding, and emotion regulation. Research on social communication and receptive and expressive language interventions are predominant and, notably, outcome measures used vary greatly across studies.

Conclusions: Findings from this scoping review will map information from empirical research about the types of interventions delivered by SLPs (e.g. oral motor speech intervention, social skills interventions, pre-literacy interventions). Findings will provide information about: intervention characteristics, dosage (i.e. intensity, frequency, duration), delivery methods, outcome measures used, and intervention results. This information will provide a basis to inform clinical practice development.

427.031 *(Poster)* Monitoring Parent Positive Support, Child Social Behavior and Expressive Language within a Randomized Controlled Trial of a Parent Mediated Intervention for Toddlers with Autism: Implications for Part C Early Intervention

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Background: This presentation reports results of an exploratory examination in which brief practitioner-friendly progress monitoring measures were used to assess the relationship between parent and toddler change within a parent mediated intervention implemented within a randomized controlled trial (RCT). The Joint Attention Mediated learning (JAML) program is a parent mediated, relationship-based and developmentally oriented intervention aimed at improving social communication outcomes of toddlers with autism. To date, practitioner measures of parent positive support and key child social and expressive language indicators have not been included in published studies of parent mediated interventions aimed at improving social communication outcomes of toddlers with autism. Practitioners, such as those providing Part C Early Intervention services, require brief, repeatable measures of parent-child interaction to make databased decisions about parent mediated intervention for toddlers with autism.

Objectives: The objective of this research is to examine whether pre-post intervention change in key parent positive supports, including following child lead and maintaining child interest, are positively and significantly correlated with child change in social behavior and expressive language as measured by progress monitoring measures designed for brief, repeated practitioner administration.

Methods: Thirty pre-post parent-toddler interaction videos were randomly selected from dyads participating in an RCT examining the effectiveness of the JAML program (Schertz et al., 2018). Videos were coded using two practitioner progress monitoring measures, the Early Communication Indicator (ECI; Greenwood et al., 2010) and the Indicator of Parent-Child interaction (IPCI, Baggett et al., 2010), with demonstrated reliability and validity for assessing the general outcomes of expressive communication and parent-child interactions that facilitate social competencies of infants and toddlers. Coders were naïve to treatment condition and timepoint. Twenty percent of videos were independently coded by two coders for the purpose of calculating interobserver agreement as defined by total number of agreements divided by total number of agreements and disagreements. Correlations were examined between pre-post change scores on the key parent indicant of following child's lead and maintaining child's interest and key child indicants of positive social behavior and use of words.

Results: Pre-post change in key parent positive supports, which included combined scores of following child lead and maintaining child interest, were moderately positively correlated with pre-post increases in child social behavior, including combined positive social behavior and follow through (r=.56, p=.03). Pre-post change in parent positive supports were also moderately and positively correlated with child use of words, with a trend toward significance (r=.47, p =.08)

Conclusions: These exploratory results provide preliminary evidence that the ECI and IPCI are sensitive to intervention change. Importantly, these metrics are brief, repeatable, and assess general outcomes pertaining social communication and expressive language, core concerns of autism. Specifically, pre-post change in key parent positive support was significantly and positively correlated with child positive social behavior change in the JAML intervention. Further, pre-post change in key parent positive support was moderately correlated with child expressive language, with a trend toward significance. These findings are encouraging and warrant examination within sufficiently powered studies.

427.032 *(Poster)* Outcomes of a Short-Term Low-Intensity Early Start Denver Model Implemented in the Taiwanese Public Health System: A Case Control Study

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Background: Early Start Denver Model (ESDM) is one kinds of Naturalistic Developmental Behavioral Intervention**.** In the past nearly 10 years, most of the ESDM studies were reported in the west, how to ESDM in the Chinese culture such as Taiwan and merged into Taiwanese public health system is an open issue.

Objectives: The purposes of this study was to evaluate the outcomes of implementing the ESDM based on Taiwanese public health policy for young children with Autism Spectrum Disorder (ASD) in the Greater Taipei area in Taiwan.

Methods: A case control study was conducted. A total of 42 children with ASD aged between 25 and 46 months were recruited. A multidiscipline team included child psychiatrists and clinical psychologists based on DSM5 diagnosis of ASD. The ESDM intervention group (N = 21, mean age = 33.23 months) matched to the control group who got community-intervention (N = 21, mean age = 35.14 months) on chronological age, overall development quotient (DQ) and sex. Children in ESDM intervention group received 9 hours per week of oneonone ESDM intervention in clinical settings for 24 weeks. Children's outcome measures were administered pre and postintervention, comprising the cognitive ability, language, adaptive behaviors and symptom severity assessed by the Mullen Scales of Early Learning, Mandarin-Chinese Communicative Development Inventory (MCDI), Adaptive Behavior Assessment System (2nd Edition, ABAS-II), and Autism Diagnostic Observation Scales (ADOS), respectively.

Results: Firstly, using the ESDM fidelity instrument, the mean scores of intervention team's fidelity over the course of the intervention was 81.05 (SD = 2.22; range: 78.03–84.98). Secondly, from the pre- to post-intervention, the results indicated that ESDM intervention group showed significantly greater improvements in nonverbal cognitive ability (Cohen's *d* 1.288) and overall cognitive ability (Cohen's *d*.939) than the control group. Thirdly, there were not significant difference in vocabulary production, adaptive behaviors and symptom severity between ESDM group and control group.

Conclusions: The study provides the first data to supports on the efficacy of ESDM in Taiwan. The results suggest that a shortterm and low-intensity ESDM intervention directly delivered in clinical settings may be a promising early intervention for young children with ASD.

427.033 *(Poster)* Parent Delivered Strategies to Improve Eating, Drinking and Swallowing Difficulties of Young Children with Autism and / or Other Neurodevelopmental Disorders: Current Practice and Future Research

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Background: Eating, drinking and swallowing difficulties (EDSD) are common in young children with autism and/or other neurodevelopmental disorders. EDSD can be caused by physical and non-physical difficulties leading to inadequate calorie intake, affecting a child and parents everyday life. Autistic children commonly show non-physical EDSD such as restricted or selective eating and rituals associated with food or mealtimes. Autism is also often associated with physical neurodevelopmental conditions such as Down Syndrome and cerebral palsy leading to both physical and non-physical EDSD. Guidance on how to address these difficulties is lacking.

Objectives: We undertook a study to answer the question: What interventions, which could be delivered at home by parents, are available to improve eating in young children with neurodevelopmental conditions and are suitable for investigation in pragmatic trials? Our study focused on both physical and non-physical EDSD.

Methods: We undertook: 1. Updates of systematic reviews, and a mapping review of the research evidence for interventions and outcome measures. 2. Two national parent and professional surveys: one about current professional practice and what is received by parents, and a Delphi survey to identify the most important interventions and outcomes. 3. Focus groups with parents, professionals and young people to discuss current practice and consultation workshops to identify future directions and research.

Results: 951 parents and professionals participated across the study: 400 parents; 479 health professionals; 62 education professionals. 10 young people were interviewed. The limitations of the research evidence regarding interventions and tools to measure outcomes was identified. The survey showed a wide range of interventions are used in NHS practice – parents and professionals reported variability in provision. Professionals and parents of autistic children reported a lack of service provision for children with EDSD. Nonetheless, parents and professionals considered many interventions were important, and led to change in EDSD. They identified 19 interventions as important to deliver when needed, and 10 outcomes that were most important to measure (including nutrition, growth, and health/safety); young people agreed these were important outcomes. Parents and professionals were positive about a proposed 'toolkit' of interventions. They thought the toolkit contained interventions that were relevant for children with physical and non-physical EDSD, and the order these would be delivered could be prioritised through shared decision-making.

Conclusions: The challenges for future clinical trials of a toolkit of interventions were evident (for example, the range of interventions that children in a comparator group might receive). Parents and professionals thought that implementation of the toolkit as part of usual practice would be a positive step. However, this would require the toolkit to be operationalised through further development including an evaluation of the feasibility and acceptability of using the toolkit in clinical practice and in the home environment by parents. Subsequent evaluation of its effectiveness could then be undertaken. The findings of this study can be used to support service development for parents and children with autism and/or other neurodevelopmental disorders, and also by funders to consider whether to commission further research including trials of interventions.

427.034 *(Poster)* Parent Strategies for Improving Language in Minimally Verbal Preschoolers

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Background: Children's early language skills are learned through social interactions with caregivers. Core impairments in social communication skills can lead to missed opportunities for children with ASD to learn from these social interactions. Early interventions for ASD that target social communication and language vary in approach -- from adult-led and structured (e.g., Discrete Trial Training) to child-led and naturalistic (e.g., JASPER; Kasari et al., 2008, 2010).

Training parents in intervention strategies is effective for improving a wide range of children's outcomes (Schultz et al., 2011). Less is known, however, about which parent strategies are most effective in improving children's language.

Objectives: 1) Examine change in parent strategy use by treatment (DTT, JASPER) and across 6-month intervention period. 2) Explore relation between parent strategies, time, treatment, and child language outcomes.

Methods: This study uses secondary data from a social communication intervention RCT. Of the original 164 participants, 143 were included in the current study (had data at both timepoints, completed assessment with same parent at both timepoints, transcripts in English). Preschoolers with ASD (Mage=44.99 months, SD=5.46) using <30 spontaneous words at baseline received 6 months of either DTT or JASPER. Parents received training in intervention strategies (based on child's treatment) during the last two months of treatment.

At entry and exit, parent-child dyads completed a videotaped 10-minute free play assessment (PCX). PCXs were coded (ICCs=.75-.88) for parents' use of strategies common across ABA-based interventions, namely: responsiveness, prompting, pacing, and environmental arrangement. Items were rated on a 5-point Likert scale; higher ratings indicated more fluent and appropriate use of strategies.

PCXs were also transcribed, coded, and analyzed for the number of children's spontaneous communicative utterances (SCU) and number of different words (NDW).

Linear mixed models were used to examine change in parent strategy use by time and treatment. Negative binomial mixed models were used to examine change in children's language across time, treatment, and parent strategies. Analyses controlled for children's age, nonverbal IQ, ADOS severity, and parents' education levels.

Results: There was a time x treatment interaction for parents' responsiveness (p=.043) and prompting (p=.040). JASPER parents increased in their appropriate use of these strategies between entry and exit; DTT parents remained stable. DTT parents used environmental arrangement more appropriately than JASPER parents (p=.040) across timepoints. There were no differences in pacing by time or treatment.

Children's SCU increased over time (p<.001). Parents' responsiveness (p=.003) and prompting (p=.020) predicted SCU. Parents' responsiveness (p=.004) and prompting (p=.033) also predicted NDW, which increased over time (p<.001).

Conclusions: Parents improved in their use of ABA-based intervention strategies over a brief training period. Parent training in JASPER was particularly effective in teaching parents to contingently respond to children's communication and prompt appropriately (prompt hierarchy, developmental appropriateness). This is especially significant since these strategies also predicted children's language outcomes. Findings add to a growing base of literature on the effectiveness of parent training on child outcomes, highlighting parent strategies that ultimately support language development in minimally verbal preschoolers.

427.035 *(Poster)* Parent-Led Training for Motivating Eye Contact in Children with Autism Spectrum Disorder: Boscc Outcome Study

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Background: Difficulty in use of eye contact is one of the earliest signs that evokes concerns in parents of young children with ASD. It could be beneficial to aid a child with ASD to initiate spontaneous eye contact by encouraging it in everyday interactions as part of natural social engagement in situations considered the most rewarding for the child. We piloted a parent-led eye contact-specific training as an additional part of treatment as usual in young children with prominent features of ASD and developmental delay. Our earlier findings revealed that eye contact use increased in free-play with the parent in the training group. The increase in joint engagement was evident after the 2-year follow-up. It is not known, however, whether the eye contact use is generalized to interaction with other persons than parents or to other aspects of social behaviour.

Objectives: The aim of the study was to investigate whether a parent-led training method targeted to improve eye contact in young children with ASD would show improvements in social interaction with other adults than parents. The Brief Observation of Social Communication Change (BOSCC) was used as an outcome measure. BOSCC comprises of 16 observational items which include 9 items of social communication and 4 items of restricted, repetitive behaviours as 13 core items and 3 additional items of other behaviours.

Methods: Twenty young (age range: 2.5-5.5 years of age) children with prominent features of ASD and developmental delay were randomly divided into a training group (N=10) and a control group (N=10). The parents of the training group were taught to do three kinds of daily exercises with their child for 4 months. The BOSCC analyses were done from ADOS-2 -assessments at baseline, 4-6-month (short-term) and 2-year (long-term) outcome. The BOSCC was coded from two 6-minute segments of the 12-minute videos that included the same pre-agreed, recommended activities of ADOS-2. The coders were blind to the status of the video and in adequate agreement with each other. The outcome effect was counted as change score delta between the three measurements.

Results: The findings showed that there were no between group differences in delta scores in any of the summary scores at any measuring points. At the item level, however, there was a significant difference in the change of eye contact in short-term outcome in a way that the training group had improved more than the control group (U=19.5 p=.018). There was greater improvement in use of gestures (U=15.5. p=.013) and the in integration of vocal to non-vocal modes of communication (U=14.0 p=.010) between the short-term and long-term outcome in training group than in the control group.

Conclusions: Our preliminary findings indicate that the parent-led eye contact training has positive effect to the use of eye contact, and it might have benefits to other aspects of the non-vocal communication in the long run. It was interesting that the findings revealed generalization of the eye contact use in a semi-structured play session with a stranger adult.

427.036 *(Poster)* Parent-Mediated Interventions for Elevated Autism Risk: Considerations for Parenting Stress and Maternal Depression

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Background: Providing empirically derived and affordable services to affected families is a primary goal of early detection researchers. Given the current prevalence of ASD, delaying services for infants at-risk for social communication difficulties is a missed opportunity to improve developmental trajectories. To better serve families, and as a measure of clinical best practice, researchers/practitioners are shifting their focus from a "wait-and-see" approach to *prospectively* providing services to children developing with elevated autism risks/concerns (ERCs). A handful of elevated-risk parent-mediated interventions (PMIs) have emerged and demonstrate subtle, yet significant shifts in social communication progress following treatment. These PMI designs have simple guidelines (e.g., increase responsiveness during play); however, less attention has considered maternal well-being within PMIs to monitor risks of maternal distress or depression that may impact treatment compliance and ultimately efficacy.

Objectives: To inform elevated-risk PMIs, this preliminary investigation addressed three aims: (1) descriptively characterized types of infant/toddler ERCs at enrollment, (2) assessed associations between total ERCs and mother reported indices of parenting stress and depression, pre- to post-intervention, and (3) assessed whether reported rates of maternal parenting stress and depression differ, pre- to post-intervention.

Methods: Twenty-one children with ERCs participated in an ongoing family routines-based PMI. At enrollment, mothers completed a series of standardized measures, including the Parenting Stress Index (PSI) Short Form and the Center for Epidemiologic Studies Depression Scale (CESD). An ERC Total Score of up to 5 was derived from reports of (1) prenatal/newborn concerns, (2) parents' developmental concerns, (3) pediatrician/clinician concerns, (4) sibling diagnostic history, and (5) flagged scores on developmental screeners. Qualifying ERCs per domain are summarized in Table 1.

Results: Overall, mothers endorsed an average of 2.95 ERCs for their infants/toddlers at enrollment. A series of partial correlations and general linear models, with terms for infant sex, income, and treatment condition, were conducted for Aims 2 and 3, respectively. Specific to Aim 2, infants/toddlers with more ERCs had, (1) mothers who endorsed significantly more stress related to their infant/toddlers being difficult before intervention, and (2) following intervention, mothers endorsed significantly more dysfunctional interactions (see Table 2). Unexpectedly, significant negative associations pre- and post-intervention for Total ERCs and depression concerns were observed such that more ERCs were associated with lower rates of maternal depression symptoms. Further inspection revealed this association to be primarily driven by the parent concerns ERC domain, r(16) =-.49, *p*=.02. In addition, other ERC domains such as sibling diagnostic history were more indicative of increased depression symptoms, r(16)=.44, *p*=.03. Specific to Aim 3, no significant mean level differences pre- to post-intervention for parenting stress or depression were observed.

Conclusions: To inform elevated-risk PMIs, this study provides preliminary support for considering and monitoring indices of maternal stress and depression when training mothers as interventionists. Future studies may build upon our preliminary investigation by further examining types of ERCs that may be more indicative of elevated stress and/or depressive symptoms, as well as how maternal reports of stress and/or depression relate to observed social behaviors during treatment.

427.037 *(Poster)* Parent-Nominated Target Problems to Assess Outcome in a Randomized Trial of Parent Training in Children with ASD and Disruptive Behavior

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Background: Disruptive behaviors that impair adaptive functioning are common complaints from caregivers of children with Autism Spectrum Disorder (ASD). These disruptive behaviors include aggression, tantrums, noncompliance, hyperactivity, impulsiveness, and self-injury.

Objectives: To describe the reliability and validity of parent-nominated target behavior problems to measure outcome in a multi-site, randomized trial of RUBI parent training versus psycho-education in young children with ASD and disruptive behavior.

Methods: Following a comprehensive assessment, participants (age 3 to 7 years) with ASD accompanied by moderate or greater behavioral problems were randomly assigned in a 1:1 ratio to manual-driven parent training (PT) or a structured parent education program (PEP) for 24 weeks. Moderate or greater behavioral problems was defined by a score of ≥15 on the Aberrant Behavior Checklist-Irritability subscale (ABC-I). To identify the parent target problems (PTPs), a clinician blind to treatment assignment interviewed parents to identify 1 or 2 chief complaints about the child's disruptive behavior. The description, which included frequency, duration, intensity, and impact of the behavior on family life, was documented in a brief narrative at baseline. The narratives were reviewed and revised at monthly follow-up visits to document behavior change over time. A panel of five raters was convened to rate change from baseline on a 9-point scale (1=normal; 2=markedly improved; 3=definitely improved; 4=equivocally improved; 5=no change; 6=possibly worse; 7=definitely worse; 8=markedly worse; 9=disastrously worse) at Weeks 8, 12, 16, and 24. Raters participated in a teleconference to calibrate the scoring of the PTPs on the 9-point scale. Following this calibration conference, raters independently scored PTPs for all cases blind to treatment condition.

Intraclass correlation (ICC) across the panel of five raters exceeded 0.7 at each time point (overall mean=.76, range=.74-.79) supporting solid inter-rater reliability. Thus, PTP scores for the two target problems were averaged across the five raters yielding a mean score for each child at each time point. The mean scores for PT was compared to PEP using an intent-to-treat mixed effects linear model.

Results: 169 children (mean age 4.7 ± 1.2 years, 87.5% male, 12.8% IQ < 70) of the original 180 study participants had complete PTP data. At Week 8, the difference in mean PTP scores between PEP and PT was moderate (effect size=.56, p=.001). By week 24, the difference between PEP and PT was large (ES=.75, p<.001). PT participants showed a more significant reduction in target problems than PEP participants.

Conclusions: The behavior narratives captured on PTPs offer a systematic method of tracking individual child-specific outcomes over time in a clinical trial. The FDA and other federal agencies have highlighted the importance of patient-reported outcomes. Parent/caregiver narratives provide important information about the patients with ASD that can also be used to track child-specific outcomes in clinical practice.

427.038 *(Poster)* Parent-Reported Generalization of Functional Communication Training in Young Children

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Background: Problem behavior is observed at substantially higher rates in children with autism spectrum disorder (ASD) than in their typically-developing peers (e.g., Soke et al., 2018). Functional communication training (FCT) is a behavior analytic approach that involves teaching an appropriate communicative response that serves the same function as a specific problem behavior (Reichle & Wacker, 2017). Despite their narrow aim, focused interventions like FCT may also reduce non-targeted behaviors; accordingly, there is hope that the effects of the treatment within the training context (e.g., during home-based therapy sessions) will generalize to other contexts (e.g., during car rides) and other behaviors. FCT is widely used for children with ASD (Tiger et al., 2008) and has strong evidence of its effectiveness, including findings from a recent randomized controlled trial (Lindgren et al., under review). Yet little is known about the generalized effects of FCT without programming for them.

Objectives: We evaluated treatment effects outside of the training context of parent-mediated FCT for young children with ASD conducted using a telehealth delivery model. We employed parent-rating scales used in previous behavioral treatment work (e.g., Bearss et al., 2015; Bearss et al., 2018; Scahill et al., 2016) for participants whose targeted problem behavior was effectively treated with FCT. We examined: 1) generalization of treatment effects to settings and contexts beyond the training setting, 2) generalization of treatment gains to various problem behaviors, and 3) parent perception of stress related to the child prior to and at study completion.

Methods: A sample of thirty young children (ages 21 to 84 months; 24 male, 6 female) with ASD who exhibited problem behavior was drawn from federally-funded, multi-site research on the assessment and treatment of problem behavior in children with ASD. Each participant received FCT treatment through weekly, 1-hour telehealth sessions for 2 to 6 months or until discontinuation criteria were met (i.e., problem behavior decreased by 80% or greater from baseline rates). Parents completed pre- and post-treatment rating scales (*Home Situations Questionnaire-Pervasive Developmental Disorders* [*HSQ-PDD*]; *Aberrant Behavior Checklist*, Irritability subscale [*ABC-I*]; *Behavior Problems Inventory* [*BPI*]; *Parenting Stress Index*, Child Domain [*PSI*]).

Results: A linear mixed model approach was used to compare scores on *ABC-I*, *BPI*, *HSQ*, and *PSI* measures. Statistically significant differences between pre- and post-treatment were found for the *ABC-I* ($F(1, 28) = 24.24$, $p < .001$), *BPI* ($F(1, 28) = 23.37$, $p < .001$), and *HSQ* ($F(1, 28) = 35.15$, $p < .001$) in the hypothesized direction. Analyses for the *PSI* demonstrated similar results ($F(1, 26) = 6.71$, $p = .016$) for all participants who completed pre- and post-treatment measures.

Conclusions: The current study extends the research on FCT for young children with ASD by indicating generalized effects of FCT across targeted and non-targeted problem behaviors across settings. Implications for generalization effects of parent-mediated treatments for young children with ASD will be discussed. Intentional integration of self-report measures—the standard for most behavioral and pharmacological treatments studies in ASD (Matson & Burns, 2019)—into behavior analytic treatment approaches will be discussed as well.

427.039 *(Poster)* Parental Stress As a Predictor for Treatment Outcome in Preschool Children with ASD and Other Social Challenges

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Background: Research suggests that parents of children with autism spectrum disorder (ASD) may experience higher levels of stress compared to parents of typically-developing children (Karst et al., 2014). These stress levels may be more pronounced during early childhood as parents begin navigating their child's diagnoses and seeking resources (Estes & Macduffie, 2019). Since caregivers with high stress levels may be less engaged in early intervention programs, they may in turn be less likely to implement good parenting practices that result in positive outcomes for their children (Estes & Macduffie, 2019). Consequently, parental stress has been associated with delays in social relatedness in children with ASD (Davis & Carter, 2008). Although preliminary research has also demonstrated that high parental stress may reduce the effectiveness of early teaching interventions for children with ASD (Osborne et al., 2007), there remains a dearth of literature investigating the effect of parental stress on treatment outcome specifically in early social skills interventions.

Objectives: The present study seeks to examine whether baseline parental stress predicts social skills treatment outcome for preschool children with ASD and other social challenges. We hypothesized that higher parental stress levels at baseline would predict lower improvements following social skills training.

Methods: Participants included 58 preschool children (75.9% male; mean age=4.57; *SD*=0.78) presenting for treatment through the UCLA Program for the Education and Enrichment of Relational Skills (PEERS®), an evidence-based, caregiver-assisted social skills intervention for youth with ASD and other social challenges (Laugeson et al., 2011). Baseline parent stress was measured using total pre-treatment scores on the Parenting Stress Index, Short Form (PSI-SF; Abidin 1995), with higher scores indicating greater parental stress. Treatment outcome was measured using change in total scores from pre- to post-test on the Social Responsiveness Scale-Second Edition (SRS-2; Constantino & Gruber, 2012), with decreases in SRS-2 scores representing greater improvement in social responsiveness.

Results: A paired sample t-test reveals significant improvement on the SRS-2 pre- to post-treatment (mean=6.586, *SD*=7.952, $p<.001$). A linear regression was calculated to predict treatment outcome on the SRS-2 in relation to baseline parental stress levels on the PSI-SF. Analyses reveal a significant regression ($F=8.632$, $p=.005$), with an R^2 of .134, indicating that higher baseline caregiver stress levels are related to greater improvements in social responsiveness at completion of the program, contrary to expectation.

Conclusions: Results of the present study differ from prior research documenting decreased effectiveness of early teaching interventions in stressed parents, with current data revealing that parents reporting higher baseline stress experience greater gains in their children's social responsiveness following treatment. These findings suggest that the PEERS® intervention, which includes elements of parent training, may offer highly stressed parents of children with ASD and other social challenges the skills required to communicate effectively with their child, possibly leading to reduced behavioral difficulties and improved social functioning. Overall, this study highlights the importance of providing targeted resources to parents with greater needs, as this may translate into enhanced treatment outcomes for children with challenging social behaviors.

427.040 *(Poster)* Pivotal Response Treatment Parent Training Delivered Via Telehealth: A Pilot Study

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Background: The high prevalence of autism spectrum disorder (ASD) requires the need for widespread dissemination of evidence-based treatments. Previous research has demonstrated that Pivotal Response Treatment (PRT) is an effective treatment for improving language and communication skills of young children with ASD. Parents can learn to implement PRT with fidelity, leading to gains in child language. However, access to such training programs is limited. Telehealth-delivered PRT parent training may be a promising approach to disseminate such treatment widely and quickly.

Objectives: The objective of this pilot study was to determine whether PRT parent training delivered via video conferencing was effective for improving child communication abilities.

Methods: To date, eleven participants (2 female; mean age=43 months) and their parents were recruited from a university ASD clinic/research program. Parents received 12 weeks of PRT training (1hr/week) that was delivered via video-conferencing. The majority of sessions included parent and child, with the clinician giving live feedback. Language and communication skills were assessed pre- and post-treatment using the MacArthur Bates Communication Development Inventories (CDI), Vineland Adaptive Behavior Scales (VABS), and a 10-minute language probe recorded at home, during which parents were instructed to try to get their child to communicate as much as possible. Social abilities were measured using the Social Responsiveness Scale-2 (SRS-2). All comparisons were conducted using paired-samples t-tests. Participant recruitment is ongoing.

Results: Number of words produced on the CDI significantly improved after treatment (baseline M=103.09, SD=101.93; week12 M=190.82, SD-146.03; t(10)=-3.115, p=.011), as did number of words understood (baseline M=173.00, SD=117.28; week12 M=200.27, SD=115.47; t(10)=-2.582, p=.027). Participants' overall communication standard score on the VABS also improved (baseline M=69.56, SD=10.03; week12 M=76.44, SD=10.32; t(8)=-3.077, p=.015). Following treatment, children showed improvement in independent use of intelligible speech as evidenced by significant increase in response to parents' non-verbal prompts (baseline M=0.18, SD=0.41; week12 M=4.09, SD=3.99; t(10)=-3.36, p=.007) and in spontaneous utterances (baseline M=2.27, SD=2.41; week12 M=5.18, SD=6.06; t(10)=-2.42, p=.036), when coded from the home video language probe. No significant changes in SRS-2 scores were found.

Conclusions: Preliminary results from this ongoing pilot study indicate that children improved their language abilities across a variety of measures after they and their parents took part in a 12-week telehealth PRT parent training program. Though the training focused on expressive language, receptive vocabulary also improved, indicating that the benefits may not be limited to the explicit aims of the training. The findings from the home videos indicate that children moved toward an increased spontaneity of speech. Increased responsiveness to non-verbal prompting also most likely reflects an improvement in parents' ability to prompt effectively using non-verbal means. These preliminary findings demonstrate that PRT parent training can be implemented via video conferencing and that it can lead to gains in child language. Additional findings from this ongoing study will be examined and if consistent with current observation will warrant future randomized controlled trials to replicate the findings and compare parental fidelity of implementation between PRT delivered via telehealth versus in-vivo.

427.041 *(Poster)* Pre-Pilot Evaluation of CST Program: A Qualitative Analysis

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Background: Developmental Disorders are defined, according to ICD-10, as a set of conditions that are characterized by hyperkinetic activity and / or persistent and repetitive instances of alteration of social, aggressive or challenging behavior (WHO, 1994). These disorders usually begin in childhood with an alteration or delay of functions related to the maturation of the central nervous system (WHO, 2010). The consequences of these disorders in children and / or adolescents have direct and indirect consequences, which has been associated with reducing their health and wellbeing and their families (Peasgood et al, 2016). Training interventions on psychosocial skills and for caregivers are focused on transmitting to children and their caregivers methods and strategies to reduce problematic behavior and improve social behavior (WHO, 2018). The World Health Organization developed the Caregiver Skills Training Program (CST) to improve skills and quality of life in caregivers of children with autism.

Objectives: Conduct a qualitative assessment of the feasibility and acceptability of CST in the central commune of Santiago, Chile.

Methods: We conducted a pre-pilot study of CST in caregivers of children with autism in the central commune of Santiago, Chile, in 2017-2018. CST was implemented by two facilitators and included 9 group training sessions and 3 in-home visits. Feasibility and acceptability of CST was qualitatively assessed by an external team and included: 1- Focus groups with caregivers and 2- In-depth interviews with caregivers and facilitators.

Results: In focus groups with caregivers, 5 dimensions were identified: 1- Usefulness of the program, components and strategies; 2- Acceptability, implementation and impact; 3- Adverse effects; 4- Attendance barriers and abandonment; 5- Suggestions. Caregivers reported that liked the in-home visits, the content of the group training sessions and the interaction with other caregivers. They found that it improves the coping of challenging behaviors and mentions empowerment in facing demands of educational and family establishments. They did not report negative experiences, however, women mentioned that it was difficult for them to transmit the skills that they learned to their male partners. Among the suggestions of caregivers are: post-intervention follow-up, incorporation of aspects related to future challenges in adolescence, and training in educational establishments. In the in-depth interviews with facilitators, 7 dimensions were identified: 1- Acceptability; 2- Material evaluation; 3- Impact; 4- Barriers to implementation; 5- Training and supervision; 6- Home visit evaluation; 7- Suggestions. Facilitators reported that CST has good acceptability and that the quality of the content was good. Facilitators did not report negative experiences, however, they indicated that the content to provide in each session was long.

Conclusions: In the qualitative records analyzed CST appears to be a feasible and acceptable intervention for caregivers of children with autism in Chile. CST should be implemented from a mixed, large-scale approach, ideally including a randomized clinical trial, to prove benefits for children with autism and their caregivers.

427.042 *(Poster)* Predictors of Parent-Reported Use of Special Education or Early Intervention Services Among Preschool-Age Children with Autism in the SPARK Cohort

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Background: Accessing early intervention (EI) services is helpful to improving behavioral health outcomes for children with autism spectrum disorder (ASD). Prior research has shown that white, high-income families and those living in metropolitan areas are more likely to access EI services (Payakachat, Tilford & Kuhlthau, 2017; Monz, Houghton, Law, & Loss, 2019).

Objectives: To identify predictors of accessing special education or early intervention services among preschool age children with autism participating in the SPARK Study.

Methods: Data for this study come from SPARK, an online research study that includes individuals with a professional diagnosis of autism and their family members. SPARK collects participant information online. Parents were asked to complete the Social Communication Questionnaire (SCQ) and Background History Questionnaire (BHQ) about their children with ASD. A multivariate logistic analysis was used to identify predictors of accessing public EI services. The primary dependent variable, ever “accessing special education supports or early intervention services through the school” (Y/N), in addition to the independent variables for race, ethnicity, household income, sex at birth, zip code, and language level were used for analysis. A total of 2,388 children with ASD, between the ages of two and five were included in the study. Categorization of metropolitan vs. non-metropolitan were derived using zip codes based on US Census criteria.

Results: The majority of the sample were white (84%) and male (78%), with a mean age of 3.9 years (SD = 0.73). Close to half (45%) was non-verbal. The sample was approximately equally distributed across three household income brackets (<= $35K, between $36K and $80K, >= $81K), and close to two-thirds (63%) live in a metropolitan area. A majority (82.4%) reported having accessed services through the school. In the unadjusted analyses, male sex at birth, living in an urban area, and higher income were all positively associated with accessing EI services ($p<.05$). After adjusting for these factors and race, ethnicity, SCQ score, language level, and metro/non-metro area, families that reported a household income of >=$81K were 2.4 times more likely to access EI services compared with those in the lowest income bracket (<=$35K; 95% CI:1.81, 3.23). Additionally, families living in a metropolitan area were 1.3 times more likely to access EI services than those living in a non-metropolitan area (95% CI: 1.07, 1.69).

Conclusions: Findings from this study support prior research that has found that living in a metropolitan area and having a higher income are associated with a greater likelihood of accessing early intervention services. These findings also further underscore the need to increase access to early intervention among under resourced families.

427.043 *(Poster)* Preliminary Study on the Effectiveness of Kindergarten-Based Integrated Intervention in Children with Autism

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Background: Autism spectrum disorder (ASD) occurs worldwide, however adequate therapy programs to support children with ASD are not readily available in many parts of the globe. Integrated models of therapy use a combination of existing therapies simultaneously to reinforce common goals, these often consist of both autism specific practices and general rehabilitation therapies. Due to the versatility of integrated therapy models they may be more accessible for countries in which autism awareness and support is not as prevalent.

Objectives: The current study assesses the effectiveness of an integrated model, which utilizes a combination of occupational therapy, speech-language pathology, and psychiatry within a classroom setting.

Methods: 36 children (aged 2-6) received integrated intervention as a full day kindergarten program (40 hours a week) over 12 months. Knowledge & cognition, communication, adaptability, and autonomy were assessed 3 times over the span of the intervention. Measures in developmental ability of these four domains were compared to the child's actual age and the expected developmental milestones of a typically progressing child to produce a measurement of developmental age. Variation in developmental age across assessment periods was then used to calculate effect size.

Results: The therapy shows a strong upward trend in improving autonomy (g=1.35) and adaptive score (g=1.12) after 6 months. Language (g=0.69) and knowledge (g=0.73) also show an upward trend after 6 months, however this result is inconclusive due to large standard deviation. However the effect was not linear as the consecutive 6 months of therapy yielded only a small positive effect for knowledge & cognition (g = 0.17), communication (g = 0.26), adaptability (g= 0.18) and autonomy (g = 0.23). The net effect over the full 12 months of therapy was highly effective across all 4 domains.

Conclusions: Integrated therapies come under particular interest internationally as they are more affordable and accessible to replicate than ASD specific therapies such as Applied Behaviour Analysis or TEACCH, however they are studied far less. This study shows integrated therapy to have some positive effect when applied as a full day program to preschool children, however it is highly likely that confounding variables are leading this effect. Future research should look towards identifying these confounding factors and the impact they have on developmental support.

427.044 *(Poster)* Reported and Actual Practices: Part C Early Interventionists Working with Families of Toddlers with or at Risk for ASD

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Background: Early intervention is commonly provided to young children with or at risk for ASD through home- and community-based Part C services (IDEA, 2004). When working with children under 3, early interventionists should use a family-centered, routines-based, caregiver-implemented intervention approach in natural environments to build caregiver capacity and support child outcomes (e.g., McWilliam, 2010; Woods et al., 2011). A gap remains between recommended and actual practice in community-based intervention (e.g., Dingfelder & Mandell, 2011; Sawyer & Campbell, 2017), and studies have found discrepancies between interventionists' reported and actual practices (Campbell & Sawyer, 2009; Fleming et al., 2011). This phenomenon is possibly explained by the Dunning-Kruger effect (Dunning, 2011; Kruger & Dunning, 1999), emphasizing an inability to recognize one's own inabilities, resulting in inaccurate self-assessment of skills. To improve community-based early intervention for families of young children with or at risk for ASD, further examination of reported and actual practices is necessary.

Objectives: The primary objective was to examine differences between interventionists' reported and actual practices to support caregiver-implemented intervention during home visits with families of toddlers with or at risk for ASD. A second objective was to compare interventionists' and caregivers' reported practices.

Methods: Participants consisted of 11 Part C early interventionists and caregiver/child dyads. Children had a diagnosis of ASD or were at risk due to social communication delays. Interventionists video-recorded home visits with caregiver/child dyads and researchers rated interventionists' actual practices using the Caregiver-Implemented Intervention Scale (Authors, 2018). Interventionists and caregivers independently rated the interventionists' typical practices using the Family-Professional Interaction Questionnaire (Authors, 2018). All measures used four-point rating scales to evaluate interventionists' practices.

Results: Preliminary data analysis demonstrated interventionists' actual practices were lower (M = 2.65, SD = 0.83) than their self-reported practices (M = 3.14, SD = 0.49). Results from a Wilcoxon signed-rank test revealed the difference in this small sample was not statistically significant (Z = -1.68, p = .09), but the effect size using Cohen's d was .74, showing 3.4 of a standard deviation difference. Interventionists' reported practices (M = 3.14, SD = 0.49) and caregivers' reported practices (M = 3.04, SD = 0.24) were both relatively high, with no statistically significant or noteworthy difference (Z = -1.16, p = 0.25). Visual analysis revealed a trend of larger discrepancies between reported and actual practices for interventionists with lower actual practice scores, and smaller discrepancies for interventionists with higher actual practice scores, with the exception of one participant (see Figure 1). Findings on the entire sample will be presented.

Conclusions: Preliminary results demonstrate interventionists' actual practices were lower compared to their self-reported practices, but interventionists' and caregivers' reported practices were relatively similar. The Dunning-Kruger effect is one possible explanation for the observed trend of larger discrepancies for interventionists with lower actual practice scores and smaller discrepancies for interventionists with higher actual practice scores. This study adds to the literature on community-based intervention for families of young children with or at risk for ASD, providing further understanding of the research-practice gap and implications for professional development.

427.045 *(Poster)* Responsivity in Pre-Verbal Toddlers from a Large-Scale Community Demonstration Project of the Social ABCs Parent-Mediated Intervention

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Background: Research in early parent-mediated intervention for toddlers with confirmed or emerging ASD has tended to exclude toddlers with baseline language development below a 12-month level. Information about response to early parent-mediated intervention in this group is thus limited and warrants further investigation in order to inform treatment development.

Objectives: To evaluate the role of baseline language level on response to intervention in toddlers who participated in the Social ABCs™ intervention for toddlers with identified ASD risk within a large scale community implementation.

Methods: The Social ABCs™ was delivered as part of clinical service in Hamilton Ontario (pop. 500,000). Participants included 136 families who completed the 12-week 1:1 coaching program; 98 boys (72%) and 38 girls (28%); mean age = 25.36 months (SD = 4.25; range = 14-34 months). Data were analyzed for those who completed coaching up to week 12. The primary measures of interest were video-coded child responsivity to parent language opportunities (at baseline and week 12), and a standardized measure of language using the Mullen Scales of Early Learning (MSEL) at baseline and six months after beginning the program.

Results: Toddlers' language development at baseline (MSEL Receptive and Expressive language age equivalent scores) significantly predicted week-12 toddler responsivity (R^2 = .147 and .153, respectively, both *p*'s < .001). Notably, however, baseline language level did NOT predict amount of child gain in responsivity (i.e., change from week 1 to 12); both *p*'s > .50. When the sample was divided based on baseline Receptive or Expressive Language level (< or ≥ 12 month age equivalent), all groups made approximately the same amount of gain in toddler responsivity (i.e., 38.23%, 39.0%, 39% and 38.12% for those with baseline RL or EL under 12 versus 12 or over, respectively). For all groups, regardless of baseline language level, gains in responsivity of almost 40% were achieved, with the steepest rate of gains between week 1 and 4 for all groups (see Fig. 1). Although baseline Receptive and Expressive language ability predicted some aspects of toddler responsivity, they did not predict rate of change over time.

Conclusions: Findings demonstrate that toddlers made comparable rates of improvement in responsivity to parent language opportunities regardless of whether they started the program with language levels above or below a 12-month level. This supports the inclusion of toddlers with very low baseline language levels in parent-mediated community early interventions. Findings support the effectiveness of brief parent-mediated intervention regardless of baseline language functioning.

427.046 *(Poster)* Restricted and Repetitive Patterns of Behavior and Interests in Children with Autism Spectrum Disorder: A Systematic Review of Behavioral Interventions

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Background: Restricted and repetitive patterns of behavior and interests (RRBIs) are among the core symptoms of autism spectrum disorder (ASD) are likely to have an onset during early childhood in individuals with ASD. However, interventions to address RRBIs lag far behind early interventions in the sociocommunication domain. To date, no review has concentrated on behavioral treatment of RRBIs specifically for children under eight years of age. Furthermore, previous reviews on RRBI interventions did not evaluate the methodological rigor of included studies and did not pay attention to types of intervention agents. Little is known about RRBI treatment in behavioral intervention literature for young children.

Objectives: The present review aims to address the following questions: What types of RRBIs and which operant functions have been included in behavioral intervention research? What are the effective behavioral interventions to decrease lower-order RRBIs (L-RRBI) and higher-order RRBIs (H-RRBI) of young children with ASD? How frequently were natural change agents involved in interventions addressing RRBIs? Are caregiver-implemented interventions effective in reducing RRBIs of young children with ASD? 4. Do single-case and group design research studies have adequate methodological rigor to provide empirical support for a specific intervention?

Methods: A comprehensive electronic database search was conducted using the following databases: ERIC, Academic Search Premier and MEDLINE. Key terms used in the search included auti*, pervasive developmental disorders, Asperger* in combination with each of the following terms: repetitive, stereotyp*, ritual*, restricted, rigid*, perseverative interest, circumscribed interest, sameness, self-stimulatory. Peer-reviewed journal articles in English published between January 2008 and July 2019 were included in the search process. Thirty-two studies that conducted an experimental design and included at least one participant under age eight were included for the final review. The following variables and outcomes were extracted to summarize the information from included articles: study design, demographic characteristic of participants, topography of RRBI, function of RRBI, intervention procedure, methodological rigor and intervention efficacy.

Results: Between 2008 and 2019, 32 articles involving 124 participants under eight years of age used behavioral interventions for different types of RRBIs. Findings suggested that L-RRBIs dominated the literature and were predominately treated with single-component interventions. Noncontingent reinforcement with competing stimuli is an evidence-based practice (EBP) for reducing L-RRBIs (55% percentage reduction of behavior). Consequence-based interventions (i.e., response interruption and redirection and inhibitory stimulus control) were more effective in reducing L-RRBIs (75% percentage reduction of behavior), but replications are required for them to be established as EBPs. Seven studies investigated H-RRBI interventions, and the most commonly used interventions were treatment packages. A progression to more rigorous designs is necessary to expand the evidence base of H-RRBI intervention practices. Only three studies examined interventions implemented by natural change agents had sufficient methodological rigor and generated positive results. However, the limited number of interventions carried out by caregivers precluded the investigation of intervention effectiveness and the comparison with clinician-delivered treatment.

Conclusions: Future research on both L-RRBI and H-RRBI needs to examine the efficacy of interventions implemented by natural change agents and the social validity of these interventions.

427.047 *(Poster)* Results from Infant/Toddler Pre-Emptive Intervention on Reduction of Dangerous Behavior and Increased Communication

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Background: Social-communication delays are a core characteristic of autism spectrum disorder. For infants and toddlers at-risk for autism, a delayed communicative repertoire might result in the children utilizing dangerous behavior (e.g., head banging) to communicate needs/emotions. For up to 30% of the population, speech as a communication modality never develops. Pre-emptive interventions during the critical developmental phase where speech should develop (9 mos to 2 yrs) may mitigate dangerous behavior and promote-social communication. Researchers have validated functional communication teaching (FCT) in older populations as an effective intervention to teach functionally relevant communication that is safe and generalizable. FCT might be particularly effective as a pre-emptive intervention during the formidable developmental period of 9-mos to 2-yrs-old. However, to date, there is little research evaluating this technique as a pre-emptive intervention.

Objectives: The researchers conducted the current project within the scope of a larger project (Project PLAAY) investigating pre-emptive interventions to mitigate the symptomology of autism for at-risk infants and toddlers. The presented project aimed to teach communication to infants and toddlers who were engaging in emerging dangerous behavior (e.g., head banging) or who presented as profoundly delayed in the production of speech.

Methods: A total of 37 at-risk infants and toddlers (aged 9-36 months) have participated in the project to date. Researchers conducted single-case experiments for four of the participants to evaluate the effects of the intervention on the participants' communication and dangerous behavior. For the children who engaged in dangerous behavior, researchers conducted a functional analysis to identify the communicative function of the dangerous behavior. Researchers also conducted communication modality assessments for all participants presenting with severe speech delays. Following identification of the function of the dangerous behavior and preferred method of communication, researchers implemented FCT with the participant and their caregiver.

Results: Researchers evaluated the results using visual and statistical analysis. Visual analysis of graphical displays is the gold-standard technique using in single-case evaluations. The researchers complimented their visual analysis of the graphical displays with effect size analysis using the Tau-U effect size. Visual analysis of the intervention results indicated immediate and large improvements from baseline to intervention phase for functional communication. The graphs also indicated a large and immediate decrease in dangerous behaviors. Resulting Tau-U effect sizes ranged from 0.85 to 1.0 suggesting large effects across all dependent variables.

Conclusions: Preliminary results support the use of the PLAAY intervention to treat the emerging dangerous behavior and teach functional communication. While the researchers did not directly target happiness, the researchers did note increases in indices of happiness correlating with intervention, suggesting the participants enjoyed the intervention.

427.048 *(Poster)* Scope Profile (Social, Communication, Play and Education) - an Online Intervention Based Developmental Assessment & Evaluative Tool for Children with Developmental Delays

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Background: An important challenge in early intervention of developmental disabilities in developing countries is the lack of indigenous tools for early identification that helps in planning & evaluating early intervention. With this in mind, SCoPE profile(Social, Communication, Play and Education) an online based tool was created. SCoPE profile assessment is semi structured way of assessment which helps in assessing the child's functioning age in 8 domains/15 sub domains with 222 language, learning, play, social & self help milestones which are presented in 3 developmental levels- Level 1(6-18months), Level 2 (18.1-36 months) &Level 3(36.1-54 months) linking to typical development of children between 6 months-54 months. SCoPE Profile assessment has a structured kit for assessing children & a description manual for scoring children's skills . Milestones in the checklist can be directly tested on the child by the therapist or can be an observed behavior during the assessment. Parent's feedback on child's skills are also considered in scoring.Each milestone is scored YES if mastered, Emerging if skills are emerging & NO if milestone is not achieved. Functioning age of the child in different domains is automatically calculated by the software & Primary health care provider is provided with Functioning age report & visual representation report. (figure 1) Time taken for doing SCoPE profile assessment is between 10-45 minutes based on the developmental age or level of the child. SCoPE profile is connected to an online early intervention program, assisted with coach support, which can be accessed in any far flung area and the impact of early intervention can be subsequently monitored with this tool.

Objectives: Functional age of children in Language and cognitive domains is important to plan intervention for children with developmental delays. Study was conducted to examine inter rater reliability & diagnostic accuracy of SCoPE profile in identifying children with developmental delay and also examine the concurrent validity of SCoPE profile's functional age in language & cognitive domains with Mullen scales of early learning (MSEL) in a sample of children with developmental delays.

Methods: Children aged 6- 54 months (n= 98 children) who came for regular developmental screening during their vaccination visit (n= 48 children) & those who came with concerns of developmental delay (n= 50 children) underwent comprehensive developmental assessment along with MSEL and SCoPE Profile. Functional age in language & cognitive domains was compared between both the scales in children with developmental delay.

Results: SCoPE Profile has good diagnostic accuracy & inter rater reliability with sensitivity of 98%, specificity of 85%, NPV of 97.5% and PPV of 87.9%. Pearson correlation analysis revealed a very strong correlation between SCoPE Profile functional age & MSEL age equivalence in receptive language ($r = 0.93$ $p < 0.001$) , expressive language ($r = 0.95$, $p < 0.001$), cognition ($r = 0.95$, $p < 0.001$) and fine motor skills ($r = 0.94$, $p < 0.001$).

Conclusions: SCoPE Profile can be used by general pediatricians in developing countries for early identification of children with developmental delays and also in planning & evaluating their early intervention.

427.049 *(Poster)* Sociability: Comparison across ESCS and ADOS and Prediction to Joint Engagement Gains for Preschoolers with ASD

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Background: Joint attention (JA) is core to the social deficit of autism spectrum disorder (ASD) (Mundy, et al., 1986; Mundy, et al., 1994). Initiations of Joint Attention (IJA) and Responses to Joint Attention (RJA) have been related to language gains (Tomasello and Farrar, 1986). Positive social affect has been linked to social communication deficits in ASD (Kasari, et al., 1990; Mundy, et al., 1994), but it has not been operationalized by a measure or investigated as a predictor of outcome.

Objectives: The current study aims to identify a sociability variable and determine whether it is a unique predictor of child improvements in joint engagement within a randomized controlled intervention trial for preschoolers with ASD.

Methods: 94 families received caregiver-mediated intervention or caregiver education (Kasari, et al, 2014). ADOS items were labeled IJA, IBR, Sociability, or RJA based on Early Social Communication Scales (ESCS) coding conventions. ESCS Sociability is the percentage of child initiations to share a toy out of total opportunities. ADOS Sociability is the combination of responsive smile, facial expressions, and shared enjoyment. Sociability, IJA, IBR, and RJA on the ESCS and ADOS were correlated at entry via a multitrait-multimethod matrix. Spearman correlations were used for the nonnormal data and the ordinal matrix variables.

Ordinal logit regression models were used to assess the predictive value of, RJA, IBR, and Sociability as measured by the ESCS or ADOS in joint engagement change. Joint engagement was coded for total duration in mutually exclusive states as described in Adamson, et al., (2004) from a 10-minute taped caregiver-child interaction. Change scores across time from entry to exit were categorized into negative change, zero/minimal change, and positive change categories.

Results: Monotrait-monomethod validity diagonals confirmed convergent validity. IJA and RJA had significant associations between the ADOS and the ESCS (r=-0.329, n=94, p= <0.001; r= -0.459, n=94, p= <0.001). ADOS Sociability was moderately related to IJA on the ESCS (r= -0.325, n=94, p= <0.001; r= -0.330, n=94). ESCS sociability, however, was not significantly associated with any domain other than Fine Motor on the MSEL (r=0.215, n=94, p= <0.05).

Two models were used to determine whether entry IJA, RJA, and sociability were related to joint engagement gains: one for the domains as measured by the ESCS and one for the domains as measured by the ADOS. Results for the ESCS model showed no significant predictors of total joint engagement change with nonsignificant condition, total MSEL score, and chronological age covariates. The same model with ADOS domains showed that total Mullen score (B= -0.051, p= 0.000) and RJA scores (B= -0.485, p=0.005) were significant predictors of joint engagement change.

Conclusions: ESCS domains were not unique predictors, but cognitive scores and ADOS RJA were significantly predictive of total joint engagement change. For Module 1 RCT participants, cognition played a greater role versus IJA or Sociability in engagement gains. Further work determining predictors of improvement for preschoolers with ASD and limited language is needed.

427.050 *(Poster)* Social Communication Predictors of Successful Inclusion Experiences for Students with Autism in an Early Childhood Lab School

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Background: Access to inclusive learning environments has been required by law for over 40 years. Yet, improvement in the rates of children experiencing inclusion has been insubstantial. While placement decisions should be based on student need, they are typically the result of multiple forces, including characteristics of larger systems and practices (Kurth, Morningstar, & Kozleski, 2014), family preferences and resources, and the availability of supplementary aids and services (IDEA, 2004). Research suggests that inclusive early childhood education can benefit the cognitive, communicative, social, and emotional development of young children with Autism Spectrum Disorder (ASD). However, research samples of children enrolled in such programs (e.g., Walden Early Childhood Program/Early Emory, Children's Toddler School, Project DATA) tend to be self-selected, and the factors that predict enrollment and attendance are poorly understood.

Objectives: This study examined predictors of preschool enrollment and attendance in an inclusive, university-based lab preschool (Preschool Education Lab, PEL) serving children with and without ASD.

Methods: PEL operates as a full-day, state-licensed preschool, and consists of three classrooms serving 2-, 3-, and 4-year-olds (class sizes of 12, 16, and 18 children, respectively). Each classroom is co-taught by three teachers, and includes 6 children with ASD. Classrooms for 2- and 3-year-olds are tuition funded; the classroom for 4-year-olds is publicly funded. Between July 2018 and October 2019, parents of 84 children with a prior ASD diagnosis or parental concerns about ASD contacted PEL to seek enrollment. Demographic information can be found in Table 1. Parents completed a battery of eligibility surveys, including a demographic survey, the MacArthur-Bates Communication Development Inventories (CDI), Modified Checklist for Autism in Toddlers (M-CHAT R; <31 months), and the Social Responsiveness Scale (SRS-2; >30 months). The enrollment decision-making process consisted of four steps – Step 1: Review of Eligibility Surveys; Step 2: In-Person Eligibility Observations (EO); Step 3: Invitation to Enroll; and Step 4: Sustained Preschool Enrollment. A flow diagram depicting families' progress across the steps is presented in Figure 1.

Results: We used logistic regression analyses (SAS, PROC LOGISTIC) to identify child or demographic characteristics that predict decisions at each step. Results showed that parent-reported gestures (CDI, total gesture score) were the strongest predictor of our decision to invite children for EOs (Step 1), *Wald's Chi-Square*=12.8, *p*<.001. In contrast, higher parent-reported language skills (CDI, words produced) [*Wald's Chi-Square*=0.0, *p*<.01], and a younger chronological age [*Wald's Chi-Square*=12.0, *p*<.001] were the strongest predictors of our decision to invite families to enroll in the preschool following an EO (Step 2). Whether eligible families chose to enroll (Step 3), and whether enrolled families chose to remain in our program (Step 4) was best explained using a range of practical considerations such as tuition expenses, daily commute, and alternative programming options.

Conclusions: This research paints a complex picture of forces that influence placement decisions for children with ASD who seek enrollment in an inclusive early childhood education program. A better understanding of these forces is necessary to evaluate outcomes and scale the availability of inclusive preschool options for children with ASD.

427.051 *(Poster)* Stress and Empowerment in Parents of Minimally Verbal Children with ASD Following an Enhanced Pivotal Response Treatment Group

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Background: In addition to core social communication impairment in Autism Spectrum Disorder (ASD), many children with ASD demonstrate deficits in the use of functional language. Parents of children with ASD display increased levels of parenting stress compared to those of typical development (Hayes & Watson, 2013). This stress can negatively impact both child and parent treatment outcomes, including caregiver empowerment (Taylor et al., 2017). The current study assessed minimally verbal children with ASD in a Pivotal Response Treatment (PRT) group that targets child communication deficits, with a supplemental parenting stress treatment.

Objectives: 1) Identify baseline relationships among parenting stress, family empowerment, and child behaviors and 2) examine change in parenting stress and family empowerment from pre- to post- treatment.

Methods: Nineteen caregivers (M_{age}= 35.6) and their minimally verbal children (N_{male}= 18; M_{age}= 3.12) with diagnosed or suspected ASD were enrolled in group-based enhanced PRT parent-training. Prior to treatment, parents completed the following measures: Parenting Stress Index (PSI-4; Abidin, 2012) assesses parenting stress characteristics of child and parent; Family Empowerment Scale (FES; Koren, et al., 1992) measures empowerment in families as related to the caregivers, providers, and community; Child Behavior Checklist for Ages 1.5-5 (CBCL/1.5-5; Achenbach & Rescorla, 2001) assesses child emotional and behavioral problems. Bivariate correlations at baseline explored aim 1. Wilcoxon tests assessed pre-post change across treatment conditions based on a subset of families (n=9) with complete data.

Results: Bivariate correlations demonstrated significant positive relationships between PSI-Life Stress and CBCL-Anxious/Depressed (ρ= .728, p= .041), showing that higher parental life stress is related to higher child anxiety at baseline. Also, CBCL-Withdrawn/Depressed positively correlated with PSI-Parent (ρ= .824, p= .012), and PSI-Total Stress (ρ= .873, p= .005), showing that higher parent stress is related to higher child withdrawal. Correlations also demonstrated significant negative relationships of family empowerment (FES) with PSI-Parent (ρ= -.496, p= .043) and PSI-Total Stress (ρ= -.485, p= .048), showing that lower caregiver empowerment is related to higher stress.

Wilcoxon tests demonstrated significant changes on several parent and child stress characteristics from pre- to post- treatment in the following subscales: PSI-Reinforces Parent (Z= -2.55, p= .011), PSI-Competence (Z= -2.10, p= .035), PSI-Role Restriction (Z= -2.52, p= .012), and PSI-Depression (Z= -2.43, p= .015). The PSI-Child (Z= -2.02, p= .043), PSI-Parent (Z= -2.08, p= .038), and PSI-Total Stress (Z= -2.32, p= .021) significantly decreased from pre- to post-treatment. There was also a significant change in family empowerment following treatment, on the FES-Family subscale (Z= -2.37, p= .018). No significant differences were noted in internalizing or externalizing behaviors as a result of the current treatment.

Conclusions: The current study noted significant relationships between family empowerment, parenting stress levels, and child behaviors. Family empowerment is highly related to several stress characteristics in both parents and children. Post-treatment, parent-reported stress symptoms and family empowerment showed improvements. The findings further support the importance of addressing parenting stress and family empowerment in parent interventions for minimally verbal children with ASD, especially due to the comorbid child behavior symptoms that may impact parenting stress.

427.052 *(Poster)* The Effect of Joint Attention and Imitation on Language Growth during a Parent Mediated Intervention Trial for Autism Spectrum Disorder

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Background: Imitation and joint attention are important tools for social-communicative development during early childhood. During early development, children use imitation as their main form of communication (Nadel, 2002). Additionally, children learn to orient to novel environments though responding to joint attention (RJA). Children with autism spectrum disorder (ASD) often present with delays in imitation skills and deficits in joint attention. Previous literature has shown that targeting imitation and joint attention skills may lead to improvement in socio-communicative development (Ingersoll, 2012; Kasari, Paparella, Freeman, & Jahromi, 2008). However, little is known on how baseline levels of these skills predict treatment response in parent mediated interventions.

Objectives: The present study examined the effects of baseline imitation and RJA skills on language growth during a parent mediated intervention trial for ASD.

Methods: To date, 66 children with ASD (ages 19-93 months) were enrolled in an RCT of project ImPACT, an empirically validated parent-mediated intervention. Language was assessed at baseline, 3-4 months later, and 8-9 months later using the Vineland Adaptive Behavior Scales (VABS) and the MacArthur-Bates Communicative Development Inventories (MCDI). Spontaneous object imitation skills were examined in a social-interactive context using the Unstructured Imitation Assessment at baseline. RJA was measured at baseline using the Early Social Communication Scales, a structured observation measure.

Results: Multilevel linear growth models were used to examine whether RJA and object imitation skills predict language growth over a short-term period. Analyses included baseline chronological age, developmental quotient, and time as fixed effects; the main parameters of interest were the RJA*Time and Imitation*Time interactions. Intercept variance and residual variance were included as random effects. There were significant main effects of time for both sets of predictors, such that children had increased word production and increased communication age equivalents over time.

When controlling for the effects of age and developmental level, children with higher levels of baseline RJA had higher communication age equivalents and word production, as indicated by a significant effect of baseline RJA. A significant RJA*Time interaction for both outcomes indicated that children with higher baseline RJA had accelerated communication growth compared to those with lower baseline RJA (Table 1).

When controlling for the effects of age and developmental level, higher levels of baseline object imitation did not significantly predict communication age equivalents or word production. However, there was a significant Imitation*Time interaction, such that children with higher levels of baseline object imitation had accelerated communication growth for both outcomes compared to those with lower baseline object imitation skills (Table 2).

Conclusions: Imitation skills and joint attention at baseline predicted short term acceleration in language growth during a parent mediated intervention trial. Children with higher levels of RJA and imitation at baseline show more communication and expressive language growth over time. These findings have potential implications for understanding response to intervention, individualized goal setting, and identifying potential treatment targets to optimize outcomes.

427.053 *(Poster)* The Effect of Treatment Intensity and Style on Parent Sense of Efficacy in a Multisite Randomized Trial of ASD Intervention for Young Children

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Background: Comprehensive, intensive intervention for young children with ASD delivered in the home by therapists requires a high level of parental engagement, time, and resources. To our knowledge, no randomized controlled trials have previously evaluated the secondary effects of these types of interventions on parents; thus, the impact on parent sense of efficacy is currently unknown. Home-based intervention has the potential to provide increased parent support but support may vary based on the number of intervention hours per week (intensity) and the type of parent involvement required (style). Pre-intervention parent characteristics such as parent stress may influence whether daily staff visits are experienced as supportive or as intrusive, for example. These differing experiences may influence a parent's sense of efficacy.

Objectives: To examine whether the effect of treatment style (discrete trial teaching/DTT vs naturalistic developmental behavioral intervention/ESDM) and intensity (15 vs 25 hours per week) on change in parent sense of efficacy varies by baseline level of parent stress.

Methods: We randomized 87 children with ASD, age 13 to 30 months, into one of four conditions: 15 versus 25 intervention hours crossed with DTT versus ESDM (see Consort Diagram; Figure 1). Intervention took place in-home for 12 months with highly trained, supervised intervention teams at three sites across the United States. Baseline parent stress (Questionnaire on Resources and Stress) was collected prior to beginning treatment. Parent efficacy (Parenting Sense of Competence questionnaire) was collected at baseline and 12 months later, at the end of treatment. The putative moderator was baseline parent stress. The dependent variable (DV) was parent efficacy. Analysis involved mixed effects modelling using full maximum likelihood estimation. For the DV, a random intercept and a fixed slope model was selected. We tested main effects and interactions involving time, treatment intensity and style, and baseline parent stress in the same model to test moderation effects.

Results: Changes in parent efficacy across 12 months of intervention were related to treatment intensity but not treatment style. Follow-up analysis evaluated whether baseline parent stress moderated the significant effect of treatment intensity (see Table 1). We observed a significant three-way interaction between time, intensity, and baseline parent stress. These effects remained significant when site was entered in the model.

Conclusions: In the context of a randomized, intent–to-treat intervention trial, the greatest gains in efficacy for high stress parents were found in the low intensity group. The greatest gains for low stress parents were found in the high intensity group. Style of intervention (DTT vs ESDM) did not have a main effect on parent efficacy. This is the first randomized study of which we are aware to address the question of what intensity and style of intervention will facilitate the greatest sense of efficacy for parents. Our findings suggests that a "one size fits all" approach to recommendations for treatment intensity may not be justified. Parent stress and intervention intensity may be important considerations to support improved parental efficacy.

427.054 *(Poster)* The Effect of the Transporters Emotional Understanding Intervention Program on the Promotion of Peer Cooperative Play in Young Children with ASD

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Background: Children with ASD often experience difficulties in emotion recognition (ER). Whereas ER deficits are believed to underly the social interaction difficulties children with ASD experience, the association between ER and social functioning in children with ASD was hardly examined. Moreover, examinations of the effect that interventions which aim to teach ER have on social functioning improvements were limited to parents' or teachers' reports.

Objectives: (1) to examine the differences between young children with ASD and their typically developing (TD) peers on ER, on the ability for peer cooperative play, and on the relationship between these two abilities; (2) to examine the effect that using *The Transporters* (TT), an animated series found to improve ER and social empathy, has

on the ability for peer cooperative play in young children with ASD.

Methods: for aim (1), two groups of 4-7 years-old children, 38 (9 girls) with ASD and 28 (5 girls) TD children, matched on age, gender and cognitive abilities, were recruited. Participants were tested on a 3-level ER task (Golan et al., 2010) and in addition participated in "Don't drop the ball! game" - a cooperative game with a peer, aimed to balance a ball on a board while trying to keep if from falling.

For aim (2), a group of twenty-three 4-7 year olds (2 girls) with ASD who watched TT daily for 8 weeks was compared to a matched group of 22 participants (6 girls) with ASD, who watched a control series. Participants took different versions of the ER task and the peer cooperative game twice – before and after watching the series. Peer interactions were video-recorded and micro-analytically coded for children's affect, affect energy, vocalization, instruction following, context adaptive social behavior, gaze direction, stereotypic behavior and play-promoting behavior.

Results: Children with ASD exhibited poorer ER on all generalization levels and showed difficulties to promote shared play, compared to their TD peers. During peer play, children with ASD showed less game-promoting behavior, and expressed positive affect longer, but less intensely than their TD peers. Participants' ER scores were positively correlated with their expression of positive affect and with game-promoting behavior in the ASD, but not in the TD group.

The examination of intervention effects revealed improved ER on all generalization levels when watching TT- but not the control series. Moreover, children from the TT group demonstrated improved play-promoting behavior following the intervention, compared to children from the control group (Fig. 1). A positive correlation was found between participants' improvement on ER tasks and their improvement on play-promoting behavior in the TT group, but not in the control series group.

Conclusions: Our findings indicate that ER deficits are associated with cooperative play difficulties in children with ASD, and that TT intervention-related gains in ER abilities are associated with peer cooperative play improvements. These findings provide additional support for the generalizability of TT training effects.

427.055 *(Poster)* The Impact of a Group-Based Early Start Denver Model Parent Education Program on Stress and Self-Efficacy in Parents of Young Children with Autism Spectrum Disorder in Taiwan

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Background: Increasing evidence shows that intensive early intervention can lead to improved outcomes for children with Autism Spectrum Disorder (ASD). However, in low-resourced regions, children with ASD can only receive limited early intervention, far below the recommendation of the National Research Council (U.S.) in 2001. Researches indicate that brief parent training can positively impact children's progress as well as parental level of stress or sense of competence. Hence, viewing parents of children with ASD as the primary intervention receivers is ideal in low-resourced regions.

Objectives: The current study was part of an effectiveness study for implementing the Early Start Denver Model (ESDM) in Taiwan. This study aimed to examine the effects of a parent education group based on ESDM principles within the Taiwanese health system for parents of young children with ASD in northern Taiwan.

Methods: A case control study was conducted with 42 children with a DSM-5 diagnosis of ASD aged 25–46 months. Children receiving one-on-one ESDM intervention in the ESDM group (N = 21, mean age = 33.23 months) and children receiving community intervention in the control group (N = 21, mean age = 35.14 months) did not differ at baseline in individual and family/parents demographic variables, overall development quotient and symptom severity, and were with no difference of mean intervention hours per week during the study. Parents in the ESDM group, who were in groups of three, participated in a biweekly one-hour parent education for 12 sessions. In these sessions, an ESDM-certified therapist taught parents ESDM strategies through lectures based on the ESDM parents' manual (Rogers, Dawson, & Vismara, 2012) and discussions on five-minute home videos of parent-child interactions. The parental outcome measures were obtained pre and post- education, comprising Parenting Stress Index (Third Edition) and Parental Self-Efficacy Scale, which was developed by Taiwanese researchers with excellent psychometric properties in reliability and validity.

Results: There were no differences between two groups in parental outcome measures at baseline. After 12 group-based parent education sessions, parents in the ESDM group reported some improvements in parental self-efficacy, and a significant decrease in parent-related parenting stress, especially in "Attachment" and "Role Restriction" subscales. Such parental progress in the ESDM group was not correlated with the children's progress. Parents in the control group showed no positive post-education changes in parental self-efficacy or parenting stress. The improvements of parents in the ESDM group in overall parental self-efficacy, parent-related parenting stress, and stress related to attachment were significantly greater than those of the control group parents.

Conclusions: This study suggests that an ESDM-inspired group-based parent education program can positively impact parenting stress and parental self-efficacy for parents of young children with ASD, especially helping parents to become closer to their children and more sensitively and effectively responding to children's need. Further studies in Taiwan need to investigate the relationship between the outcomes of child interventions and parent training through examining parent-child interactions and incorporating other groups (e.g., group with only parents who receive parent education/training, group with only children who receive interventions).

427.056 *(Poster)* The Relationship of Early Social Skills to Language, Social Behavior, and Overall Responsiveness to Early Intervention in Children with Autism

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Background: Joint attention, the ability to coordinate one's attention with that of another person (Dawson et al., 2004), and imitation, the ability to copy another person's behavior (Sevlever & Gillis, 2010), are two of the initial methods by which children learn from and interact with the world around them (Trevarthan, 1979). These two skills are related to the development of language, social skills, and play. Further, they seem to come naturally in typically developing children. For children with autism spectrum disorder (ASD), however, these skills are often delayed or entirely absent, thereby potentially leading to significant impediments in the acquisition of crucial functional skills (Dawson et al., 2004). Social orienting theory posits that children with ASD exhibit such deficits in joint attention and imitation because of their lack of attention to social stimuli and, as a result, the decreased attempts by others in their environment to engage them (Dawson et al., 2004). One early intervention model that is based on social orienting theory is the Early Start Denver Model (ESDM), which considers dyadic interactions between the therapist and the child as a prime avenue for learning not only basic social skills such as joint attention and imitation but also more complex social skills, language, and play (Rogers & Dawson, 2010).

Objectives: The primary objective was to determine whether joint attention and imitation development were significantly correlated with each other as well as with social skills, language, and play development. A secondary objective was to demonstrate meaningful skill development in the first six months of ESDM intervention. A final objective was to examine whether joint attention and imitation at baseline would predict overall responsiveness to intervention.

Methods: Data, both archival and current, from 23 children from an ESDM program were examined to investigate these objectives. The primary outcome measure was the ESDM checklist, which was used both as an initial assessment measure as well as a progress monitoring tool.

Results: Results indicated that all children in the study made significant progress in all areas in the first six months of intervention. The hypothesized positive relationship between joint attention and imitation was supported; however, results did not indicate a trajectory wherein joint attention was acquired prior to imitation. Results supported the relationship between both joint attention and imitation skills and subsequent language, social, and play skills. Contrary to hypothesis, baseline skill levels did not significantly predict overall performance.

Conclusions: The results from the current study provide replication and extension of previous studies documenting the effectiveness of ESDM. Additionally, they give insight into the relationship between two skills often marked as deficits for children with ASD early on – joint attention and imitation – and other important domains, including language, social skills, and play. Specifically, joint attention and imitation development are significantly positively related. These two domains are further significantly positively related to language, social skills, and play.

427.057 *(Poster)* Understanding the Relationship between Problem Behaviors and Parental Stress in Children with ASD Following the UCLA PEERS® Intervention

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Background: Children with autism spectrum disorder (ASD) are known to possess a variety of behavioral difficulties, which may contribute to high levels of stress in their parents (Miranda, Mira, Berenguer, Rosello, & Baixauli, 2019). Parental stress may in turn further impact disruptive behaviors in children (Shawler and Sullivan, 2017), resulting in a bidirectional relationship between parental stress and problem behaviors. The UCLA PEERS® for Preschoolers program is a 16-week caregiver-assisted intervention designed to target children's social deficits and improve their relationship skills. PEERS® for Preschoolers has been shown to decrease children's problematic behavior (Park, Moulton, & Laugeson, under review); however, research has yet to examine changes in parental stress throughout the program. Furthermore, the relationship between children's problematic behaviors and parental stress throughout the program has not yet been evaluated.

Objectives: The present study aims to explore change in parental stress following the UCLA PEERS® for Preschoolers intervention. Further, the study seeks to examine a potential correlation between a reduction in children's problematic behavior and a reduction in parental stress following the intervention.

Methods: Participants included 44 children between 4-6 years of age (M=4.59; SD=0.757). All children in the sample had a parent-reported baseline T-score of ≥ 60 on the Social Responsiveness Scale, Second Edition (SRS-2; Constantino, 2005), indicating mild to severe deficits in social interaction. Preschoolers' problem behaviors were evaluated using the Social Skills Improvement System (SSIS; Gresham and Elliott, 2008) before and after the intervention. The Parent Stress Index (PSI-4; Abidin, 2012) was also conducted at pre- and post-intervention to assess any change in parents' stress levels.

Results: A paired samples t-test was conducted to examine the change in children's problem behavior and parental stress levels. As expected, the results indicate a significant decrease in problem behaviors, (t(43)=3.850, p<.005), and in parental stress levels, (t(43)=3.439, p<.01). In order to understand the relationship between the intervention's effects on children's problem behaviors and parental stress, a Pearson correlation coefficient (r) was calculated to compare the change on the SSIS and PSI-4 from pre- to post-intervention. Results indicate that the change in problem behavior scores of children with social interaction deficits following the PEERS® intervention is significantly correlated with a change in their parents' stress levels (r=.321, p<.05).

Conclusions: These findings support prior research indicating that the PEERS® for Preschoolers intervention is successful in significantly reducing children's problem behaviors, and also suggest that the intervention may successfully decrease parental stress levels. Further, these results indicate a correlation between child behavior and parental stress, supporting the bidirectional relationship suggested by previous studies. This study is important because a significant correlation between child behavior and parental stress will better inform caregiver-assisted interventions, leading to improvements in both parent and child outcomes. Future research might explore the sustainability of this relationship and its strength across populations with other developmental disabilities in order to promote more targeted caregiver-assisted interventions.

427.058 *(Poster)* Unintended Treatment Effects? Exploring Parent Factors in Enhanced Group Pivotal Response Treatment

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Background: Parenting stress is typically elevated for parents of children with autism spectrum disorder (ASD) relative to parents of typically-developing children or children with other neurodevelopmental disorders, and is further magnified when the child also has intellectual or language impairments (Davis & Carter, 2008; Hayes & Watson, 2013). This stress can result in lower parental self-efficacy and higher rates of parental depression and anxiety symptoms, making it even more difficult to handle challenging behaviors in children with ASD (Miranda et al., 2019). Thus, it is important to understand relationships among parent factors, such as stress, psychopathology, and perceived support, as well as treatments that can support parent outcomes.

Objectives: This study (1) assesses baseline relationships among several parent characteristics, including perceived mood, support, and self-efficacy, as well as ratings of affect and stress during a brief interaction with their child; and (2) explores pre-treatment to post-treatment change in these parenting factors, which, with the exception of parent stress, were not explicit treatment targets.

Methods: This study includes 28 parents of minimally verbal children (mean age=2.99 years) with diagnosed or suspected ASD. Parents participated in group-based Pivotal Response Treatment (PRT) supplemented with parent stress management training. Parents completed the following self-report measures from the Patient-Reported Outcomes Measurement Information System (PROMIS®) battery: Depression, Anxiety, Self-Efficacy, Social Isolation, and Emotional Support. They also completed measures about their feelings during a brief interaction with their child: Positive and Negative Affect Schedule (PANAS; Crawford & Henry, 2004) and Subjective Units of Parenting Stress Scale (SUPSS; adapted from Singh et al., 2007). Pre-treatment Spearman bivariate correlations were conducted between all aforementioned parent variables. For a subset of parents whose post-treatment data are currently available, paired Wilcoxon Signed-Rank Tests were conducted to assess change in PROMIS measures (n=6) and parent-child interaction variables (n=10).

Results: At pre-treatment, higher levels of stress during parent-child interaction were related to higher negative affect (ρ=.51, p=.006), higher emotional support was associated with less social isolation (ρ=-.44, p=.039), and increased depression was related to higher anxiety (ρ=.63, p=.002). Additionally, self-efficacy was significantly positively correlated with emotional support (ρ=.45, p=.034) and negatively with social isolation (ρ=-.54, p=.009), depression (ρ=-.57, p=.006), and anxiety (ρ=-.62, p=.002). There were significant pre-post decreases in SUPSS (Z=-2.55, p=.011), PANAS Negative Affect (Z=-2.26, p=0.024), PROMIS Social Isolation (Z=-2.02, p=.043), and Depression (Z=-2.02, p=.043), and significant pre-post improvement in Self-Efficacy (Z=-2.20, p=.028).

Conclusions: These results highlight (1) important relationships between parent factors, including the relationship of pre-treatment self-efficacy with parental emotional support, social isolation, and anxiety; and (2) improvements in parental self-efficacy, social isolation, stress, negative affect, and depression after a PRT parent training group supplemented with stress management intervention. While sample size is limited, these findings suggest the possible role of enhanced PRT to alter untargeted areas, such as parental depression, self-efficacy, and perceived social isolation, as well as additional stress management tools to decrease stress during parent-child interactions. Future research should explore these relationships with a larger sample, and ASD treatment should consider directly targeting parental factors.

427.059 *(Poster)* Utilization of Developmental and Behavioral Intervention Techniques in Usual Care: Initial Validation of a Self-Report Rating Scale in a Sample of Applied Behavior Analysis Providers.

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Background: Naturalistic developmental behavioral interventions (NDBIs) are a class of early interventions for autism spectrum disorder with growing empirical support (Schreibman et al., 2015). NDBIs emerged through an integration of techniques from applied behavior analysis (ABA) and developmental psychology, and share several core features (Schreibman, Jobin, & Dawson, 2019). Measures of NDBI instructional strategies are in the early stages of development (e.g. the *NDBI-Fi*; Frost, 2018), and to date there are no self-report tools for assessing provider use instructional strategies from this class of interventions.

Objectives: The objectives of this study were to provide an initial validation of a self-report measure of the utilization of individual NDBI instructional strategies which was adapted from an observational measure, the *NDBI-Fi*.

Methods:

This study was conducted using an online survey of ABA providers across the United States recruited via the Behavior Analyst Certification Board mass email service (N=368). Qualifying providers reported that they currently engage in direct service provision for at least one child age 6 or younger. Respondents rated the percent of a recent session with a specific child that they used each of 20 instructional strategies. Descriptions of these instructional strategies were developed in a previous study via expert consensus. The survey also included questions about training background, service setting, and demographic variables.

Results: An exploratory factor analysis with principal axis factoring and Promax rotation indicated a 2-factor solution, according to examination of the eigenvalues and scree plot. Factor loadings in the pattern matrix suggested the presence of a behavioral strategies factor and a developmental strategies factor (Table 1). Four items were excluded due to cross-loading or low factor loadings (.4-.3-.2 rule; Howard, 2016). A behavioral scale (Cronbach's α=0.85) and developmental scale (Cronbach's α=0.83) were calculated by averaging across the items loading onto each factor. Linear regression showed that use of developmental strategies was significantly predicted by NDBI competency (β=6.56, p<0.001) when accounting for years of ABA experience (β=-0.303, p=0.057), providing evidence for convergent validity. Pearson correlations showed evidence of discriminant validity as well; as predicted, use of developmental strategies was not significantly correlated with competency in the TEACCH model (r=0.01), Discrete Trial Training (DTT; r=0.02), or Verbal Behavior (r=0.02), all of which are non-NDBI intervention models.

Conclusions: This study found that self-reported utilization of NDBI instructional strategies followed a two-factor structure, which aligns with the dual theoretical origins of this class of interventions. We also found evidence of convergent and discriminant validity for the developmental strategies; greater use of developmental strategies was positively correlated with self-reported competency in NDBIs, and uncorrelated with competency in non-NDBI intervention models (i.e. TEACCH, DTT, Verbal Behavior). Together, these results provide initial evidence for the validity of this self-report measurement tool of NDBI instructional strategies. Such work will support future research exploring the similarities and differences between NDBIs and usual care.

427.060 *(Poster)* What Is the Lasting Effect? Results of a 10-Year Follow-up of Early Intensive Behavioral Intervention

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Background: Although there is general consensus that moderate-to-high intensity early intervention is beneficial for children with developmental delays, little is known about the long-term effects of these interventions on outcomes of interest. In 2008, a novel, prospective study tested predictors of developmental outcomes (IQ, Adaptive behavior, ASD severity) after early intensive behavioral intervention (EIBI) for young children with autism spectrum disorder (ASD; aged 20-59 months) and compared those outcomes to a community-based sample of same-aged peers with ASD (Smith, Klorman, & Mruzek, 2015). Predictors included social engagement and sensory-motor rituals. At exit, across both groups, higher IQ predicted better outcomes and (after controlling for age/IQ), social engagement but not sensory-motor rituals predicted IQ and adaptive functioning. This 10-year follow-up study evaluates and compares the outcomes of children who originally received EIBI compared to treatment as usual (TAU) to examine the long-lasting impact of early intervention.

Objectives: Ten years after the original study:

1. We compared outcome of the EIBI group and TAU group on ASD symptom severity, IQ, adaptive skills, and overall clinical severity. Groups were also compared across academic skills development, language level, and rates of co-occurring mental health issues.
2. We assessed the original predictors on long-term outcome in the EIBI group. We hypothesized that high social engagement in the original study will predict superior outcome and high sensorimotor behaviors will predict lower outcome scores.

Methods: From the initial pool of 136 participants (71 EIBI, 65 TAU), 110 met eligibility criteria for the follow-up study. Of that subgroup, 38 EIBI and 22 TAU participants completed follow up. Participants completed assessments of IQ (Stanford-Binet-V), academic skills (Woodcock-Johnson), language (Clinical Evaluation of Language Fundamentals-V), and diagnostic classification (ADOS and Social Responsiveness Scale). Their parents completed interviews and questionnaires on ASD symptoms, co-occurring mental health issues (KSADS), adaptive skills (Vineland), social skills (Social Skills Improvement System), and communication (Children's Communication Checklist). Trained raters who were masked to initial treatment group assignment integrated all assessment results into a DD-CGAS score.

Results: The original sample demonstrated significant IQ group differences; i.e., EIBI participants (m = 60.5) scored significantly lower than the TAU group (m = 75). This significant difference maintained at follow-up with both groups improving similarly, EIBI group (ABIQ m = 74.5, SD = 14.9) and TAU group (ABIQ m =89.6, SD = 15.9). The EIBI group scored higher on ASD symptoms and lower on adaptive skills at follow-up but performed better in academic testing and had fewer internalizing behaviors.

Conclusions: Long-term follow-up of EIBI is crucial to understanding the lasting impact of the intervention regardless of what interventions and treatment may follow it. Our results indicate that children with early access to services demonstrated improved cognitive skills compared to their early assessments. EIBI appeared to have the greatest effects on academic performance and may serve as a protective factor against internalizing mental health disorders. Further, cognitive and developmental level early in life is confirmed as a predictor of long-term success in multiple outcomes, regardless of treatment received in early childhood.

Interventions - Non-pharmacologic - School-Age, Adolescent, Adult

PANEL SESSION — **INTERVENTIONS - NON-PHARMACOLOGIC - SCHOOL-AGE, ADOLESCENT, ADULT**

214 - Back to School: Identification and Treatment of Executive Function Challenges in the School Setting for Autistic Adolescents

Panel Chair: Benjamin Yerys, *Center for Autism Research, Children's Hospital of Philadelphia, Philadelphia, PA*

Discussant: Kara Hume, *Frank Porter Graham Child Development Institute, University of North Carolina at Chapel Hill, Chapel Hill, NC*

Schools are a critical setting for delivering executive function treatment. They are a setting that places the heaviest executive function demands on children and are an almost universally accessible setting for delivery of treatments, thereby reducing disparities. Two challenges in the field are finding ways to both measure and intervene with executive function skills in the school setting. In two talks, we examine the measurement of executive function with multiple methods and informant reporters for autistic children. This includes one talk examining convergence of profiles and developmental trends in teacher and parent ratings of executive function skills, and another talk assessing executive function with direct observation, and teacher ratings as part of a comprehensive ecologically-valid skill assessment. In two talks, we present feasibility and efficacy of behavioral interventions targeting executive function skill development in autistic adolescents. One talk focuses on the feasibility and initial signal of efficacy for a middle school-based intervention targeting planning/organization, monitoring, ignoring distractions, and initiating work independently (AIMS-O). The other talk focuses on the efficacy of a high school-based intervention targeting cognitive flexibility, planning, and emotion regulation skills (Flexible Futures). This symposium will summarize cutting-edge research focused on executive function skills in the school setting.

214.001 *(Panel)* Where the Rubber Meets the Road: Measuring Executive Function Outcomes in the Classroom with a Masked Observation Tool

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Background: The lack of precise, objective, ecologically-valid executive function (EF) outcome measures complicates school-based intervention trials. Objective EF tasks are critiqued for lacking ecological validity, while informant-report EF measures are subject to placebo responses of up to 40%. In the context of treatment trials, we developed the Classroom Observation Scale of Executive Function (COSEF) that can be administered in 15-20 minutes and has shown sensitivity to EF school-based treatments in two randomized controlled trails to date.

Objectives: Investigate reliability and validity of COSEF in baseline data collected as part of a randomized effectiveness trial of *Unstuck and On Target*.

Methods: Participants were 3rd-5th graders with ASD (n=47) or ADHD (n=94), who met DSM-5 diagnostic criteria as determined by an experienced clinical psychologist and cutoff criteria on the ADOS-2 (for ASD), or the Mini International Neuropsychiatric Interview-Kid (for ADHD). All participants also had: parent or teacher reported flexibility problems and a Full Scale IQ (FSIQ) score>70. See Table 1. The COSEF was collected during random academic periods of the school day by masked research assistants who had established reliability in live coding above 80%. The following behaviors were coded for presence or absence: Following Rules, Appropriate Transitioning, Getting Stuck, Expressing Negativity or Overload, Participating in Class and Social Reciprocity. Two items are reverse scored. Lower scores indicate greater problems. Because the COSEF is comprised of 6 dichotomously scored items, its internal reliability was evaluated with the Kuder-Richardson-20 statistical test.

Other baseline characterization and outcome measures included the WASI-2; Woodcock Johnson-3 Reading and Math Fluency tests; and the Swanson, Kotkin, Agler, M-Flynn, and Pelham Scale (SKAMP). The SKAMP is a teacher-report measure of classroom behavior, which includes 13 standard items, tapping EF-related skill (e.g. completing work). Two novel items (accepting criticism/feedback; having meltdowns/tantrums) were added per published instructions (Bhatara et al., 2006). Higher scores indicate more problems in the classroom. Convergent validity was investigated through partial correlations between COSEF average scores and the SKAMP and Fluency tests.

Results: The internal reliability of the 6-item COSEF is adequate given its brevity ($\alpha = 0.6$) The COSEF was not significantly related to race, gender, diagnostic group, family income, or whether the observation occurred in special or general education. The COSEF average score trended toward a significant correlation with FSIQ (p=0.12). Partial correlations controlling for FSIQ revealed that the COSEF was significantly related to teacher SKAMP report (r=-0.44; p <.001), Math (r=0.25; p=.011) and Reading (r=0.24 = p=.014) Fluency scores.

Conclusions: The COSEF shows preliminary evidence of reliability (internal and inter-rater) and convergent validity. Its medium-size correlation with teacher reported classroom learning behaviors that require EF and small correlation with academic fluency scores are encouraging indications of its relevance to specific EF related skills required for success in the classroom. Its brevity, sensitivity to change in two previous treatment trials (Kenworthy, et al., 2015; Anthony et al, 2019), and capacity for treatment-masked administration increase its value as a measure of outcome.

214.002 *(Panel)* Real-World Executive Function Profiles for Autistic Children Converge across School and Home Settings

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Background:

Executive function (EF) is a collection of skills that allow us to regulate our thoughts, actions, and emotions in the service of goals. These skills are often impaired in children with a diagnosis of autism spectrum disorder (ASD), and they are important predictors of adaptive and academic functioning outcomes. Extant studies on real-world EF in autistic children have revealed notable impairments in the home setting. Real world EF impairments have not been assessed in the school setting for autistic children.

Objectives:

To characterize informant ratings of EF for autistic children from both the home and school setting.

Methods:

A total of 344 participants (ASD N=241 (217 Male: 24 Female), typically developing control [TDC] N=103 (90 Male: 13 Female) between the ages of 6 and 18 were enrolled. EF skills were assessed using the Behavior Rating Inventory of Executive Function (BRIEF) in home and school settings. The BRIEF captures executive function in everyday situations and is comprised of eight scales: Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, and Task Monitor. Families chose the teacher or school professional who knew the child best as the school setting rater and the caregiver who knew the child best as the home setting rater. A MANOVA was conducted to examine differences between the ASD and TDC groups. Within the ASD group, ANOVAs were conducted to examine peak impairments and effect of age, correlations and linear mixed effects models were run to examine discrepancies between settings, and linear regressions were completed to determine whether ratings were predictive of adaptive behavior beyond age, gender, IQ, and ASD symptoms.

Results:

ASD and TDC groups differed on all BRIEF scales in both settings (F's>9, p's<0.01, η^2>0.20). The Shift scale was the peak impairment in the ASD group in both settings (p's<0.05) and scales for which there was an effect of age (Shift, Plan/Organize, Organization of Materials, and Task Monitor for the school setting and Organization of Materials for the home setting) were rated as more impaired as age increased (p's<0.05). Correlations indicated positive associations between all BRIEF scales in both settings (r's>0.23) excluding Initiate (r=0.04) while linear mixed effects models revealed rater type significantly affected the Inhibit, Emotional Control, and Working Memory scales for participants with IQ>70 (χ^2's>4.34, p's<0.05). Linear regressions revealed ratings from both settings predicted adaptive behavior in the corresponding setting (DR^2's>0.067).

Conclusions:

This study is the first to show that autistic children's real-world EF profiles in the school setting are comparable to their profiles at home. In both settings the Shift scale was the peak impairment, EF impairments increased with age, and EF skills predicted adaptive behavior. Correlations indicated moderate-to-strong associations between raters on all scales excluding Initiate. However, linear mixed effects models revealed rater type to affect ratings on Inhibit, Emotional Control, and Working Memory scales for participants with IQ>70. This study documents the stability of real world EF profiles across settings, and that within-raters teachers and caregivers are observing similar relationships with outcomes.

214.003 *(Panel)* Feasibility and Initial Efficacy of the Achieving Academic Independence in Middle School–Outpatient Intervention for Middle School Youth with ASD

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Background: Youth with autism spectrum disorder (ASD) frequently experience academic problems in a variety of domains. While some of these academic struggles stem from key features of ASD, they are also strongly linked to deficits in executive functioning (EF) such as organization, time management, prioritization, and initiation. Students must be able to initiate tasks, perform multistep sequences of events, reflect, reason, plan and prioritize, sustain performance and complete tasks, be flexible in their thinking, and monitor their performance. However, 35-70% of teens with ASD without an intellectual disability (ID) present with EF deficits. Common academic EF challenges include difficulties getting started on tasks, managing distractions, planning for studying, multi-tasking, keeping materials organized, prioritizing tasks, and starting school work independently. Families and teachers qualitatively report academic EF deficits are key contributors to school problems for youth with ASD. There is a clear need for interventions targeting academic EF skills in ASD. Yet, there are no randomized clinical trials demonstrating the efficacy of EF interventions for middle-school teens with ASD.

Objectives: To assess the feasibility and initial efficacy of the Achieving Academic Independence in Middle School–Outpatient (AIMS-O) intervention. AIMS-O includes content related to the importance of EF, how to use behavior agreements, problem solving, homework and study skills.

Methods: 21 youth with ASD without ID (age M=12.2, SD=1.0, 76.2% male, 95.2% White, IQ M=109.7, SD=13.8) in the 6th (n=7), 7th (n=7), and 8th (n=7) grades with EF deficits (i.e., T>65 on parent *or* teacher planning/organization monitor, or organization of materials subscales of the Behavior Rating Inventory of Executive Functioning, BRIEF-2) participated in 3 sequential open trials. Parents and teens attended 7-weekly 90 minute AIMS-O sessions and parents and teachers completed ratings before and after AIMS-O. Feasibility and satisfaction were primary outcomes. Cohen's *d* effect sizes (small >.2, moderate >.5, and large >.8) were computed for measures of EF and academic behaviors to explore initial efficacy.

Results: Attendance was excellent (M=6.33, SD=1.0) and families completed most of the 8 homework assignments (M=5.10, SD=1.8). Satisfaction ratings were >4 on a 1 to 5 Likert scale (5=best) for effectiveness of information taught, worksheets/handouts, visuals, and instructors, and slightly lower for how well the teen understood the materials (M=3.81, SD=.24). Similarly, satisfaction ratings for each content area (problem solving, behavior agreements, organization, time management, study skills, study cards, and summarizing) were >4, and slightly lower for the ease of establishing/maintaining a behavior agreement (M=3.89, SD=.25). Moderate to large effect sizes were obtained for parent-rated BRIEF-2, Homework Problem Checklist, Children's Organizational Skills Scale (COSS), and study-developed measures. Small to moderate effect sizes were obtained for teacher-rated BRIEF-2, COSS, Academic Performance Survey, and Classroom Performance Survey. Particular gains were seen for organizational skills, homework behaviors, and academic productivity.

Conclusions: Initial data show that AIMS-O is feasible to deliver, that parents were satisfied with the content, and preliminary evidence that gains were observed in the areas targeted by AIMS-O. A randomized clinical trial is needed to rigorously assess efficacy.

214.004 *(Panel)* Preliminary Outcomes of a New School-Based Executive Function Treatment for Transition-Age Youth with ASD

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Background: Individuals without intellectual disability make up the fastest-growing subgroup of ASD, but as few as 9% reach full functional independence as adults (Farley, McMahon, & Fombonne, 2009). Executive Function (EF) problems are pivotal targets for intervention (Hume, Loftin & Lantz, 2009) because they are common (Hill, 2004), linked to independence (Pugliese et al., 2015), and responsive to treatment (Kenworthy et al., 2015). Flexible Futures (FF) is a new EF intervention for transition-age youth with autism spectrum disorders (ASD) targeting flexibility, goal-setting, planning, and self-advocacy through cognitive behavioral techniques including self-regulatory scripts, guided practice, scaffolded teaching, and visual supports. It is implemented by school personnel to maximize accessibility, intervention dosage and generalizability.

Objectives: To evaluate the effectiveness of FF on improving EF skills in high school students with ASD compared to students who received the usual care in their school environment (IEP/504 & other specialized services for ASD).

Methods: Flexible Futures (FF) was compared to treatment as usual (TAU) in 8 high schools across the DC Metro Area using a randomized, clustered, clinical trial design. All participants (*n*=47, 8 female) were in 9th-12th grade (M age=16.4, SD=1.3), had an FSIQ ³80 on the WASI-2 (see Table 1), and received prior ASD diagnoses supported in this trial by Social Communication Questionnaire scores > 11 (*n*=36) and/or ADOS-2 autism spectrum classification (*n*=19). Groups were not different on key demographic variables (see Table 1).

To account for inequality of variances between groups on two outcome variables, independent samples *t*-tests and corresponding effect sizes were used to examine between-group pre-post change on objective measures: WASI Block Design (problem-solving), EF Challenge Task (EFCT; planning & flexibility during social interaction tasks), and classroom behavior (initiation, organization, shifting, participation). Informant report was also used to examine change in: interventionist, parent, and child knowledge about intervention content; parent Behavior Rating Inventory of EF (BRIEF, Plan/Organization & Shift scales); and Adaptive Behavior Assessment System (ABAS; Global and Practical domains).

Results: The Flexible Futures group improved significantly more than TAU on the EFCT (*t*= 5.12, *p*<0.001, *d*=1.6), classroom behavior (*t*=-2.38, *p*=0.03, *d*=0.7), ABAS Global (*t*=2.09, *p*= 0.04, *d*=0.6) and Practical skills (*t*=2.10, *p*= 0.04, *d*=0.7), and interventionist (*t*= -3.74, *p*= 0.01, *d*=1.3) and student (*t*=-2.84, *p*=0.01, *d*=1.0) FF content knowledge. Medium, but not statistically significant, improvements were also made on Block Design (*t*=1.71, *p*=0.09, *d*=0.5), BRIEF Shift (*t*=1.94, *p*=0.06, *d*=0.6), and parent FF content knowledge (*t*=-1.87, *p*=0.07, *d*=0.6). No improvement difference was noted on BRIEF Plan/Organization. Significant gains on the EFCT (d=0.9), global adaptive skills (d=0.9), and students' knowledge of FF content (*d*=0.8) were maintained at 6-month follow up even though 50% of TAU students were also receiving the intervention at this time.

Conclusions: This pilot RCT demonstrated that FF implemented at school led to multi-modal improvement in flexibility, planning, problem-solving, classroom behavior, and adaptive skills with medium-large effects. Interventionists, students, and parents in FF demonstrated improved knowledge of intervention content post-treatment, and students remembered intervention content after the intervention ended. Next steps include a larger effectiveness trial.

ORAL SESSION — INTERVENTIONS - NON-PHARMACOLOGIC - SCHOOL-AGE, ADOLESCENT, ADULT
319 - Evidence-based Training and Evaluation of Life Skills

319.001 *(Oral)* The Teacch Transition Readiness and Employability Evaluation As a Transition Intervention Outcome Measure

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Background: Transition-aged individuals with Autism Spectrum Disorder (ASD) with average intellectual skills experience challenges in postsecondary education and employment compared to their peers (Roux et al., 2015; Taylor & DaWalt, 2017). While Pre-Employment Transition Service Programs are being offered through Vocational Rehabilitation, little evidence base exists for these programs. To establish a strong evidence-base for these programs, there is a critical need to develop meaningful outcome measures (Bal et al., 2018). Currently, a majority of measurement tools rely on informant or self-report measures with few objective measurement tools used in interventions targeting transition-aged youth in ASD. The Transition Readiness and Employability Evaluation (TREE) was developed to provide an objective measure of employment readiness through behavioral observation.

Objectives: The objectives of the current study were to (a) evaluate the TREE as a measure of employment readiness in adolescents and adults with ASD without intellectual disability, and (b) examine the TREE as an outcome measure following participation in a transition intervention.

Methods: The TREE is a 20-item measure that provides a series of executive function, social communication, and emotion regulation presses during a simulated work environment appropriate for students with ASD and average or higher IQ. Two 15-minute employment tasks appropriate to office (e.g., filing, assembly of information folders) and computer data entry (e.g., accounting receipts, entry of evaluations forms) settings are presented. Items are rated from 0-2, with higher scores indicating greater difficulties. Participants included 75 adolescents and young adults ages 16-21 with ASD (Mean Age = 19.1 years) without intellectual disability who were participating in a community college-based intervention, the TEACCH School Transition to Employment and Post-Secondary Education (T-STEP) program. Confirmatory factor analysis was conducted to examine construct validity at pre-test. Participants completed the T-STEP, a community college transition readiness course, counseling services typically available on a community college campus, and an on-campus internship to practice readiness skills. Change across pre and post-testing were examined.

Results: The confirmatory factor analysis indicated that the three-factor model showed adequate fit, $\chi^2(164) = 188.4$, $p = .09$, RMSEA = .05, 90% CI [.00, .07], CFI= .92, TLI=.91. All factor loadings were significant ($p < .01$). The executive function factor was significantly associated with the social communication (B=.55, $p < .001$) and emotion regulation (B=.47, p=.001) factors. Social communication and emotion regulation were significantly associated (B=.59, $p < .001$). Following completion of the T-STEP program, participants made significant improvements across executive function from a score of , t(75) = 4.06, $p < .001$, Cohen's d= .88, social communication , t(75) = 4.77, $p < .001$, Cohen's d= 1.00, and emotion regulation t(75) = 2.20, $p = .03$, Cohen's d=. 46.

Conclusions: The results of this study provide support for the factor structure of the TREE. The TREE demonstrated sensitivity to change providing support as an intervention outcome measure to assess transition readiness and employability skills in transition aged adolescents and adults with ASD without intellectual disability. Ongoing studies are using the TREE as an objective outcome measure in RCTs.

319.002 *(Oral)* Results of an Open Trial to Evaluate the Effectiveness of Virtual Reality Job Interview Training in Transition Age Autistic Youth Engaged in School-Based Transition Services

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Background: Virtual reality job interview training (VR-JIT) is an efficacious internet-based intervention designed for adults with severe mental illness to improve interview skills through repetitive practice and feedback. Given the low employment rates of transition age autistic youth, VR-JIT may help enhance their employment outcomes.

Objectives: We evaluated the effectiveness and acceptability of delivering VR-JIT within school-based transition programming for transition age autistic youth and youth with other educational disabilities.

Methods: School partners (n=9) were recruited from a network of schools in Illinois or Michigan receiving state support to implement federally-mandated transition services. School administration partnered with the research team to implement VR-JIT within the transition curriculum and teachers completed surveys using individualized education plans to provide background and employment status data on n=279 autistic students and students with other educational disabilities. Also, n=115 students reported on VR-JIT acceptability and usability after completing VR-JIT training.

Results: Students (ages 16 to 22) were primarily diagnosed with autism, learning disability, other health impairment, or emotional disability. 64% of students were male and 68% were Caucasian, 16% Latinx, and 12% African-American. Regarding VR-JIT dosage, 25% of students completed a 1-5 virtual interviews (ie low dose), 46% completed 6-14 virtual interviews (ie medium dose), and 31% completed 15 or more virtual interviews (ie high dose). By six-month follow-up, 32% of student trainees obtained a new job (the uncorrected employment rate did not differ between autistic and non-autistic students; p>.10). Meanwhile, 24% of low-dose students, 32% of medium-dose students, and 40% of high-dose students with autism obtained competitive employment by 6 month follow-up; suggesting a dose-effect. A multinomial logistic regression model revealed: 1) VR-JIT use predicted a greater likelihood of employment by 6-months at OR=1.51, p=.009; CI: 1.11, 2.05 level; 2) autistic students were less likely than non-autistic students to obtain employment by 6-months at OR=0.4, p=.039; CI: 0.24, 0.96; and 3) autistic students were less likely to sustain a job between baseline and follow-up compared to non-autistic students at OR=0.40, p=.040; CI: 0.17; 0.96. This model covaried for IQ, biological sex, presence of an emotional disability, and grade level. More than 70% of students reported VR-JIT was enjoyable, helpful, and improved their skills. In turn these variables correlated with VR-JIT use (i.e., total completed trials, high score, minutes engaged in elearning, minutes engaged with virtual interviewer) (all r>0.20, p<0.05). These results did not differ by educational category.

Conclusions: These promising findings suggest that using VR-JIT to enhance transition services may lead to higher rates of competitive employment. Moreover, the more students used the tool, the more they found it to be acceptable and easy-to-use. Consistent with prior research, autistic students were less likely to obtain new jobs as compared to their peers with other educational disabilities. Future research is needed to evaluate the effectiveness and implementation of VR-JIT in a large-scale randomized trial as well as develop new interventions to help autistic students sustain employment.

319.003 *(Oral)* "Kontakt© Helped Me Reach My Goals!" the Efficacy of a Social Skills Group Training Program for Autistic Youth

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Background: While social skills group training (SSGT) interventions show efficacy in improving the social communication and interaction abilities of autistic youth, previous randomized controlled trials (RCTs) evaluating these interventions have emphasised parent proxy reports, largely neglecting the views of autistic adolescents themselves. Further, the efficacy of SSGT interventions is rarely considered in comparison to active controls, limiting the ability to investigate the potentially confounding effect of exposure to a supportive social context.

Objectives: This study investigated the efficacy of KONTAKT©, a manualised evidence-based SSGT program, in supporting Australian autistic adolescents in achieving their meaningful social goals in comparison to an active control group, a manualised purposely designed cooking skills program called Super Chef of equivalent dose.

Methods: Employing a pragmatic two-armed RCT design participants (N=90) were randomly assigned to either KONTAKT© (SSGT intervention) (n=46) or the Super Chef cooking group (active control group) (n=44). Participants (26 female and 64 males) were autistic adolescents aged 12 to 17, with an IQ of over 70 (m=102.38, SD=14.89). Both programs ran for 16, 90-minute sessions, were facilitated by two trained and experienced therapists from the Autism Association of Western Australia and were monitored for intervention fidelity. The primary outcome was predefined as adolescents' progress towards achieving their personally meaningful social goals, as measured by Goal Attainment Scaling (GAS). Secondary outcome measures included autistic adolescents ASD traits, their quality of life, facial emotion recognition skills, social anxiety, and feelings of loneliness. Outcomes were rated by adolescents themselves, their parents and blind experts at three time points, baseline, post-intervention and at three-month follow up (the primary analysis time point). A random-effects regression model (linear mixed model) examined changes in the dependent variables, using time (post-intervention and follow-up), age, IQ, gender, and depressive or anxious behaviour as the independent variables.

Results: While intent-to-treat analysis (N=90) demonstrated that both groups reported statistically significant progress towards their personally meaningful social goals over time (post-intervention (ES=1.39, p<0.001) and follow-up (ES=1.39, p<0.001)), KONTAKT© participants demonstrated significantly greater progress towards their goals than their peers attending Super Chef at follow-up (ES=0.21, p=0.043). The majority of secondary outcomes for both groups (ASD related traits, emotion recognition, and social anxiety) improved significantly over time, however, KONTAKT© participants demonstrated a statistically significant reduction in their social interaction anxiety compared to the Super Chef group (ES=0.23, p=0.03).

Conclusions: The design of this study addresses many of the limitations of previous research in this field. Findings suggest that KONTAKT© has efficacy in supporting autistic adolescents to achieve their personally meaningful social goals, while reducing their anxiety related to social interactions more effectively than compared to another manualised program providing a comparative social context. Further research is needed focussing on the longer term effects of SSGT interventions such as KONTAKT© and understanding those subgroups likely to benefit most from such interventions. (ANZCTR: ACTRN12617001117303, ClinicalTrials.gov: NCT03294668)

319.004 *(Oral)* Influence of Leadership Profiles on Implementation of Professional Development Model

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Background: Leadership styles have been associated with implementation of evidence-based practices (EBPs) in elementary schools for students with autism (Stadnick et al., 2019) but have not been examined following the completion of a school-based intervention. This study aimed to examine how leadership profiles were influenced by implementation of the National Professional Development Center (NPDC) on autism model of professional preparation to promote EBPs in elementary schools.

Objectives: The objectives of this study were to determine (1) the leadership profiles of principals, teachers, and school staff, (2) how these leadership profiles differed by intervention group, and (3) how these leadership profiles related to attitudes and implementation of EBPs.

Methods: Participants (n = 539) included principals, teachers, and school support staff from 59 elementary schools serving students with autism. Schools were randomly assigned to the intervention group or services as usual. Schools in the intervention group received ongoing training, coaching, and materials to implement EBPs with students with autism over one school year. An Implementation Index was completed for all schools to document all features of the NPDC model throughout the school year. At the end of the school year, participants completed the Evidence Based Practices Attitudes Scale, a measure of attitudes of school personnel towards EBPs and the Multifactor Leadership Questionnaire, a measure of leadership models. Principals self-rated, and teachers and school staff rated their principals.

Results: A two-level latent profile analysis was completed, and three profiles were identified: *Optimal* (53.2%), *Suboptimal* (36.9%), and *Passive* (9.8%). The *Optimal* class demonstrated the highest transformational and transactional leadership scores and the lowest passive avoidant scores. The Suboptimal class displayed a similar profile, but their transformational and transactional leadership scores were lower, and passive avoidant scores were higher than the Optimal class. The *Passive* class demonstrated the most passive avoidant behaviors. Participants in the control group were more likely to be in the *Passive* class compared to the *Suboptimal* (OR = .310, SE = .14, $p < .001$) and *Optimal* classes (OR = .042, SE= .05, $p < .001$). Individuals in the *Optimal* class had significantly higher scores on the Implementation Index compared to the *Passive* class (B = -4.48, SE = 1.05, $p < .001$), but not the *Suboptimal* class. The *Optimal* class were more likely to have more positive attitudes towards implementing evidence-based practices compared to the *Suboptimal* (OR= .56, SE= .13, $p = .001$), and the *Passive* classes (OR= .50, SE= .24, $p = .04$).

Conclusions: Leadership styles were associated with attitudes towards evidence-based practices and the implementation of the NPDC model. Specifically, scores of the implementation index were higher for schools with *Optimal* leadership styles compared to the *Passive* style. Further, the *Optimal* leadership class was more likely to have more positive attitude towards evidence-based practices. Additionally, control schools were more likely to be in the *Passive* class. Further research is needed to determine if the implementation of the NPDC model was associated with more preferred leadership styles (i.e. *Optimal* or *Suboptimal*).

ORAL SESSION — INTERVENTIONS - NON-PHARMACOLOGIC - SCHOOL-AGE, ADOLESCENT, ADULT

320 - Novel Interventions for Individuals with ASD and their Families

320.001 *(Oral)* Behavioral Outcomes of Biofeedback-Based Videogame Training in Youth with and without Autism: A Randomized Controlled Trial

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Background: Decreased postural stability is commonly reported in autism spectrum disorder (ASD) (Lim et al., 2017) and is linked to more severe autism symptoms (Radonovich et al. 2013; Travers et al., 2013). Further, adolescents with ASD show an early plateau in postural stability development (Minshew et al., 2004). Recently, we developed a biofeedback-based balance video game to appeal to adolescents with ASD. A quasi-experimental design found that playing this game was related to balance improvements and was perceived as beneficial and enjoyable by the participants and their families (Travers et al., 2018). A critical next step is to compare this intervention to an active control condition.

Objectives: Investigate whether a videogame-based, visual-biofeedback balance training improved postural stability, daily living skills, and autism symptom severity compared to a sedentary videogame control condition in 13-17 year-olds with and without ASD.

Methods: This pilot study was a parallel forms randomized controlled trial (RCT) pre-registered at clinicialtrials.gov (#NCT02358317). Thirty-four participants with ASD and 28 age-matched participants with typical development (TD) underwent diagnostic testing and a pre-training assessment (neuroimaging, cognitive, autism symptom severity, and motor assessments) and then were randomly assigned to the balance videogame intervention or to the sedentary videogame control training. Each participant individually completed the assigned training in the lab for 3 sessions each week over the course of 6 training weeks. At the end of training, neuroimaging, symptom severity, and motor assessments were repeated.

Results: Before training, participants with ASD demonstrated decreased postural stability compared to participants with TD, $t(60) = 2.56$, $p = .01$, but within the balance-training group, both the ASD and TD groups showed similar improvements in balance with training, $t(30) = 0.19$, $p = .85$. To test the effects of balance training, we performed 2 (pre vs. post) x 2 (balance vs. control) x 2 (ASD vs. TD) ANOVA's. Individuals in the balance-training condition showed significantly greater pre-post reductions in postural sway during visual feedback compared to individuals in the control condition, $p = .04$, and these reductions were similar across diagnostic groups, $p = .22$. Pre-post daily living scores did not change with training, $p = .99$, but SRS-2 scores decreased pre-to-post in the ASD balance training group compared to the ASD control group, $p = .02$.

Conclusions: In a highly controlled RCT, biofeedback-based video game training improved postural stability in comparison to a sedentary, videogame control group. This finding suggests that individuals with and without ASD may benefit from intensive biofeedback-based balance training framed as a video game. While balance challenges may be highly prevalent in ASD, the results suggest that balance training is as likely to benefit those with ASD as those without ASD. Within the ASD group, decreases in parent-rated autism symptom severity were observed in the balance-training group but not in the sedentary-control group, suggesting that the balance training led to decreased autism symptom severity. However, the mechanisms of this effect are unclear. Future analyses will examine the pre-post structural brain imaging measures to understand the neurobiological basis of these behavioral changes.

320.002 *(Oral)* A Pilot Randomized Controlled Trial of a Daily Living Skills Intervention for Adolescents with ASD

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Background: Individuals with autism spectrum disorder (ASD), even those without a comorbid intellectual disability (IQ ≥70), have bleak outcomes because of difficulties successfully navigating the transition to the adult world (Hume et al., 2014). Daily living skills (DLS) are everyday activities such as hygiene, cooking, cleaning, navigating the community, and managing money that are critical to independent functioning in adulthood. *DLS were the only significant factor found to predict a positive outcome in adulthood for individuals with high functioning ASD* (Farley et al., 2009). Despite their importance, the DLS of adolescents with ASD are often 6-8 years below their chronological age. While the acquisition of DLS should be amenable to intervention, there are currently no evidence-based group intervention packages that target DLS in adolescents with ASD. A pre-post trial (n=7) of *Surviving and Thriving in the Real World (STRW)*, a group treatment for adolescents with ASD without ID and their parent that targets specific DLS (i.e., cooking, laundry, self-care, and money management) using evidence based strategies (e.g., task analysis, video modeling). Results demonstrated that o*ver the course of a 12-week intervention, adolescent participants gained an average of 2 years of DLS (Duncan et al., 2017), which is not only clinically meaningful, but suggests that the gap between age and skill level can be significantly reduced.*

Objectives: The primary aim of the study was to conduct a feasibility pilot RCT to test the efficacy of the STRW intervention using goal attainment scaling (GAS) and the Vineland-3 as primary outcome measures.

Methods: The feasibility pilot RCT consisted of 11 adolescents with ASD between 14-18 years and their parents. Participants were randomly assigned to either the 15-week STRW group or the waitlist control group. All participants had IQs≥70 and met criteria for ASD on the ADOS-2. Information on DLS was collected using (1) the Vineland-3 and (2) a GAS protocol was created for each adolescent from a parent interview that assessed skills in the 4 main areas targeted in the STRW intervention. DLS were evaluated post-treatment and at 6-month follow-up.

Results: From baseline to post-treatment, adolescents in the STRW group gained an average of 1.5 to 2 year of DLS on the Vineland-3, while the waitlist control group did not show improvement in DLS. The STRW group had significant changes in the Personal and Domestic subdomains and DLS domain of the Vineland-3 ($p<.05$) and these gains were maintained at follow-up (all p's <.06). On the GAS, the STRW group demonstrated significant improvement from baseline to post-treatment ($p<.05$), while the control group did not. The gains on the GAS were maintained at follow-up.

Conclusions: This study demonstrates that adolescents are acquiring and maintaining DLS after completion of the STRW intervention. We are currently conducting a more rigorous RCT (n = 120) with a social skills intervention as a comparison group. A DLS intervention package for adolescents with ASD without ID that uses evidence-based strategies for teaching DLS and incorporates parental involvement has the potential to directly affect current functioning and future adult outcomes.

320.003 *(Oral)* Resilience Intervention for Parents of Children with Autism: Findings from an RCT of the Amor Method

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Background: Parents of children with Autism Spectrum Disorder (ASD) face unique parenting challenges. Parental stress may inhibit treatment gains for the child, particularly for parent-delivered interventions (Bekhet, Johnson, & Zauszniewski, 2012). While it is essential to enhance and sustain the well-being of parents of children with ASD, developing interventions for parents remains a prominent gap in ASD research (Weiss et al., 2013). Bridging this gap, the AMOR Method (Acceptance, Mindfulness, Optimism, Resilience) is a novel resilience intervention developed to address unique parenting challenges in ASD by enhancing parental resilience.

Objectives: A randomized controlled trial (RCT) of the AMOR Method was conducted to examine its efficacy in improving resilience and well-being in parents of young children with ASD. The study aimed to measure change in resilience among parents in the AMOR group from baseline (BL) to post-treatment (PT), relative to the waitlist (WL) group. Secondary aims were to evaluate increased positive practices, enhanced parental well-being, and improved parental perceptions of child behaviors as a result of participation in the AMOR Method.

Methods: Thirty-four parents of children with ASD (4-10:11 years) were randomized to either 8 weeks of the AMOR Method (n = 17) or to waitlist (WL; n = 17). To measure resilience changes, all parents completed the Connor-Davidson Resilience Scale (CD-RISC; Connor & Davidson, 2003) at the BL and PT timepoints. Parents completed additional measures of parental mindfulness, acceptance, optimism, as well as measures of parenting stress, internalizing symptoms, self-efficacy, self-compassion, marriage happiness, and family empowerment. Parents also completed measures of child problem behaviors, strengths and difficulties, and social impairment. Repeated measures ANOVA were employed to evaluate the pre- and post-treatment differences between and within groups.

Results: Repeated measures ANOVA revealed significant increase in resilience ($F = 10.316$, $p <0.01$) in the AMOR group (see Table 1). Additional improvements were observed in mindfulness ($F = 4.929$, $p = 0.035$), optimism ($F = 9.347$, $p = 0.005$), parenting stress ($F = 10.237$, $p = 0.004$), parental distress ($F = 5.391$, $p = 0.029$), dysfunctional interaction stress ($F = 5.866$, $p = 0.023$), general stress ($F = 4.684$, $p = 0.040$), anxiety ($F = 5.657$, $p = 0.025$), self-compassion ($F = 4.571$, $p = 0.042$), marriage happiness ($F = 9.864$, $p = 0.004$), and family empowerment ($F = 12.308$, $p = 0.002$; see Figure 1). Analyses revealed improvements in parent ratings of child inappropriate speech ($F = 4.689$, $p = 0.043$) and emotional problems ($F = 8.007$, $p = 0.013$) in the AMOR group only. No significant group differences emerged in acceptance, depression, self-efficacy, and total child problem behaviors or social impairment.

Conclusions: Findings suggest that the AMOR Method is a promising intervention for improving resilience in parents of children with ASD. Targeting resilience appears to be a pivotal treatment goal with cascading improvements in other domains of parental stress management, well-being, and positive parent functioning. Continued investigation with larger samples is needed to understand mechanisms of change and predictors of treatment response.

320.004 *(Oral)* Mindfulness-Based Therapy for Adults with Autism: Improving Disability-Related Quality of Life, Executive Functioning, and Emotional Regulation

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Background: Emerging research suggests mindfulness-based stress reduction (MBSR) interventions reduce depression, anxiety, and autism-related symptoms in adults with autism spectrum disorder (ASD). However, treatment gains have not been compared to active control groups, making it difficult to assess the magnitude of mindfulness-specific benefits.

Objectives: We compared MBSR's efficacy to a social support/stress education control group which accounted for peer- and instructor-mediated social support and educational components of MBSR. We also sought to determine if instruments/subscales tapping into domains of executive function, emotion regulation, and mindfulness would be improved in adults with ASD, as seen after MBSR in other populations.

Methods: In two independent cohorts, a total of 54 adults with ASD were randomly assigned to an 8-week MBSR or support/education intervention. Depression and anxiety were assessed using self-report Beck Depression Inventory-II (BDI-II) and State-Trait Anxiety Inventory (STAI-1=State; STAI-2=Trait), as well as informant-report Anxiety, Depression, and Mood Scale (ADAMS) Total and subscales 'Depression', 'General Anxiety', and 'Social Avoidance'. ASD-related symptoms were assessed using self-report Adult Repetitive Behavior Questionnaire (ARBQ) subscales 'Motor, 'Sensory', and 'Insisting on sameness', Social Responsiveness Scale-2 Total, and the World Health Organization's Disability Assessment (WHO-DAS) Total and subscales 'Difficulties', 'Unable', and 'Reduce Activities/Work', as well as informant-report WHO-DAS-Total. Executive function/emotion regulation were assessed using self-report Behavior Rating Inventory of Executive Function (BRIEF) subscales 'Inhibit', 'Emotion', 'Initiate' and 'Behavioral Regulation', as well as informant-report Emotion Dysregulation Inventory (EDI) subscale 'Reactivity' and the Strengths and Difficulties Questionnaire (SDQ) subscale 'Emotion'. Finally, mindfulness traits were assessed using the Five Facets Mindfulness Questionnaire (FFMQ) Total. Repeated measures ANCOVA were performed with a within-group factor of time, between-subjects factor of group, and cohort covariate. Significant interactions were followed by within-group analyses.

Results: Main effects of time without interactions indicated improvements in both groups on self-reported BDI-II ($F(1,52)=12.57;p=0.001$), STAI-1 ($F(1,51)=5.37;p=0.03$), STAI-2 ($F(1,52)=5.70;p=0.02$), ARBQ-subscales 'Sensory' ($F(1,49)=4.04;p=0.05$) and 'Insisting on sameness' ($F(1,49)=6.69;p=0.01$), as well as informant-reported ADAMS-Total ($F(1, 31)= 9.91;p=0.004$) and subscales 'Depression' ($F(1,31)=10.60;p=0.003$) and 'General Anxiety' ($F(1,31)=5.94;p=0.02$).

Group by Time interactions were detected on self-report WHO-DAS-Total ($F(1,47)=6.93;p=0.01$), WHO-DAS-subscale 'Difficulties' ($F(1,47)=5.25;p=0.03$), ABRQ-subscale 'Motor' ($F(1,49)=5.52;p=0.02$), BRIEF-subscales 'Inhibit' ($F(1,21)=10.00;p=0.01$), 'Initiate' ($F(1,21)=5.38;p=0.03$), and 'Behavioral Regulation' ($F(1,21)=4.44;p=0.05$), and FFMQ-Total ($F(1,49)=490.12;p=0.051$), as well as informant-report ADAMS-subscale 'Social Avoidance' ($F(1,31)=7.12;p=0.01$), SDQ-subscale 'Emotion' ($F(1,31)=12.60;p=0.001$), and EDI-subscale 'Reactivity' ($F(1,16)=4.61;p=0.05$). Within-group analyses revealed that the MBSR group demonstrated significant improvements on WHO-DAS self- and informant-report Total Scores ($F(1,24)=16.79;p<0.001$; $F(1,12)=4.74;p=0.05$) and 'Difficulties' subscale ($F(1,22)=5.87;p=0.02$), ARBQ-subscale 'Motor' ($F(1,24)=6.66;p=0.02$), BRIEF-subscales 'Inhibit' ($F(1,9)=5.41;p=0.05$) and 'Initiate' ($F(1,9)=26.30;p=0.001$), and EDI subscale 'Reactivity' ($F(1,7)=8.14;p=0.03$) that were absent in the support/education group.

Conclusions: These results suggest that mindfulness training may lead to specific benefits in the domains of disability-associated quality of life, executive functioning, emotion regulation, and repetitive motor behaviors. Conversely, benefits in depression, anxiety, sensory symptoms, and flexibility can be gained through intervention programs that provide stress education with peer- and instructor-mediated social support, but do not require mindfulness training specifically. Taken together, MBSR is likely a more robust program for a breadth of symptom improvements in adults with ASD. However, community-led support groups can provide critical benefits if MBSR is inaccessible.

POSTER SESSION — INTERNATIONAL SOCIETY FOR AUTISM RESEARCH - NON-PHARMACOLOGIC - SCHOOL-AGE, ADOLESCENT, ADULT

428 - Interventions - Non-pharmacologic - School-Age, Adolescent, Adult Posters

428.001 *(Poster)* A Community-Based Motor Skill Intervention for Children with ASD Ages 4-6: An Exploratory Pilot Investigation

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Background: Fundamental motor skills are the foundation skills required for children to engage in more complex games and activities; they include running, throwing, catching, kicking, etc. Evidence indicates that children with ASD experience delays in their fundamental motor skills, but with intervention these delays can be mitigated. However, most published motor skill interventions for children with ASD are laboratory-based, and not run in a community setting with community-based instructors.

Objectives: The purpose of this study was to pilot an 8 week, group, fundamental motor skill intervention (90 mins/week) for 4-6 year old children with ASD delivered by a community based organization. The objective was to determine feasibility of this type of delivery model and to examine if motor skills improve.

Methods: A local community-based soccer club was recruited to deliver the intervention. The instructors and volunteers were trained by the researchers on the curriculum as well as basic behaviour management. Each week a different skill was the focus (e.g. throwing, catching, kicking, running, jumping, etc.). All assessments were conducted by the research team, but the delivery of the intervention was led by the community partner exclusively.

9 children with ASD (8 male, 1 female, mean age= 5.7 ± 0.56 years) were recruited for an 8 week, 90 minutes/week, fundamental motor skill intervention. Motor skills were measured using the Test of Gross Motor Development-2 (TGMD-2) before and after the intervention. Parents were asked to provide feedback on the program in writing.

Results: At the pre-test assessment, all children with ASD were significantly delayed in their motor skills as measured by the TGMD-2. There were significant improvements as indicated by the Gross Motor Quotient, (Time 1 mean = 60.33 ± 15.35, Time 2 mean = 74.22 ± 23.91) p = .004; as well as for the Locomotor sub-score, (Time 1 mean = 10.78 ± 10.63, Time 2 mean = 19.22 ± 11.88), p = 0.014, and object control sub-score, (Time 1 mean = 12.67 ± 8.31, Time 2 mean = 22.11 ± 14.68) p= .005.

While parents were overall very happy with the pilot program, they indicated the most valuable part of the program was meeting the other families and the time to talk while watching their children participate in the program. They did suggest that the lead instructor should have a coaching and/or pedagogy background to maximize instructional time.

Conclusions: All the children demonstrated significant delays in motor skills at the baseline assessment and made improvements through the intervention. The research team learned a lot from this pilot study; specifically, about the amount of training and support required for community-based groups to deliver a motor skill intervention program for children with ASD. More, evidence-informed, programs for children with ASD are needed and more research is required on the most effective curricula and mode of delivery, particularly in the community setting.

428.002 *(Poster)* A Gaze-Driven Video Game Intervention for Attention Orienting in Individuals with ASD

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Background: Although our group (Townsend, et al.,1996; Miller, et al., 2014) and others (Schmitt, et al., 2014; Johnson, et al., 2016) have noted the difficulties individuals on the spectrum have with orienting attention and gaze, even in very early childhood (Zwaigenbaum, et al. 2005; Elsabbagh, et al., 2013), specific interventions addressing this deficit are lacking. Here we report on a pilot clinical trial using gaze-driven video games quantify the metrics and timing of saccades using a high-accuracy video-based eye tracking system in a sample of children and adolescents.

Objectives: We sought to measure performance on an array of attention and eye movement tasks both before training and after 8 weeks of training on our purpose-designed, gaze-driven video games.

Methods: Twenty-three individuals with ASD (mean age 17.31 [4.3]) engaged in 8 weeks of at-home training using eye tracking-enabled PC computers delivered as part of the study. Participants were asked to play the games approximately 30 minutes per day, 5 days per week over the 8 week period. Three video games were available initially that trained principles of fast and accurate shifts of attention, steady fixation, and looking ahead toward the target goal in a dynamic setting. After 10 hours of game play on these games, an additional game, incorporating multiple principles, was unlocked for play. The average participant played for 22 hours at home over the trial. In the pre- and post-tests in the lab, we measured covert attention orienting, pro- and anti-saccade performance, performance on simulated driving tasks, and parent assessment using an ADHD rating scale.

Results: We observed multiple improvements in performance on our objective behavioral tasks post-training, including improved speed of attention orienting ($p < 0.0001$), speed of attention disengagement ($p < 0.003$), stability of gaze fixation ($p < 0.03$) and accuracy of the direction of saccades in an anti-saccade task ($p < 0.02$). Tasks to examine efficacy of change were a spatial attention task that controlled for motor response and processing speed to measure speed of attention orienting and disengagement (Townsend et al, 1999) and typical pro/anti-saccade tasks that requires shifting gaze to either the location of a stimulus or to the opposite side of a stimulus. Mid-level attention performance was assessed with two simulated driving tasks--a divided attention task that demanded fast and accurate responses to peripheral cues while maintaining speed and lane position on a driving course (with no other cars), and a Challenge Drive through urban, suburban and rural settings with multiple sudden occurrences that demanded a prompt response from the participant. We found significant post-training improvement on the divided attention task including fewer missed/ignored responses ($p < 0.04$) and fewer roadside/lane excursions ($p<0.05$). Finally, we used the Vanderbilt NICHQ parent report questionnaire to examine change in ADHD symptoms. We found significant improvement in inattention ($p < 0.03$) and only marginal change in hyperactivity ($p < 0.06$).

Conclusions: Our analysis suggests that gaze-driven video games can be useful for training attention orienting and that this training affects behavior in multiple related, but untrained, tasks.

428.003 *(Poster)* A Randomized Controlled Study of Compass: How Much and What Type of Coaching Is Needed to See Teacher Adherence to Intervention Plans and Student Goal Attainment Progress?

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Background: The Collaborative Model for Promoting Competence and Success (COMPASS) is an evidence-based, consultation and coaching intervention that is ideal for embedding EBPs into the public school classroom. COMPASS starts with a parent-teacher consultation facilitated by a consultant producing goals and intervention plans individualized to the student with ASD, teacher, and environmental context using an evidence-based practice in psychology framework (McGrew, et al., 2015). This is followed by coaching with implementation fidelity feedback and progress monitoring.

Objectives: Three previous RCTs with COMPASS used the researchers/developers as consultants. We needed to demonstrate that school-based consultants can be trained to implement a complex intervention such as COMPASS with high fidelity. We also sought to understand how much (dosage) and what type of coaching (written vs face-to-face) is needed by teachers to achieve effectiveness and show maximum adherence to the intervention plans and student goal attainment progress.

Methods: An iterative design was applied for the development and testing of a COMPASS training package, followed by a between group design to understand the differences of dosage and coaching on teacher adherence and child outcomes.

Community consultants (n=12) were trained over three cohorts. Consultants ages' ranged from 24-60 years and averaged 11 years of consultation experience. Consultants worked with 4 teacher-student dyads. Teachers (n=36) ranged in age from 23-55 years. Students (n=36) were between the ages of 4 and 13, and all were receiving special education services under the eligibility category of autism.

After completing training, consultants provided an initial 3-hour consultation to each teacher. Follow up coaching varied across four conditions: 1) four coaching sessions, 2) two coaching sessions, 3) four written feedback emails of student's goal attainment progress and teacher intervention plan adherence, and 4) consultation only. Consultants and researchers rated teacher adherence to the intervention plans on a 0-4 scale (0 = 0%; 4 = 76-100%). Student goal attainment progress was evaluated on a scale of -2 to +2 (-2 = present level of performance; 0 = achieved annual goal; +2 = greatly exceeded goal).

Results: Full data will be available in April 2020 from all 12 consultants. Preliminary results on teacher adherence from the four coaching sessions condition demonstrated results consistent with previous RCTs of steady increased adherence to the intervention plans over the four coaching sessions (from 25% to about 60%) with goal attainment change score of 2.4. Adherence for teachers who received two coaching sessions stayed at approximately 37% with a goal attainment change score of 1.9. Adherence for teachers who received four written feedback emails increased from 37% to 50% with a goal attainment change score of 2.2. For the no coaching condition, the final goal attainment change score was 1.6.

Conclusions: Preliminary results indicate that how often coaching occurs, rather than type of coaching matters. Once final data are collected, if the findings are similar, important implications for practice are offered for the efficiency and effectiveness of coaching.

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428.004 *(Poster)* A Targeted Social Communication Group Intervention for Adults on the Autism Spectrum with Limited Functional Language

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Background: Adults on the autism spectrum who have high support needs are critically under-represented in the autism treatment literature (Siegel, 2018; Russel et al., 2019). The exclusion of autistic individuals who are not conversationally fluent and have co-occurring intellectual disability neglects a population in dire need of targeted support. Very few adults with high support needs have regular access to appropriate social skill training or social activity programs (Gotham et al., 2015). The development of social communication interventions that promote purposeful engagement and social connection may improve quality of life for this population.

Objectives: To explore the preliminary feasibility and efficacy of a 10-week social communication skill intervention specifically designed for autistic adults with high support needs.

Methods: This study used a multiple-baseline research design to evaluate a modified version of the START socialization program (Vernon, Miller, Ko, Barrett, & McGarry, 2018), adapted and individualized for adults with ASD who have high support needs. Five autistic young adults (18-25 years) with intellectual disability (mean IQ = 50.2) and limited functional language (mean verbal IQ = 48.6) completed ten 90-minute weekly intervention sessions. The peer-mediated sessions consisted of: individual check-in/out meetings with the young adult and a parent; guided socialization time; introduction of social skill topics via popular movie examples, video modeling, and small group practice; and structured social games. Social motivation and experiential learning were crucial programmatic considerations (Pallathra et al., 2018). Prior to participation, participants were assigned to staggered baselines consisting of 2, 4, or 6 unstructured conversations with novel, untrained peers. Outcome measures were derived from both unstructured and structured conversations (with a trained peer following a social conversation script in the latter), along with parent-completed survey measures. Conversations were behaviorally-coded in Datavyu (Datavyu Team, 2014) for a number of key social communication features (κ = .65-.92).

Results: Findings from 3-minute unstructured conversations indicate that *percent of time on-topic* (duration of on-topic conversation contributions/ individual speaking duration) increased from baseline (*M* 48.7, *SEM* 17.1) to post-intervention (*M* 59.5, *SEM* 13.3; Figure 1). Similarly, *listening behaviors* (listening duration / conversation duration) increased from baseline (*M* 18.1, *SEM* 6.8) to post-intervention (*M* 33.4, *SEM* 9.2). For the structured conversations, the Wilcoxon Signed Ranks Test in R indicates that increasing numbers of *on-topic responses* from pre- to post-intervention trended toward significance ($V = 1$, $p = .06$; Figure 2). Additionally, there were significant improvements on the Social Responsiveness Scale-2 *Social Communication Index* ($V = 10$, $p < .05$). On the treatment satisfaction scale post-intervention, mean rating for helpfulness of the intervention content was 4.5 (*SD* 0.5; 1 = not helpful to 5 = very helpful).

Conclusions: Findings support the preliminary efficacy of our intervention model in improving social communication for autistic adults with high support needs. To our knowledge, this investigation is the first to evaluate a socialization program specifically designed for this population. Next steps include a randomized controlled trial to further evaluate feasibility and efficacy of our socialization program for adults who are notably under-represented in the treatment literature.

428.005 *(Poster)* ACT Based Insomnia Intervention for Autistic Adults

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Background: Across the lifespan, insomnia is one of the most common co-occurring conditions in Autism Spectrum Disorder (ASD), with up to 80% of children and adolescents and two thirds of adults reporting poor sleep. Insomnia symptoms in autistic individuals are associated with anxiety, depression, fatigue, poorer daytime functioning, behavioural difficulties, poorer academic performance, and underemployment. The close relationship between mental health difficulties and insomnia highlights a clear and critical need for interventions focused on insomnia treatment. Behavioural interventions, primarily parent training programs, have been shown to be efficacious in treating sleep onset and night waking in younger children. However, currently there are no published, empirically supported psychological interventions for insomnia in autistic adults. This knowledge gap contributes to risk of significant harm due to overprescribing poorly chosen medications or lack of treatment.

Objectives: Our aim was to investigate the efficacy of a combined Acceptance and Commitment Therapy (ACT)/Behavioural Therapy (BT) for insomnia in autistic adults (ACT-i).

Methods: Twelve adults expressed interest in the study and 11 met screening criteria (age 18-70 years, insomnia severity index (ISI) ≥8, autism spectrum disorder diagnosis); eight individuals were able to attend available session dates. Participants were assigned to one of two intervention groups (4/group) within a multiple baseline over time design. Each group completed questionnaires on anxiety and depression (HADS), experiential avoidance (BEAQ), psychological distress (CORE-10), daytime fatigue (FFS), pre-sleep arousal (SAAQ) and sleep (ISI [primary outcome measure], PSQI) at pre-intervention, post-intervention, and 2-month follow-up. A daily sleep diary was completed during pre-intervention, post-intervention, and again at 2-month follow-up. Actigraphy data were also collected for 7-days pre- and post-intervention. Client satisfaction was also ascertained. Intervention consists of 4 x 2-hour, therapist-led intervention sessions teaching ACT and sleep hygiene principals. It was modified from an existing sleep intervention, following feedback from three autistic adults.

Results: Six males and two females age 19-68 years, with ASD diagnosis confirmed by sighting original diagnostic reports, began intervention. At pre-intervention ISI scores ranged from 9-26 (M=17.9, SD=6.1). At post-intervention, wilcoxon signed ranks test indicated significant improvements on the ISI ($Z=-.253$, $p<.01$), PSQI ($Z=-2.13$, $p<.05$), CORE-10 ($Z=-2.31$, $p<.05$), HADS anxiety ($Z=-2.21$, $p<.05$) and BEAQ ($Z=-2.37$, $p<.05$). There was a non-significant reduction in HADS depression scores. Furthermore, majority of participants showed reliable clinical change on the ISI and treatment acceptability was good, with a modal rating of "4" (agree) on a 5-point scale. At the 2-month follow-up, there was no significant changes in any scores from post-treatment, indicating that improvements were maintained. Sleep diary and actigraphy showed considerable inter- and intra-individual variability, and no significant changes were found in response to intervention.

Conclusions: The outcomes from this pilot study indicate that ACT-i was both efficacious and acceptable in reducing self-reported insomnia symptoms in autistic adults. Significant improvements were also seen in anxiety symptoms and behavioural flexibility. Importantly, gains were maintained up to 2-months post-intervention. Next steps are to revise the group protocols based on participant feedback and clinician experiences and conduct a larger randomised control trial.

428.006 *(Poster)* Acceptability and Feasibility of Teacher-Delivered Westmead Feelings Program in Special Education Schools: A Mental Health Promotion Intervention for Children with Autism Spectrum Disorder

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Background: The Westmead Feelings Program (WFP) is a mental health promotion intervention for children with Autism Spectrum Disorder and co-occurring Intellectual Disability (ASD/ID) targeting emotions competence skills. Controlled trials have demonstrated that school counsellor delivered WFP improves emotions competence and reduces mental disorder symptoms in autistic children, with and without co-occurring ID (Ratcliffe et al., 2019; Ratcliffe et al., 2014). Teaching social-emotional skills in classrooms is a priority (Saggers et al., 2015). However, research has focussed on the delivery of social, rather than emotion skills interventions (Laugeson et al., 2014). Given the importance of teachers educating autistic children in emotion skills, research examining classroom-based interventions is warranted (Alexander et al., 2015; Greenway et al., 2013).

Objectives: The aims of this study were to investigate whether WFP delivered by teachers in special education schools to children with ASD/ID and their parents is acceptable and feasible and examine treatment efficacy. It was hypothesised that WFP teacher delivery would be acceptable and feasible and treatment efficacy would be demonstrated.

Methods: This is a mixed-method study utilising quantitative and qualitative methods. Participants were seventy-seven children and seventy-two parents, recruited from eight special education schools in New South Wales, Australia. The majority of children had a diagnosis of ASD/ID and were eight to 12 years old. Teachers and teacher's aides were also recruited into the study. Teachers received training to facilitate WFP over eight months to children and parents. Fidelity checks were completed in four classrooms. Feasibility data was collected from teachers and parents. Efficacy data was collected from teacher's aides, parents and children. Quantitative data was analysed using standard statistical methods: frequencies and percentages for categorical variables and means (standard deviations) and medians (interquartile ranges) for continuous variables. Qualitative data was analysed utilising a thematic approach and realist method (Braun & Clark, 2006).

Results: Teacher's aides described gains in social and emotional development in 87% of children, specifically emotions recognition, communication, regulation, and self-confidence. Analysis of quantitative data from parent and child reports indicated that WFP helped with child social and emotion skills. All parents would recommend WFP for other children. On average, teachers reported that WFP content was important for children with ASD/ID to learn and they would deliver WFP again. Teachers rated low satisfaction with parent session implementation due to a lack of teacher time and parent engagement. Despite these challenges, parent quantitative data indicated that WFP helped parents understand their child and teach their child about emotions. All parents who attended sessions indicated they would continue using WFP and would recommend parent sessions for other parents.

Conclusions: Teacher-delivery of WFP to children with ASD/ID in special education schools is acceptable and feasible. Delivery of parent sessions has low acceptability and feasibility and future studies can explore face-to-face session alternatives. There is preliminary evidence that WFP has benefit to children's emotions skills and a study that examines efficacy utilising standardised measures is warranted. This study addresses the research gap into the delivery of school-based emotion skills interventions for autistic children.

428.007 *(Poster)* Adaptation of a Virtual Reality Environment in Children with ASD to Support the Training of Executive Function Skills.

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Background: Difficulties in executive functioning are frequently present in children with ASD, affecting their quality of life (Vries & Geurts,2015). Currently, intervention strategies must be innovative and adapted to children with ADS. Virtual Reality has begun to become an effective tool in the medical and educational field, however, its use in ADS are very limited and their effectiveness and safety in children with autism is poorly understood.

Objectives: The aim of this study was to explore the use of an Immersive virtual environment adapted for children with ASD, as a tool for training executive functioning skills.

Methods: For this study, a virtual environment was completely designed in Spanish, using the development platform Unity graphics engine and Oculus libraries that allow stereovision with its Oculus Gear VR glasses, following the principles of the Multiple Errands Test (Shallice & Burgess, 1991). 21 children diagnosed with ASD(M age= 10.7,SD=1.1,WISC-III,CIT,M=110,SD=15) and 21 typically developing children (M age=10.7,SD= 11.1,WISC-III, CIT,M=106,SD=20) participated in this study. Prior to first immersive session, All participants were applied the Wechsler Intelligence Scale for Children, (WISC-III v.ch), the Battery of Neuropsychological Assessment for Executive Function in Children(ENFEN)and the Perception of Differences test (CARAS-R). Parent completed the Behavior Rating Inventory of Executive Function 2 (BRIEF-2). During the following six weeks, children participated in a 15-minutes immersive activity in which they had to complete a series of errands at home, in the city and the supermarket. In each session, the children were accompanied by a psychologist who observed on another screen in real time the activities carried out by the child, being able to interact verbally with him. The data was collected by the MySQL database, and then analyzed and evaluated. At the end of the activity, a cybersickness questionnaire (Kennedy, 1993) was administered. The ENFEN, CARAS-R and BRIEF-2 were repeated after the six-week.

Results: No significant differences were observed between the ASD and typically developing group regarding intellectual performance and executive functioning before the immersive sessions, except for a poor performance in attentional control (CARAS-R), and planning skills (ENFEN), in the ASD group. Significant differences between groups were observed in daily executive functioning. The ASD group showing more difficulties in behavioral global score F(1.38)=20,722,p =.001). After the first immersive session, most participants felt little or no cybersickness (91%ASD group; 95% typically developing group). In addition, cybersickness scores were significantly reduced upon reaching the last session (MS1=22;MS2=18,t=2,606,p=.013). After the intervention, the ASD group enhanced performances in attentional control(CARAS-R,MT1=7;MT2=7.7,t=-2.870,p = .009), planning (Rings,MT1=3.5;MT2=,5,t=- 4.985,p=.001),ENFEN) and daily cognitive regulation (CRI, BRIEF-2,MT1=64;MT2=58,t=3,119,p=.005).

Conclusions: This study suggest that VR can be a safe, entertaining and effective strategy to enhance executive functioning in children with ASD. Creating a virtual environment designed for ASD also have increased de immersion experience effective during the activity and has helped in the training of executive functions.

428.008 *(Poster)* Adaptive and Maladaptive Emotion Regulation Strategies Reported By Children with Autism

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Background: Children with autism are at a greater risk for emotional and behavioural problems compared to their peers without disabilities (Maskey et al., 2013). They have been shown to display greater emotion dysregulation in times of distress (Jahromi, et al., 2012). Many interventions have been developed to target emotion regulation problems and improve children's ability to cope with stressful situations (Soffronoff, Attwood & Hinton, 2005; Weiss et al., 2018). Traditionally, child-reported gains have been captured using standard questionnaires that assess outcomes of regulation, providing limited information on what specific regulation skills they have learned (Callear, Harvey, & Bimler, 2016). Research has yet to closely examine the content of learned strategies that children acquire from therapy to cope with distressing situations.

Objectives: To examine reported coping strategies by children with autism when asked about two hypothetical scenarios eliciting anxiety and angry feelings.

Methods: Data were collected from 32 children with autism (87.5% male) participating in a 10-session cognitive behavioural therapy program to improve emotion regulation. Children were 8 to 13 years of age (M = 9.78 years, SD = 1.66) with at least average intelligence (FSIQ; M = 105.28, SD = 15.52). At pre- and post-intervention assessments, children listened to two scenarios and were asked to identify strategies to cope with anxiety (*James and the Maths Tests* (Atwood, 2004a)) and anger (*Dylan is Being Teased* (Atwood, 2004b)). Verbal responses were transcribed verbatim and coded by two coders. Guided by the Transdiagnostic Emotion Regulation Framework (Weiss, 2014), responses were grouped into adaptive and maladaptive strategies based on the distressing scenario. Strategies were further categorized into appropriate domains identifying specific responses (i.e., *Adaptive*: help-seeking, self-regulation, etc.; *Maladaptive*: dysregulation, impractical). Coded responses were summed.

Results: Preliminary coding demonstrated good inter-rater reliability for all items (ICC = .80). Paired samples t-test showed an increase in child-reported *adaptive strategies* for the *James* task (pre-intervention: M = 1.13, SD = 1.04; post-intervention: M = 2.13, SD = 1.52; $t(31)$=-4.14, $p <$ .001) and no significant changes for the *Dylan* task. Within the *adaptive strategies* domains, self-regulation strategies increased for the *James* task (pre-intervention: M = 0.78, SD = 0.83; post-intervention: M = 1.56, SD = *1.39*; $t(31)$=-3.37, p = .002) and approached significance for the *Dylan* task (pre-intervention: M = 0.39, SD = 0.62; post-intervention: M = 0.74, SD = 0.89; $t(30)$=-2.08, p = .05). Child-reported *maladaptive strategies* significantly decreased for the *Dylan* task (pre-intervention: M = 0.28; SD = 0.66; post-intervention: M = 0.00; SD = 0.00; $t(35)$=2.53, p = .02) and no changes for the *James* task.

Conclusions: Following therapy, children were more likely to report several adaptive strategies for an anxiety-provoking scenario learned in therapy and were less likely to report on maladaptive strategies in an angry scenario. The *James* and *Dylan* open-ended tasks successfully captured acquired knowledge in therapy for children with autism and their ability to generate coping strategies. Further research may administer open-ended tasks to measure children's treatment gains and examine their capacity to demonstrate and apply learned coping strategies.

428.009 *(Poster)* Akl-T01: A Digital Intervention to Treat Inattention

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Background: Children with impaired cognitive control have challenges in their everyday life and school function. Cognitive training has previously been shown to improve attention, providing an alternative to prescription medication. Based on our previous study investigating brain training in children with sensory processing disorders (Anguera et al. 2017; PLOS ONE), we posit that attention can be improved in a clinical pediatric population with ADHD after a 4 week training period with a prescribable home-based iPad digital treatment.

Objectives: To determine whether a video game-based iPad intervention (AKL-T01) adapted for school-aged children with ADHD shows improvements in cognitive control using parent report, direct assessment, and electroencephalography (EEG).

Methods: 12 unmedicated children (10 boys), aged 8-12 years, underwent training on a provided iPad equipped with AKL-T01. AKL-T01 is a 4-week long digital intervention designed to improve cognitive control abilities (by adapting based on individual needs). Patients were recruited from the community as well as from the Marin Cortica Healthcare Center. Research inattention criteria was a parent report of ≥ 6/9 on the Vanderbilt ADHD Diagnostic Parent Rating Scale as well as a rating of ADHD-Inattentive subtype on the Mini-International Neuropsychiatric Interview for Children and Adolescents (MINI Kid) screener. Cognitive control was determined prior to and following intervention using parent report (Vanderbilt) and direct assessment (Test of Variables of Attention (TOVA)). Additionally, changes in midline frontal theta, an EEG marker associated with focused attention processing, was assessed using a custom designed perceptual discrimination task.

Results: Using the parent report measure of inattention, there was a significant decrease in symptoms ($p=0.035$) after playing AKL-T01 for 4 weeks. In addition, impulsive response time using TOVA significantly improved ($p=0.04$, $n=10$) after training. Two were excluded due to a very high false alarm rate (80%), which suggests that they did the task incorrectly. When looking at resting state midline frontal theta with EEG, there was a significant increase in activation following training during the eyes open portion. Additional investigations for task dependent EEG are ongoing.

Conclusions: This study furthers our understanding of the role of brain training for children with neurodevelopmental disorders. We replicated the improvement in parent report as well as a neurophysiologic signature of ADHD in a novel cohort. This study emphasizes the ability to guide beneficial brain plasticity with an engaging, home based digital intervention. It may have broad applications across neurodevelopmental disability cohorts who also have cognitive control challenges, such as individuals with known genetic conditions (e.g. 16p11.2 deletion) or categorical diagnoses (e.g. Autism and Sensory Processing Disorders). In addition to this preliminary analysis, enrollment is ongoing and outcomes from a larger sample will be available in May of 2020.

428.010 *(Poster)* An Evaluation of the Acceptability of the Family Check-up Intervention for Caregivers of Children with Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) carry a particularly high burden of emotional behavioural problems (EBP). Although not considered core symptoms, prevalence rates of EBP (i.e. aggression, anxiety, hyperactivity) are estimated to be as high as 70%. Any intervention aspiring to alleviate EBP and improve life course-outcomes in children with ASD needs to involve caregivers in an empowering and meaningful way. But to our knowledge, there are no interventions that target parenting skills and consider ecological assessment of risk and protective factors influencing child EBP. The Family Check-Up (FCU) is a promising intervention model for families with children with ASD. The FCU is a brief, assessment-based, tailored intervention developed to decrease EBP by promoting positive parenting and family management practices. Studies of the FCU in populations of children at risk of EBP (without ASD) have demonstrated reliable reductions in childhood EBP, caregiver depression, and other outcomes.

Objectives: The objective of the current study is to investigate the feasibility and acceptability of the "Family Check-Up" (FCU) as part of a larger FCU research program aimed at reducing EBP among children with ASD. The study will use a mixed-methods approach to collect initial quantitative and qualitative data from participating caregivers regarding the acceptability of the FCU in addressing the needs of families of children with ASD.

Methods: We followed a sequential explanatory mixed methods research design and implemented the FCU program with dyads/triads of caregivers and verbal children with ASD and EBP recruited through hospital-based ASD services and community partners. Participating caregivers and children completed an initial "Get to Know you" interview with a clinician, a second assessment visit including questionnaires and videotaped interactions addressing child EBP and development, caregiver well-being, parenting and family functioning. The feedback visit concludes with review of overall family well-being, relationships, and strengthens, goal-setting and establishes a collaborative menu of available services for the family. Impact of the FCU on child EBP, and intervention dose/fidelity was assessed and estimated via descriptive quantitative measures (e.g. counts, means, rates). Qualitative interviews with caregivers were completed after completion of the FCU and focused on issues related to feasibility and applicability of the program.

Results: Recruitment is ongoing and the present results include preliminary analysis of data from 5 dyad/triads (child mean age=11 years olds, expressive and receptive language = low average to average). Using principles of interpretative description to analyze interviews, preliminary codes indicate that families find the FCU program applicable and beneficial to supporting overall well-being of families of children with ASD. Caregivers perceive the program may be particularly relevant to newly diagnosed families or families of children experiencing transitions (daycare to school, school to jobs). Caregivers described that the program validated their parenting skills, and the program provided support around defusing family conflicts.

Conclusions: Key findings from this study will inform future adaptations to the intervention, and possible clinical trials that will test the effectiveness of the FCU for families of children with ASD.

428.011 *(Poster)* An Examination of Interdisciplinary School Providers' Attitudes Toward Evidence-Based Practice

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Background: Many students with Autism Spectrum Disorder (ASD) struggle with psychiatric difficulties and have trouble accessing mental health services (Rotheram-Fuller and MacMullen, 2011). For these reasons, schools are the location of choice to deliver interventions; however, they often lack resources, training, and staff to be able to provide evidence-based interventions (Mychailyszyn et al., 2011). The Facing Your Fears – School Based (FYF-SB) program is an adaptation of an evidence-based, cognitive-behavioral group intervention for children with ASD and anxiety (Facing Your Fears, Reaven et al., 2011) designed to be delivered in the school setting by interdisciplinary school providers. Studies have shown that attitudes may impact a person's willingness to learn and adopt new interventions (Stahmer & Aarons, 2009). The current study examined school provider attitudes toward evidence-based interventions and explored whether there were differences between attitudes of mental health and non-mental health providers. Training non-mental health providers was a novel approach to improve access and sustainability within the school system.

Objectives: (1) To examine school providers' attitudes toward learning an evidence-based intervention; (2) To compare mental health and non-mental health providers' attitudes toward learning a new intervention; (3) To determine if provider attitudes are related to acceptability with the intervention and continuity in the second phase of the study.

Methods: Thirty-four interdisciplinary school providers from 11 elementary/middle schools were trained to deliver FYF-SB to students meeting inclusion criteria pre-treatment (e.g., SCARED, SRS-2), and those from traditionally underserved backgrounds. After a year of experience with FYF-SB, those school providers then became trainers for a new cohort of providers as part of a "Train-the-Trainer" approach to ensure sustainability of FYF-SB. Pre-training, providers completed a demographic questionnaire and a measure of attitudes toward evidence-based practices on a 0-4 Likert scale (4= most positive attitude; EBPAS; Aarons, 2004). Following FYF-SB training and implementation, school providers completed a questionnaire measuring their perceptions of the feasibility, acceptability, and appropriateness of FYF-SB on a 1-5 Likert scale (1=highly feasible/acceptable).

Results: Eight out of 11 schools completed the intervention. Of the providers enrolled in the study, 45% were mental health and 55% were non-mental health providers. School providers were generally open and willing to adopt a new evidence-based intervention (M=3.22; SD=.39). There was no difference between mental health and non-mental health providers in attitudes toward adopting a new evidence-based intervention, $t(29)=-.174$, $p=.346$. Attitudes were not related to overall acceptability with the intervention or retention of providers in year two of the study; however, overall acceptability was high (M=2.47; SD=.35) and all but two providers continued in year two.

Conclusions: These results indicate that interdisciplinary school providers in this study were generally receptive to adopting an evidence-based intervention to address anxiety in students with ASD. There were no differences between providers' attitudes (mental health vs. non-mental health). Regardless of attitude, perceptions about feasibility and acceptability of FYF-SB were high. Preliminary findings suggest that non-mental health providers may be good candidates for learning an evidence-based intervention for youth with ASD, potentially increasing capacity to treat co-occurring mental health conditions in schools.

428.012 *(Poster)* Assessing Cranial Electrotherapy Stimulation (CES) Benefits in a Clinical Cohort

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Background: Cranial electrotherapy stimulation (CES) is a type of noninvasive transcranial pulsed-current stimulation that is intended to modify brain activity. CES has been studied in adults for anxiety, insomnia, pain, and headaches. Although the precise mechanisms of action are unknown, symptomatic benefits may be mediated by modulation of cranial nerves with parasympathetic efferents. CES has not been investigated in pediatric populations; nor is it known specifically whether CES is beneficial for other symptoms related to imbalanced autonomic nervous system function, including constipation, emotional dysregulation, sensory over-responsivity, and motor tics. We hypothesized that CES may be a promising therapy for children and adults with autism and other neurodevelopmental conditions characterized by autonomic dysregulation.

Objectives: To determine feasibility and benefit of an FDA-approved device for CES with a clinical cohort of children with neurodevelopmental disorders.

Aim 1 (feasibility): For children undergoing a 4-week CES trial, we aimed to determine the degree of compliance with and tolerance of the treatment, based on parent report.

Aim 2 (benefit): Following completion of the trial, we aimed to determine benefit based on parent report of clinical global improvement (CGI) and clinician recommendation to continue treatment.

Methods: 17 participants (12 boys and 5 girls), aged 4-18 years, underwent four weeks of at-home CES therapy for 20 minutes a night, 5 days/week at 50 microamperes (lowest possible dose/time). 16 of 17 participants completed the pre- and post-trial sessions. The initial (pre-trial) session is dedicated to training the participants on device use and determining tolerance for the treatment. A symptom questionnaire, the Repeated CES Symptom Survey (RECESS), is also completed. During the post-trial session, the RECESS is completed a second time, along with a CGI scale. The RECESS (administered online using Qualtrics) evaluates parasympathetic nervous system gated functions including: insomnia, gastrointestinal issues, headaches, involuntary movements, emotional dysregulation/autonomic hyperarousal, anxiety, and sensory over-responsivity.

Results: There was a high completion rate, with 94.1% of children completing the four-week trial. In response to the question: "Please rate how well your child tolerated the CES treatment" on a scale of 1-100, the median score was 71, with a range of 9-100. On our participant-reported measure of benefit, the median was 51, with a range of 1 to 100. Of the 17 participants, 76.5% were recommended to continue based on the CGI and clinical consultation.

Conclusions: These findings provide initial evidence that a four-week in-home treatment of CES is feasible in participants 4-18 years of age. Furthermore, it may improve clinical symptoms related to dysregulation of the autonomic nervous system. We continue to enroll participants and analyze data and will be able to present outcomes of a larger sample and details by clinical symptom in May of 2020.

428.013 *(Poster)* Autism Course for Romantic Partners – an Online Program

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Background: Autism symptoms can have a major impact on romantic relationships. If so, their romantic partners often seek accessible individual help, before considering more intensive couples therapy.

In 2005, the Autism Course for Spouses was developed as a group training program. It was found to be effective (Blijd-Hoogewys & Talboom, 2013). Women reported significant improvements concerning the interaction with their autistic husbands, their coping style, their general wellbeing, and their self-esteem.

In 2017, an online version was developed, aimed at not only spouses but also husbands of adults with ASD.

Objectives: The objective of this study was to test whether the online Autism Course for Romantic Partners is effective.

Methods: The online Autism Course for Romantic Partners contains seven sessions. They are ideally offered in a blended fashion: four internet sessions, alternated with three face-to-face sessions with a therapist. The participant can choose between two video therapists (a man or a woman who have recorded the films), next to their own face-to-face therapist. Both participant and face-to-face therapist can follow the online progress and can chat while using this online program.

The program focuses on autism characteristics (also including the more female autism phenotype), autism information processing, partner relationship issues, parenting issues, and communication skills. These subjects are explained in short films, can be read in a script, and are accompanied by multiple exercises that can be done at home.

Over the past two years, N = 238 romantic partners from all over the Netherlands were invited to take part in this online program (98 men, 140 women), of which N = 180 romantic partners started the program (76% acceptance rate).

Results: The romantic partners reported a 33% decrease of their problems. Their therapists reported a 57% decrease of observed problems, a 78% improvement of overall therapy quality and a 67% reduction in face-to-face contacts needed.

Conclusions: Results show that the online Autism Course for Romantic Partners Spouses seems an effective training program. Further research is warranted.

428.014 *(Poster)* Biomarkers of Successful Neurofeedback Training in Children with Autism Spectrum Disorder

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Background: Neurofeedback is one of the most promising methods for training EEG self-regulation in children with autism spectrum disorder (ASD). There are several neurofeedback protocols proposed for ASD with most differences being in the type of training (e.g., theta/beta ratio, coherence), topography (Cz or Pz), guidance by quantitative EEG (qEEG) and number of sessions (e.g., 20 vs. 30, etc.). Most of studies of neurofeedback in ASD focus on behavioral and EEG outcomes and do not analyze any associated psychophysiological processes taking place during successful training. In particular, some cardiorespiratory and electrodermal effects of training are important for the understanding of neurofeedback training effects and defining their role as potential moderators.

Objectives: We proposed that 24 sessions of prefrontal neurofeedback training will be accompanied by changes in power of targeted EEG bands (e.g., 40 Hz centered gamma band) and ratios of individuals bands (e.g., theta/beta ratio), as well as by changes in electrodermal and cardiorespiratory indices. Autonomic activity patterns were hypothesized to reflect specifics of psychophysiological processes occurring during neurofeedback training in children with autism.

Methods: Outcomes measures along with EEG, ECG, pneumogram and skin conductance measures included behavioral ratings by parents. The protocol used a training for wide band EEG amplitude suppression ("InhibitAll") with simultaneous upregulation of the relative power of 40 Hz-centered gamma sub-band activity. In a pilot study on 6 children diagnosed with ASD (13.6 years, SD=1.3, 2 girls) in a 24 session-long course aimed at prefrontal 40 Hz-centered EEG gamma upregulation and theta-to-beta ratio downregulation we recorded ECG, pneumogram and electodermal activity. QEEG analysis at the training site was completed for each session of neurofeedback to determine the relative power of the individual bands (theta, beta, and gamma) and their ratios (theta/beta) within and between sessions. We analyzed Aberrant Behavior Checklist (ABC) and Achenbach's ASEBA ratings by parents (pre- and post-treatment).

Results: Dynamics of psychophysiological measures were analyzed during each neurofeedback session and across the whole course. Regression analysis revealed significant linear increase of skin conductance level (SCL, $p=0.002$) along with decrease of respiration rate (RSR, $p<0.001$) during each successful neurofeedback session without any statistical changes of SCL or RSR across the course of training. Heart rate variability (HRV) measures (e.g., HF of HRV) showed significant increase during each individual session. According to parental reports hyperactivity subscale scores of ABC ($p=0.024$) and ASEBA DSM-oriented scores of attention-related problems ($p=0.014$) decreased by the end of neurofeedback course.

Conclusions: Psychophysiological measures represent useful markers of attention and emotional engagement of children with ASD during neurofeedback and can be used as predictors of successful performance during training sessions and general behavioral outcome of the intervention. In particular, trend towards increase of electrodermal activity along with RSR deceleration and increased indices of respiratory sinus arrhythmia in HRV may reflect more active attention to training targets and/or experience of emotion states reflected in the observed pattern of psychophysiological indices.

428.015 *(Poster)* CBT Based Approaches to Intolerance of Uncertainty for Autistic Adults Experiencing Anxiety

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Background: Anxiety is a significant problem for many autistic people. There is growing evidence that some aspects of anxiety may present differently in ASD and that ASD related features of anxiety should therefore be considered during assessment and treatment. Furthermore, the presentation of anxiety is often complex and autistic people frequently present with multiple anxiety disorders concurrently, making it difficult to develop tailored packages based on specific anxiety sub-types. Effective interventions that target trans-diagnostic anxiety related mechanisms may be a parsimonious solution offering more efficient and inclusive targets for treatment. Intolerance of uncertainty (IU) described as the tendency to react negatively on an emotional, cognitive and behavioural level to uncertain situation and events is a transdiagnostic construct linked with a number of mental health conditions with a particularly strong association with anxiety disorders. Recent research indicates that IU is strongly associated with anxiety in autism and is associated with characteristics of ASD, including insistence on sameness, avoidance of unexpected events and desire to make life as predictable as possible. The first intervention programme specifically targeting IU in autistic children was published in 2017 (Coping with Uncertainty in Everyday Situations; CUES, Rodgers et al 2017, 2019). CUES aims to develop behavioural skills in coping and tolerating uncertain situations. The CUES programme has now been adapted for use with autistic adults and adolescents.

Objectives: To consider data from two recent single case experimental design studies of the CUES manualised treatment programme focusing on IU, one with autistic adults and autistic adolescents.

Methods: Four autistic adults participated in study one. Four autistic adolescents, aged between 14-18 years participated in study two. In both studies an eight session programme (Coping with Uncertainty in Everyday Situations – Adult (CUES-A) or Adolescent CUES-Adol©) was developed and delivered to participants on an individual basis. Outcome data related to IU, anxiety, restricted and repetitive behaviours and feasibility and acceptability were recorded. Analysis based on single case experimental design was used to provide evaluation of preliminary effectiveness and the feasibility, acceptability of the programmes.

Results: Analyses of outcome measures indicate that the programmes have promise as a treatment option for autistic adults and adolescents experiencing anxiety characterised by IU. Data regarding retention, acceptability and feasibility indicate that the participants valued the programmes.

Conclusions: These studies sought to take the first steps towards the development of an intervention for autistic adults and adolescents, which focuses on intolerance of uncertainty, an important transdiagnostic construct underlying anxiety.. Preliminary outcome data indicate that both programmes have promise as methods to enable autistic people to tackle the everyday challenges conferred by high levels of intolerance of uncertainty. Evaluation of the acceptability and feasibility of the CUES-A© and CUES-ADOL© programmes indicates that the programmes are feasible to deliver directly to autistic adults and adolescents, are acceptable and possess face validity. Our findings indicate that the CUES programme has promise as a treatment option for autistic adults and adolescents experiencing IU as part of their anxiety.

428.016 *(Poster)* Changes in Anterior Cingulate Cortex Surface Area Among Adolescents with Autism Spectrum Disorder over the Course of the PEERS® Social Skills Intervention

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Background: The social brain has been posited to include several areas such as the amygdala, anterior cingulate cortex (ACC; e.g., Stevens et al., 2011). fMRI studies have shown a functional connectivity between the amygdala and ACC when participants are presented with emotional stimuli (Stevens et al., 2011). Morphology comparisons of the ACC between autistic individuals and Neurotypical individuals have shown decreased surface area(e.g., Periera et al., 2018). Further study is needed to better understand these findings. Additionally, adolescents with ASD who receive a well-validated social skills intervention have demonstrated neurological changes, via EEG, coinciding with improvements in social behavior (Van Hecke et al., 2013). No known published study, has examined surface area of brain structures in ASD over the course of such an intervention.

Objectives: 1) Compare ACC surface area across sample populations of autistic adolescents and typically-developing adolescents 2) Examine changes in this regions across the Program for the Education and Enrichment of Relational Skills (PEERS®; Laugeson & Frankel, 2010) using a randomized controlled trial (RCT).

Methods: Forty-six male adolescents (37 ASD, 9 typically developing (TD) aged 11-16 participated. See Table 1 for descriptive statistics and volume means. An RCT (experimental (EXP) vs. waitlist-control (WL) vs typically-developing (TD) controls) of PEERS®was conducted for the ASD group. Structural MRI scans were collected twice (before and after PEERS®) using a GE 3T scanner. Freesurfer Autorecon Processing (Fischl et al., 2002) was used for whole brain structural segmentation. Bilateral ACC measures were extracted and analyzed.

Results: One-way ANOVAs revealed no significant difference between groups on any measure of the ACC. Repeated measures MANOVAs for Time (pretest vs. posttest) by Group (EXP vs. WL vs. TD), revealed no significant multivariate effect. However, an explorative Univariate follow-up showed a significant interaction effect (Time x Group) was present in the surface area of the right ACC. Paired sample *t*tests demonstrated a decrease ($t(15) = 2.320$, $p = .035$) of the right ACC surface area in the WL group, only, across intervention; Table 2 shows the descriptive statistics, *F*values, and significance levels for the univariate follow-ups.

Conclusions: Significant decreases were uncovered for right ACC surface area for adolescents with ASD who did not receive the intervention, whilst no significant changes were found for those who did receive PEERS® or were TD controls. Research has yet to elucidate the relation of surface area and social challenges. However, structure size is often used as an analogue for absolute neuron count which is associated with thresholds of activation prior research has shown (Herculano-Houzel et al., 2009.2012), and hypo-activation of the ACC is associated with greater social challenges (Urbain et al., 2015). The PEERS®intervention, shown to improve social behavior (Laugeson et al., 2009), may contribute a protection factor, in the form of developing appropriate social skills, against a reduction in surface area of the ACC; therefore providing the opportunity to not diminish in functional activation. Those who did not receive PEERS® may not develop these social skills targeted by the intervention; thus no protection factor is conferred unto them.

428.017 *(Poster)* Children with Autism with Lower Verbal Abilities Benefit More from Music Interventions

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Background: Music therapy (MT) has emerged as an evidence-based therapeutic intervention for children with autism (Geretsegger et al., 2014; Thompson et al., 2014; Sharda et al., 2018). Given the heterogeneity of autism, it is important to understand which specific subgroups benefit most. A recent RCT by Sharda et al. (2018) demonstrated a significant increase in social-communication in children with autism who underwent MT, as compared to a control play-based therapy (nonMT). In another study, Crawford et al. (2017) found that children with autism with lower verbal abilities (RR: 1.45) benefited more from MT.

Objectives: Here, we explore potential differences in response to MT (or a control therapy) related to verbal abilities on two outcomes reflecting key areas of impairment in autism: a) level of triadic joint engagement, or attention to and engagement with the therapist while involved in joint activities (Adamson et al., 2009) and b) a parent-report measure of pragmatic communication and autism-related behaviors (DSM-V, American Psychiatric Association, 2013). Second, we examine if verbal ability predicts or interacts with change in triadic joint engagement and/or pragmatic communication and autism-related behaviors.

Methods: The present analysis included 51 participants with autism, 6 and 12 years old, from a prior RCT (Sharda et al., 2018). Participants were randomly assigned to receive either MT (n = 26) or nonMT (n = 25). Verbal IQ (VIQ) range was from 55 to 142. a) Videos from therapy sessions were coded by independent raters blind to timepoint using a joint engagement coding scheme (adapted from Adamson et al., 2004; Kasari et al., 2010). We analyzed the change from first to last therapy sessions in percent time spent per activity in the highest level of joint engagement, ***coordinated joint engagement*** b) Parent reported scores on the Children's Communication Checklist-2 (CCC-2, Bishop, 2003) were available pre- and post-intervention. We analyzed change on a composite score from subscales reflecting pragmatic communication and autism-related behaviors (CCC-prag-aut; Leonard et al., 2011). Verbal ability was measured by the VIQ subscore of the Wechler's Abbreviated Scale of Intelligence (WASI-II) or the WISC-IV/V. Linear fixed-effects models were used to examine the effects of Intervention Group (MT vs. nonMT), VIQ, and Intervention Group X VIQ.

Results: Children receiving MT exhibited a) significantly more time spent in coordinated-joint engagement with the therapist during the session (= -57.59, p < .01), as well as b) marginally more improvement on the CCC-prag-aut than children receiving nonMT (= -16.01, p = .08). For children receiving MT, those with lower VIQ a) experienced a significantly greater increase in percent time spent in coordinated joint attention (= 0.62, p < .01). This is illustrated in Figure 1. b) This interaction was not significant for the CCC-prag-aut (= 0.10, p = .30)

Conclusions: We provide additional evidence that music-based interventions hold benefits above non-music based interventions. Furthermore, we provide evidence that music-based interventions are particularly beneficial for children with lower verbal ability, potentially because these interventions provide a medium to target social-communication without having significant verbal interaction demands.

428.018 *(Poster)* Coaching of Parents: Promoting Occupational Performance of Children with Autism and Their Families

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that has a major impact on the occupational performance and social participation of children and their families. Occupational Performance Coaching (OPC) is an intervention approach created by occupational therapists from Australia and New Zealand, aimed at working with parents to achieve occupational performance goals for themselves and their children. OPC is based on the premise that a better balance between person, environment and occupation leads to successful practice and subsequently improves occupational performance and transfer skills.

Objectives: The aim of this paper is to verify whether an intervention program based on OPC groups, conducted with parents or caregivers of children with ASD, contributes to increasing children's functionality and parental satisfaction with performance.

Methods: Three groups were conducted, with a total of 11 families of children (11 boys, mean age 5.75 ± 0,91 years) diagnosed with ASD, totaling 10 weekly meetings of one and a half hours with each group. Prior to the start of the intervention, parents responded to the Canadian Occupational Performance Measure (COPM) to set each child's goals, as well as performance and satisfaction scores for each goal on a scale of 1 to 10 (higher scores mean better performance and greater satisfaction). The groups were conducted according to the OPC proposal, using the Collaborative Performance Analysis and elaboration and discussion of strategies appropriate to the needs and possibilities of each family. As the intervention was carried out in group format, families could exchange experiences and collaborate in devising each other's strategies.

Results: After 10 meetings, parents reassessed performance and satisfaction against the goals set at the beginning of the program. The results show an average difference of 2.63 (±1,25) points between the final and initial performance score and 2.95 (± 1,81) points between the final and initial satisfaction score. According to the COPM user manual, a difference of 2.0 points or greater means clinically significant change, which suggests that for families participating in the groups, the OPC-based intervention contributed to increase children's performance and parental satisfaction.

Conclusions: The results of the use of OPC in Brazil are promising, which motivated the elaboration of a master's research project, whose objective will be to investigate if the coaching groups are viable for use in the public health system, for intervention with children with ASD. Because it is a low-cost and short-term intervention, OPC may be interesting for use in the Brazilian Unified Health System (*Sistema Único de Saúde – SUS*), enabling the care of a greater number of children with ASD and their families.

428.019 *(Poster)* Comparative Analysis of Child Behavior Outcomes Following Participation in Parent-Child Interaction Therapy for Children with and without Autism

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Background: Parent-Child Interaction Therapy (PCIT) is an evidence-based intervention that uses live parent coaching to improve parent-child relationships and positive parenting, and decrease child behavioral problems (Cooley, Veldorale-Griffin, Petren, & Mullis, 2014). Efficacy is well-established for young, typically developing children (Cooley et al., 2014; Ward, Theule, & Cheung, 2016) and emerging for young children with ASD (e.g., Masse, McNeil, Wagner & Quetsch, 2016; Scudder et al., 2019). Less is known about PCIT's effectiveness for children with ASD in community settings and outcomes relative to children without ASD. One study (Zlomke & Jeter, 2019) found that PCIT improved disruptive behavior among children with ASD similarly to typically developing peers. Moreover, there is little research on fathers' participation in PCIT and ASD interventions in general (Flippin & Crais, 2011; Rankin, Paisley, Tomeny, & Eldred, 2019).

Objectives: This study examined differences in frequency (RQ1) and parent perceptions of problem behaviors (RQ2) among children with and without ASD who received community-based PCIT. Differences in mother and father ratings of these outcomes were also explored for children with ASD in this group (RQ3).

Methods: Fifty-three children (mean age = 5.9 years; boys = 31, girls = 22) with disruptive behaviors participated in PCIT through an outpatient behavioral health clinic in a small city in the midwestern US. Twenty-six children were diagnosed with ASD. Child externalizing behavior was measured at baseline and post-intervention using the Eyberg Child Behavior Inventory (ECBI; Eyberg & Pincus, 1999). This 36-item, treatment-sensitive measure has acceptable reliability and validity (Funderbunk, Eyberg, Rich & Behar, 2003). The *Intensity* scale assesses frequency of disruptive child behaviors on a 7-point scale. The *Problem* scale is a yes/no measure that assesses the extent to which parents consider child behaviors to be bothersome. Totals are reported for both scales. One-way MANOVA addressed all research questions. For children with two participating parents, primary parent ratings were used for RQ1 and RQ2 analyses. All parents of children with ASD were included for RQ3 analyses.

Results: See table for descriptive findings. For the whole group, change in frequency of child behaviors [$F(1,43) = 3.478$, $p = .069$] and parent perceptions of behavioral problems [$F(1,43) = 2.747$, $p = 1.05$] was not significantly different for children with and without ASD. Among parents in the ASD group, change in frequency of problem behaviors [$F(1,36) = 2.277$, $p = .140$] and perceptions of behavioral problems [$F(1,36) = 1.734$, $p = .196$] was similarly rated by mothers and fathers.

Conclusions: This study is among the first to compare outcomes for children with and without ASD following participation in community-based PCIT and explore differences in mother and father perceptions. Results suggest children with and without ASD evidenced similar reductions in behavioral issues and degree to which parents found behaviors problematic. Among children with ASD, mothers and fathers perceived similar improvements in behavior post-treatment. These preliminary results suggest fathers and mothers may observe similar effects of PCIT on child behavior. Additional analyses will explore fathers' participation in PCIT compared to mothers, such as time in treatment.

428.020 *(Poster)* Comparison of Physical and Virtual Robot As a Conversation Partner for Adolescent with Autism Spectrum Disorders

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Background: Recent advances in robotics enable us to think of robot applications as an easy communication partner for individuals with Autism Spectrum Disorders (ASD). The previous studies have shown the possibilities of robot to be a partner of conversation with children with ASD to learn gaze following (Kumazaki, Yoshikawa et al. 2018a) and consult about their daily problems (Shimaya, Yoshikawa et al. 2019). However, due to the difficulties in recognizing human utterances, no automatic robots have a sufficient capability of talking and have not yet used in the daily field of therapy or intervention. Furthermore, although a pioneering research identified a potential merit of a small physical robot to attract attention of children with ASD (Kumazaki, Yoshikawa et al. 2018b), it has been unknown which type of agent is preferable for the conversation partner of adolescents with ASD.

Objectives: We examined how long the individuals with ASD can talk to physical and virtual robots. In this study, we focused on a small humanoid robot called CommU as a physical robot, which was the same one used in the previous work (Kumazaki, Yoshikawa et al. 2018b). The CG animation program was developed to faithfully reproduce the appearance and movement of CommU and used as a virtual robot. An identical dialogue system was installed to both types of robot so that they could keep asking a variety of questions to know about the interlocutor and respond to his or her answer. We conducted an experimental conversation session where the individuals with ASD talk to either of two robots for about 15 minutes and can stop anytime when they wanted to do so.

Methods: Subjects who was diagnosed as ASD and had IQ score from 60 to 100 were included. Nine and twelve adolescents with ASD who attended to the session of the physical robot condition and the virtual robot condition, respectively, were analyzed. Each subject was asked to sit and face with a robot or a monitor display on which the CG of the robot was drawn. The subject voice was captured by a microphone array device and sent to the dialogue system to make it produce the question or the response to the interlocutor person. Every about five minutes, it asked the subject if he or she allowed it to keep talking. After fifteen minutes had passed, it told that the conversation was over.

Results: Average time that subjects spent for talking was 12.7 minute (SD=4.5). The ratio of subject who did not stop the conversation was higher in the physical robot condition than in the virtual robot condition.

Conclusions: Since the difference between two condition was whether it exists in front of the subjects or it was drawn on the screen, it is conjectured that the subjects was more willing to talk more to the physical robot than the virtual robot. The contents of utterance produced by the subjects must be examined to see whether, and to which types of questions, either of robot could promote self-disclosure.

428.021 *(Poster)* Conducting Interdisciplinary Research with Children with Autism Spectrum Disorders: Lessons Learned from an Oral Care Intervention Study

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Background: Research suggests that children with autism spectrum disorder (ASD) experience widespread health disparities. However, few intervention research studies include participants and their families in the research process. In addition to calling for more research to improve health outcomes, it is also necessary to understand best practices for conducting interdisciplinary intervention research while including children with ASD and their families in the research process.

Objectives: The objective of this study was to present the challenges and lessons learned in implementing an oral care intervention among a diverse pediatric population with ASD as part of an interdisciplinary research team.

Methods: Participants in the study were 220 English- or Spanish-speaking families with children aged 6-12 years with ASD who were enrolled in an oral care intervention to improve dental care experiences. The interdisciplinary study team comprised of occupational therapists, psychologists, public health professionals, pediatric dentists/residents, dental assistants, and front desk staff. Select members of the team held monthly meetings to discuss their study- and intervention-related lived experiences, identify challenges, and brainstorm strategies to facilitate research processes; all comments were documented in meeting minutes, with specific case examples noted. Meeting minutes were mined for data pertaining to strategies, with results synthesized into recommendations that were reviewed and confirmed by senior members of the research team.

Results: Results focused on the dynamics between the research team and participants, culminating in five strategies to improve care for participants and facilitate functioning of the research team. *Flexibility* was paramount, especially in relation to scheduling around family preferences; team members also needed to expect the unexpected, being prepared for abrupt changes in child behavior and modifying adaptable aspects of the intervention in response. *Patience* was also essential, emphasizing the importance of calmness when interacting with children with ASD during intervention visits, and in being patient while conducting study procedures that may fall outside typical scope of practice. Having an *open mind* when working with participants and practitioners from diverse socioeconomic, cultural, language, and practice backgrounds was crucial. By respecting and welcoming the differences inherent in the team members and participants, we acknowledged the role that these differences play in both our personal and professional lives. Clear and consistent *communication* between team members, parents, and child participants about all aspects of the research study was important to convey key messages and discuss study goals. Lastly, it was vital to *trust the experts* and rely on the expertise of the members of the research team and parents of participants; this enabled research members to perform different tasks unique to their skill sets effectively and encouraged parental support to improve rapport and facilitate intervention visits.

Conclusions: As a member of an interdisciplinary team, research members working with children with ASD need to collaborate, communicate, and share their particular skills to support participants and their families for successful delivery of interventions. This paper presents strategies to enhance rapport with participants and other researchers and facilitate study procedures to improve future research projects and help mitigate health disparities with this population.

428.022 *(Poster)* Correlation between Fear of Negative Evaluation and Familial Loneliness in Young Adults with Autism Spectrum Disorder and Other Social Challenges

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Background: Research suggests that the quality of familial relationships has a bidirectional influence on the quality of an individual's social relationships (Parke & Ladd 2016).The connection between family relationships and socialization has been confirmed through recent studies showing the increased effectiveness of social skills interventions that incorporate supportive parent/caregiver assistance in the curriculum (Laugeson et al. 2015; Van Hecke et al. 2015). Additionally, studies have shown that individuals who feel shamed and ridiculed by their parents experience increased levels of social anxiety, specifically related to fear of negative evaluation (Caste, Inderbitzen, & Hope 1999). However, there are few studies examining the impact of familial dynamics, including family isolation and loneliness, upon self-perceived social anxiety.

Objectives: The purpose of this study was to examine whether greater feelings of familial loneliness among young adults correlates with higher levels of social anxiety, specifically related to fear of negative evaluation. We hypothesized that young adults reporting greater familial isolation would also experience greater feelings of negative evaluation among their peers.

Methods: Participants included 160 young adults (73% male; ages 17-35, mean age=22.21, *SD*=3.69) presenting for social skills treatment through the UCLA Program for the Education and Enrichment of Relational Skills (PEERS; Laugeson 2017), an evidence-based, caregiver-assisted social skills program for young adults with ASD and other social challenges. Baseline self-reported ratings of social anxiety, including fear of negative evaluation, were measured using the Social Anxiety Scale (SAS; La Greca 1998). Self-reported feelings of familial isolation were measured at baseline using the Social and Emotional Loneliness Scale for Adults (SELSA; DiTommaso 1993). All assessments were conducted prior to receiving the PEERS treatment.

Results: Pearson correlation coefficients revealed a significant positive correlation between feelings of familial loneliness and levels of social anxiety in relation to fear of negative evaluation [$r(160)=.202$, $p<.01$]. This finding suggests that individuals reporting greater familial loneliness experienced greater feelings of social anxiety specific to fear of negative evaluation among peers.

Conclusions: These results suggest that young adults who feel more isolated and alone within their families also tend to struggle more with social anxiety, particularly fear of being negatively perceived by their peers. This finding highlights the importance of providing more targeted interventions to improve family relationships as well as peer relationships. This broadened scope of treatment could prove beneficial in improving social interactions and reducing feelings of social anxiety, specifically, fear of negative evaluation. Given the established positive correlation between feelings of familial loneliness and social anxiety, future studies might investigate how this relationship changes following effective social skills intervention, particularly when family members are involved in treatment. We would hope to establish a similar positive correlation, such that a decrease in familial loneliness would be accompanied by a decrease in social anxiety following the completion of a social skills treatment such as PEERS.

428.023 *(Poster)* Depression As a Secondary Outcome of STEPS, a College Transition Support Program for Students with Autism

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Background: A sizeable portion of young adults with Autism Spectrum Disorder (ASD) without intellectual disability enter postsecondary education each year (Wei at al. 2016). However, there are no widely available, evidence-based programs designed to support them. Additionally, young adults with ASD experience increased rates of anxiety and depression (Lever & Geurts, 2016), which can impact students' quality of life and academic success (Smith, Ollendick, & White, 2019; Van Hees et al. 2015). The Stepped Transition in Education Program for Students with ASD (STEPS) is a transition support curriculum created to improve college adjustment for students by targeting self-determination and self-regulation using cognitive-behavioral therapy (CBT) and its guiding principles. The randomized, controlled trial demonstrated preliminary efficacy in increasing students' adjustment to college (withheld for blind review); however, additional research is needed to identify distal outcomes of STEPS related to co-occurring psychopathology.

Objectives: The current study aimed to determine whether participation in STEPS was associated with change in anxiety and depression symptoms as secondary outcomes of the program. We hypothesized that participants assigned to the STEPS group would show decreased anxiety and depression symptoms relative to the control group at post-treatment.

Methods: 24 treatment-seeking adults with ASD (mean age = 19.87 years; 70.80% male) were randomized to the STEPS condition (n=12) or waitlist control (n=12). Participation in STEPS included 12-16 weekly one-on-one counseling sessions that covered topics including goal-setting, problem-solving strategies, acceptance, and emotion regulation. All participants completed the Adult Self Report (ASR; Achenbach & Rescorla, 2003) to assess baseline and post-treatment depression and anxiety symptoms.

Results: A two (group: treatment group vs. waitlist group) x two (time: baseline vs. post-treatment) repeated measures ANOVA examining change in depression symptoms revealed a main effect of time [$F(1, 22)=6.60$, $p=.017$]. A significant Group x Time interaction was found [$F(1, 22)=7.13$, $p=.014$] such that STEPS participation was associated with lower depression symptoms at post-treatment. A second repeated measures ANOVA was run to examine change in anxiety symptoms. The model did not reveal a significant main effect for time [$F(1, 22)=3.65$, $p=.069$] or a Group x Time interaction [$F(1, 22)=.57$, $p=.457$].

Conclusions: Participation in STEPS, a CBT-based postsecondary transition support program, improved depression symptoms, but not anxiety symptoms relative to the waitlist control. It may be that the content of STEPS was better suited for distally treating depression than anxiety given the lack of anxiety-specific tasks like graded exposure to address participants' fears or worries. There is a need for evidence-based postsecondary programs that are efficient and effective in increasing positive outcomes for students with ASD. The current study demonstrates that STEPS may be a beneficial support program that provides secondary treatment of co-occurring internalizing psychopathology. Additional research is needed to identify underlying mechanisms of change in depression symptoms for STEPS, as well as within-subjects variables that may affect change, to strengthen the program.

428.024 *(Poster)* Descriptive Analysis of Law Enforcement Officers' Calls Involving Individuals with Autism

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Background: Little research exists to describe common interactions between LEOs and individuals with ASD. A number of highly publicized encounters between individuals with ASD and LEOs have reported on injury to caregivers or the death of an individual with ASD. Previous research offers conflicting findings as to whether people with ASD are at higher risk for involvement with the criminal justice system than the general population. It appears likely based on existing research that people with ASD are somewhat over-represented in the criminal justice system. As LEOs are the first contact between individuals and the penal system, lack of knowledge of ASD may result in LEOs misinterpreting ASD specific behavior as noncompliant, threatening, disorderly, or suspicious.

Objectives: The primary author created a bi-monthly training program for LEOs that prepares officers to respond to calls involving individuals with ASD. As part of this training, LEOs reported on calls received within the last year that include individuals with ASD. The purpose of the present study was to conduct an exploratory and descriptive analysis of LEO calls involving individuals with ASD, including the chief complaint and outcomes of calls.

Methods: One-hundred and seventy-eight LEOs attended five separate training sessions. LEOs were 61.8% male with a mean age of 40.35 years (SD = 10.0) and 12.54 years of law enforcement experience (SD = 8.8). To evaluate LEOs' prior experience with ASD, participants completed a questionnaire that included professional experiences interacting with individuals with ASD including their most recent and most stressful calls within the last 12 months. LEOs also reported on the circumstances and outcomes of the calls.

Results: Most LEOs (n=114; 64%) responded to a call involving ASD within the last 12 months, ranging in frequency from one (n=30; 16.9%) to 20 or more calls (n=21; 11.9%). For most recent calls involving an individual with ASD, LEOs reported that most individuals with ASD used words to communicate (n=68; 64.2%). The most commonly reported primary concerns included disruptive behavior (n=44; 42.7%), suspected abuse/neglect (n=20; 19.4%), and wandering/elopement (n=12; 11.7%). Most calls did not require use of physical force (n=94; 87.9%) or handcuffs (n=96; 89.7%). LEOs reported 21.7% (n=23) of calls resulted in involuntary hospitalization. For the most stressful calls, LEOs reported approximately half of individuals used words to communicate (n=41; 52.6%). Most stressful calls did not require use of physical force (n=62, 79.5%) or handcuffs (n=57; 74%), and approximately 25% resulted in involuntary hospitalization. Commons concerns for the most stressful calls included disruptive behavior (n=24; 32.4%), aggression toward self/others (n=17; 23%), suspected abuse/neglect (n=12; 16.2%), and wandering/elopement (n=11; 14.9%).

Conclusions: Most officers reported interacting professionally with individuals with ASD within the last year. Common identified concerns included disruptive behavior, wandering/elopement, suspected abuse/neglect, and aggression toward self or others. The most stressful of these incidents involved individuals with ASD who had more significant communication deficits. Stressful calls were more likely to result in use of force, handcuffs, and involuntary hospitalization. Findings provide support for the value of LEO training to respond to ASD-related calls.

428.025 *(Poster)* Direct Instruction Language for Learning Program to Promote Expressive in Children with Autism Spectrum Disorder (NCT02483910)

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Background: Language impairment is a common parental concern for children with ASD. Untreated language impairment is highly predictive of negative long-term outcomes for children with ASD. Direct Instruction-Language for Learning (DI-LL) is a commercially available intervention package with demonstrated effectiveness in children with language delays due to disadvantaged backgrounds, learning disabilities, or a primary language disorder – but it has not been carefully studied in ASD.

Objectives: Describe essential features of DI-LL and present preliminary results of a completed randomized clinical trial of DI-LL in 83 children with ASD ($\geq$4 and $\leq$ 7 years 11 months) and moderate language delay.

Methods: Children were randomly assigned in 1:1 ratio to continue treatment as usual (TAU) or to DI-LL plus TAU for six months. The primary outcome was the Clinical Evaluation of Language Fundamentals administered at baseline and endpoint by a speech pathologist who was blind to treatment assignment. The key secondary outcome was the Improvement item of the Clinical Global Impression, rated by clinician also blind to treatment assignment. DI-LL was delivered twice per week for 90 minutes per session for 6 months by bachelor-level research staff trained to reliability. The study was approved by the local IRB at the single study site.

Results: 137 children were screened; 83 (85% male, mean age of 5.6 $\pm$ 1.0 years) were randomized to TAU or DI-LL + TAU. Children with mild or severe language delay, those not in a stable TAU program or stable medication, or those in need of alternative treatment were excluded. Based on parent report, 45% were black, 22% white, 11% Asian, 16% other. The average IQ and CELF scores were 74.7 $\pm$17.1 and 53.3 $\pm$10.5, respectively. Enrollment stopped on October 1, 2019; 61 children have completed the randomized trial. The remaining 22 participants will reach endpoint by March 2020. Preliminary results will be available by May 2020.

Conclusions: DI-LL is a carefully scripted and sequenced program designed to teach basic and increasingly complex language skills. If this study supports the efficacy of DI-LL in children with ASD, it will provide an exportable intervention for a wide range of practitioners.

428.026 *(Poster)* Do Autistic Adults Benefit from Self-Guided Online Mindfulness or CBT Programs to Manage Anxiety?

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Background: Anxiety in autism is an important treatment target because of its consequences for quality of life and wellbeing. Growing evidence suggests that Cognitive Behaviour Therapies (CBT) and Mindfulness-Based Therapies (MBT) can ameliorate anxiety in autism. However, access to health care is often reduced for autistic adults, and cost-effective delivery of mental health treatments remains a challenge. There is an urgent need, therefore, to explore alternative strategies for delivering mental health services to the autism community (and the community at large).

Objectives: Given recent evidence that online mental health support tools can help reduce anxiety in the general population the current study examined whether such existing tools could also benefit autistic adults. We conducted a pilot randomized controlled trial to test whether online CBT and MBT self-help programmes could help reduce anxiety in autistic adults. These treatments may target difficulties with emotional acceptance suggested by previous work, though less directly towards intolerance of uncertainty.

Methods: 54 autistic adults with fluent language skills were randomly allocated to either an online CBT (n=16) or MBT (n=19) programme or to a waitlist control group (WL; n=19). Online intervention was present across different modules or sections over the course of about 8 weeks. Measures of anxiety, broader wellbeing, and potential processes of change were collected at baseline, after programme completion, and then 3 and 6 months post-completion.

Results: Baseline data confirmed that a combination of intolerance of uncertainty and emotional acceptance accounted for up to 61% of the variance in self-reported anxiety across all participants. The 23 participants who were retained in the active conditions (9 CBT, 14 MBT) showed significant decreases in anxiety at post-testing. Planned comparisons within each group separately showed that the main effect of time across all measures was significant in the MBT ($F(3,11) = 8.85$, $p=.003$; partial $\eta2 = .71$) and CBT groups ($F(3,6) = 7.71$, $p=.018$; partial $\eta2 = .79$) with large effect sizes, whereas it was not significant in the WL group ($F(3,13) = 1.56$, $p=.248$; partial $\eta2 = .26$) where the effect size was small. These results were maintained over 3 months and to some extent also to 6 months. Over 75% of participants who demonstrated moderate to severe levels of anxiety at baseline reported reliably reduced symptoms in at least some facets of their anxiety three months after completing a self-guided CBT or MBT course.. Reasons for programme dropout were diffuse.

Conclusions: Previous work regarding potential mechanisms of reduced mindfulness was supported, providing strong rationale for targeted treatments. Overall, results suggest that online self-help CBT and MBT tools may provide a cost-effective method for delivering mental health support to those autistic adults who can engage effectively with online support tools. Future treatments should also directly target intolerance of uncertainty as a mechanism for anxiety in autism. We also discuss ways in which online treatments can be modified similar to in-person treatments to better fit unique styles of autistic adults.

428.027 *(Poster)* Does Targeted Cognitive Control and Physical Exercise Training Generalize to Social Competence in Children?

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Background: Cognitive training and physical exercise have been posited to improve cognitive control in children and adults. Although there is still equipoise in the literature, a combined training is believed to have benefit over each intervention on its own. It is also clear that children with neurodevelopmental challenges often experience difficulties with inattention as well as with emotional regulation and social communication abilities. However, to the best of our knowledge, it has not been previously explored whether a brain and body training targeted to improved specific attention abilities and tailored for a pediatric population will have a generalized benefit to social competence.

Objectives: To examine whether an 8-week synergistic cognitive and physical training with the pediatric Body Brain Trainer (pediBBT) affects social competence. We hypothesize that school aged children will show improved emotional regulation and social communication after 24 sessions of school-based training.

Methods: Twenty children (14 boys), aged 7 to 12 years were recruited from a Northern California public school, Neil Cummins Elementary, and underwent 24 sessions (3 sessions weekly for 8 weeks) of pediBBT at the school's OT gym. PediBBT is a custom-designed, motion-capture, video game-like intervention. It consists of three modules aimed at sustained attention, working memory, and goal management in which subjects respond to stimuli by reaching, squatting, or running. Participants also completed a pre- and post-treatment battery of direct assessments and parent report forms. The Social Competence Scale (SCS) parent version, which includes Prosocial Behavior/Communication and Emotional Regulation subscales, was used as a measure of participants' social competence change with intervention.

Results: On the SCS parent version, higher scores indicate higher levels of prosocial behaviors, communication skills, and self-control. On average, overall SCS score significantly increased after 24 sessions of pediBBT ($p=0.04$). When looking at each subscale individually, the average score on the Prosocial Behavior/Communication subscale did not significantly change after treatment. However, average score on the Emotional Regulation subscale showed significant improvement following training ($p<0.01$). One outlier was excluded from analysis.

Conclusions: While these results are preliminary, they strongly suggest that cognitive and physical training targeting cognitive control—which may be preferentially right frontal parietal networks—has generalized benefit for real life social engagement. However, the finding is specific to the ability to control affective response, particularly with a negative valence rather than communication-based engagement. This finding suggests the need for further delineation of the networks subserving these functions that may be overlapping as well as a larger study in a novel cohort to replicate this potential school and home-based treatment.

428.028 *(Poster)* Does a Novel Group Parenting Intervention Reduce Emotional and Behavioural Problems in Young Autistic Children? Results from the Autism Spectrum Treatment and Resilience (ASTAR) Pilot Randomised Controlled Trial

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Background: Most young children with autism display co-occurring emotional and behaviour problems (EBPs) that tend to persist over time and impact the lives of the child and their families. There is some evidence that behavioural parenting interventions are effective for reducing EBPs in autistic children as reported by parents (Postorino et al., 2017; Tarver et al., 2019). Most trials have tested individual parenting interventions, even though groups are more scalable and have the added benefit of providing a support network for parents. Also previous studies vary in the degree to which the intervention focused on externalising behaviours versus anxiety. Furthermore, convincing conclusions about the effectiveness of these approaches cannot be drawn as many trials do not employ an active control condition or use blinded outcome measures, and there is little evidence of the cost-effectiveness of these interventions.

Objectives: The ASTAR trial tested the feasibility of trialling the ASTAR group parenting intervention against an active control and will provide a preliminary indication of potential efficacy and cost-effectiveness.

Methods: As part of the Improving Autism Mental Health (IAMHealth) research programme (www.iamhealthkcl.net), 62 parents/carers (91.9% mothers) and their 4–8 year old autistic children participated in the ASTAR pilot RCT (ISRCTN91411078). Participants were randomised 1:1 to the ASTAR group behavioural parenting intervention (Predictive Parenting) or an attention control intervention consisting of psychoeducation parent groups (Psychoeducation). Both interventions consisted of 12 weekly sessions with 6 to 8 parents/carers and content was adapted based on child verbal ability (minimally verbal versus verbal). Predictive Parenting provided specific strategies to manage both externalising behaviours and anxiety and ways to promote parental self-care and reduce stress. Psychoeducation aimed to provide knowledge about autism and social support whilst not providing specific guidance on managing behaviours or emotions. The primary outcome was a blinded objective measure of the rate of child behaviours that challenge displayed during a structured parent- and researcher-child interaction was used as the primary outcome, called the Observation Schedule for Children with Autism – Anxiety, Behaviour and Parenting (OSCA–ABP). This was used to overcome biases associated with using parent reports. Secondary outcomes included observed child compliance, child-centred parenting and child-directed parenting behaviours, parent- and teacher-reported child EBPs and parental self-report of parenting practices, stress, self-efficacy and wellbeing (see Table 1 for baseline sample characteristics and primary and key secondary outcomes). Adverse events were recorded, and we also examined preliminary estimates of the cost-effectiveness of the interventions.

Results: Feasibility of the trial was demonstrated, with good retention in both arms and high completion of measures (see CONSORT diagram in Figure 1 for participant flow through the trial). Due to ongoing analysis and publication embargo, findings from the trial are not presented here but will be completed by the meeting in May 2020.

Conclusions: This trial will add to the growing literature on the effects of behavioural parenting interventions for co-occurring EBPs in autism. It highlights the need for blinded objective measures along with the use of active control intervention conditions to be included in such trials.

428.029 *(Poster)* Efficacy of Synergized Cognitive-Physical Training for Children with Inattention

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Background: Children with issues of attention have difficulties in their everyday life and school function. Cognitive training and physical exercise have both been shown to improve attention, providing an alternative approach to prescribed medications. Here we posit that a synergistic training platform for children across the inattention spectrum, including children with ASD, may lead to improved cognitive control abilities as well as 'real-world' reported attentional function.

Objectives: To use a custom-designed, motion-capture, video game-based intervention (pediatric body-brain trainer (pediBBT)) adapted for school-aged children and deployed at a local elementary school to evidence potential improvements in cognitive control. Here we looked to determine if this platform improves cognitive control abilities in children with and without clinically significant inattention, as measured behaviorally and neurally via electroencephalography (EEG).

Methods: Twenty-two children (16 boys), aged 7-12 years, underwent 24 pediBBT sessions across eight weeks, with each session designed to take 45 minutes. A battery of pre and post assessments of cognition (Test of Variables of Attention (TOVA), working memory, multi-tasking), parent reported 'real-world' function (Vanderbilt parent report) and neural changes (EEG recordings) during rest and activation were obtained. The pediBBT intervention consists of three modules aimed at training attention, working memory, and goal management in which subjects respond to stimuli by reaching, squatting, or running. Critically, adaptive algorithms personalize the cognitive and physical training experience for each child by adjusting the level of difficulty to the heart rate and the level of performance.

Results: Direct assessment using TOVA showed statistically significant improvement ($p<.033$) for two measures of sustained attention (RT, RT Variability) and a measure of impulsivity (d'). Improvement was also observed on the behavioral measures of multitasking (d'; $p< .001$). By contrast, working memory did not show benefit with training. From a real-world perspective, 16 of the 22 participants showed improvements in their inattentive abilities based on the Vanderbilt parent report ($p= .010$). Of note, 7/8 participants no longer meet research criteria for inattentive subtype of ADHD following the pediBBT intervention. Finally, preliminary analyses efforts revealed that our neurophysiology measure (midline frontal theta) showed trends towards improvement both at rest and during a perceptual discrimination task ($p< .15$).

Conclusions: These findings provide initial evidence that an eight week, in-school, synergistic cognitive-physical training can lead to quantitative improvements in attention that span from behavioral assessment, neural markers and parent report. Future work will include a deeper interrogation of other EEG markers of attention and how potential improvements relate to other quantitative and subject reports of attention over time.

428.030 *(Poster)* Efficacy of an Intervention Group for Siblings of Children and Adolescents with ASD

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder which causes severe impairments in communication, social interaction and behaviour. In addition to their increased risk for psychopathology ASD siblings may show alterations in behavioural and emotional adjustment, life quality and relationship with their affected siblings. There is scarce evidence for effective interventions programs for ASD-siblings but preliminary studies show an improvement of ASD knowledge and self-concept.

Objectives: The first aim of the present study was to measure ASD knowledge, emotional and behavioural symptoms, levels of self-concept and self-esteem and sibling relationship quality in ASD-siblings as well as parental stress in ASD-parents. The second aim was to prove the efficacy of a psychoeducational group treatment for 8-12 aged ASD-siblings in contrast to an active control group. The third aim was to measure the correlation between the variables of improvement of symptomatology in parents and children.

Methods: The final sample included 27 High-Functioning ASD siblings (HF-ASD) whose siblings were under current treatment at the Hospital Clinic in Barcelona and/or the Catalan Asperger Association. The inclusion criteria were: to be aged between 8-12, to have a sibling under 18 with a primary diagnosis of HF-ASD and a normal intellectual level, to have a normal intellectual level themselves and not to present any serious mental disorder. Self-report and parent report measures were used to assess study variables. Participants were randomly assigned to a psychoeducational intervention group (n=14) (consisting in psychoeducation on ASD symptoms, emotional management and conflicts' resolution with siblings). and active control group (n=13) (activities related to emotional education, conversation and play, not directly related to the affected sibling). Both received a seven-session pack.

Statistical analysis were used to measure whether siblings in the intervention group had a higher and significant improvement in study variables than in the control group (Student's t-test and *Mann–Whitney U test)* and to study correlation between the variables of improvement of symptomatology in parents and children (Pearson's coefficient). ANCOVA analyses were used to study differences between groups in independent variables after the treatment. Statistical analysis was performed using the SPSS ver. 20.

Results: Participants in the psychoeducational intervention group had a significant improvement ($p<.05$) in knowledge about ASD, conflict and warmth in their sibling relationship, anxiety and self-esteem towards the control group. The correlation analysis concluded a significant correlation ($p<.05$) between the improvement in ASD knowledge and anxiety.

Conclusions: There was a significant improvement in knowledge of ASD, conflict and warmth in their siblings relationship, anxiety and self-esteem of siblings participating in a psychoeducational group as compared to those who participated in a control group. These findings suggest the relevance of psychoeducational group interventions focused on ASD siblings, who are considered a risk population.

428.031 *(Poster)* Empirical Investigation of Structural and Process Treatment Fidelity in an Autism-Specific Consultation Intervention

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Background: Fidelity, or the extent to which an intervention was delivered as originally designed, is a critical component to intervention effectiveness (Power et al., 2005). Despite the recognized importance of treatment fidelity, it remains a poorly understood construct. Treatment fidelity is now conceptualized as a multidimensional construct that includes both structural (degree to which the intervention was implemented as designed) and process (how the intervention was delivered (Harn et al., 2017) components. Given the lack of understanding of treatment fidelity, Sanetti and colleagues (2009) suggested empirical evaluations of multiple dimensions of treatment fidelity. Thus, we evaluated the associations between multiple dimensions and multiple raters of treatment fidelity when implementing a manualized consultation intervention called the Collaborative Model for Promoting Competence and Success designed specifically for students with autism (Ruble et al., 2012).

Objectives: To better understand the structural and process components of treatment fidelity of consultants in training, we asked the following questions: (a) What were the average structural adherence and process skill ratings of novice COMPASS consultants as rated by an expert? (b) What is the association between measures of novice COMPASS consultant adherence and process skills? (c) What is the association between expert adherence ratings and novice consultant, parent, and teacher adherence ratings?

Methods: School-based ASD consultants (n=12) were recruited for a study to develop and test a training package in COMPASS. Preliminary data from five trainees who conducted 11 consultations are currently available and reported (full data will be available in April 2020). Following each consultation, researchers reviewed an audio recording of the consultation and scored the consultant's adherence to structural elements of COMPASSS and process skills. Process skills and COMPASS adherence consisted of 35 and 25 dichotomously rated items (i.e., observed, not observed). Percentages of steps completed (i.e., fidelity to research protocol) or process skills displayed were calculated by dividing the total steps or skills displayed by the total number of steps. Given the non-normality of the data, Spearman correlations were used to examine associations.

Results: Preliminary data from the first 5 trainees indicated the following. The average percentage of trainee consultant adherence to structural elements of COMPASS as rated by experts was 89.8% (range 56–100%). The average percentage of process skills displayed was 87.5% (range 58-100%). Fidelity and process skills were positively correlated ($r_s = .640$, $p = .034$). Researcher ratings of fidelity were not significantly related to teacher ($r_s = .127$, $p = .711$) or novice consultant ($r_s = -.047$, $p = .892$) ratings of fidelity. However, researcher ratings of fidelity were negatively related to parent ratings of fidelity ($r_s = -.605$, $p = .049$).

Conclusions: The data are preliminary, under powered, and highly sensitive to potential outliers. The full data will include findings from 39 consultations. Preliminarily, novice consultants achieved relatively high levels fidelity in terms of adherence to protocol and process skills. Further, ratings from parents and teachers did not correspond to research ratings of fidelity. Clearly, the source of fidelity ratings needs to be considered and discrepancies between ratings understood.

428.032 *(Poster)* Evaluating Parent and Teacher Report of Emotion Regulation in Youth with ASD Participating in CBT for Anxiety in Public Schools

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Background: Youth with Autism Spectrum Disorder (ASD) are at a higher risk to experience anxiety symptoms, and difficulties regulating their emotions than their typically developing peers. Emotion regulation difficulties often present as challenging and externalizing behaviors in the classroom and can significantly interfere with participation in school. Recently, emotion regulation has been a target of treatment in cognitive behavioral therapy (CBT) programs for youth with ASD. The results are promising in that emotion regulation skills seem to improve in anxious youth with ASD who receive CBT in a clinic setting (Weiss et al., 2018). However, research has yet to examine whether youth experience improved emotion regulation at school and at home when they receive CBT within school settings.

Objectives: The aims of this study were 1) to examine change in emotion regulation skills in response to a CBT program for anxiety in a public school setting; 2) to evaluate the relationship between anxiety and emotion regulation via parent- and teacher-report.

Methods: Twenty-four school-age youth (Mean age=10.5 years; SD=1.72) participated in Facing Your Fears-School Based (FYF-SB) intervention, a clinic-based CBT program for anxious youth with ASD that was adapted for schools (Reaven et al., 2019). Parents and teachers completed the Emotion Regulation Checklist (ERC; Shields and Cicchetti, 1997), a measure of emotional regulation (ER) and emotional lability/negativity (LN) at pre- and post-treatment. Higher scores on ER suggest positive affect and regulation skills while higher scores on the LN subscale suggest higher levels of negative affect. Pre- and post-treatment anxiety was measured using the Parent Screen for Childhood Anxiety and Related Disorders (SCARED; Birmaher et al., 1999) and the School Anxiety Scale-Teacher Report (SAS-TR; Lyneham et al., 2008). Only a portion of participants completed pre- and post-treatment data even with multiple reminders (n=17).

Results: There were no significant differences in either ER or LN pre- post-treatment, in parent or teacher report (See Table 1). However, according to parent and child report, significant reductions in anxiety did occur following participation in FYF-SB (ABCT presentation, Reaven et al., 2019). When evaluating the relation between emotion regulation and anxiety at pre-treatment, parent-reported ERC scores and SCARED scores were significantly correlated, ER: r= -.42, p=.046; LN: r=.52, p=.01. Teacher-reported LN was marginally correlated with SAS-TR total, r=-.40, p=.07, however ER was not significantly correlated with SAS-TR total, ER: r=-.15, p=.51.

Conclusions: At pre-treatment, parent and teacher-reported anxiety was correlated with some measures of emotion regulation suggesting that higher emotion negativity/lability and lower emotion regulation skills is related to higher anxiety at baseline. Preliminary findings from the present study suggest that although significant decreases in anxiety occurred following intervention, similar improvements in emotion regulation did not occur. Although these constructs were related at baseline, lack of improvement in emotion regulation may suggest that additional strategies that specifically target emotion regulation *may* be beneficial to address these difficulties. Limitations of the present study include a small sample size, missing data from some parents and teachers, as well as potentially limited sensitivity of the ERC to measure change.

428.033 *(Poster)* Examining Outcomes of Group CBT Targeting Anxiety in Children with Autism Spectrum Disorder

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Background: Anxiety disorders are common in children with autism spectrum disorder (ASD), yet appear distinct from ASD deficits (Kerns and Kendall, 2012). Anxiety disorders can manifest as various clinical presentations and can lead to marked functional impairment. Several interventions targeting anxiety symptoms within the context of ASD exist, with modified cognitive behavioral therapy (CBT) showing significant improvement in anxiety symptoms among youth (Chalfant et al., 2007). *Facing Your Fears* (FYF; Reaven et al., 2011) is a manualized, evidence-based, family-focused group intervention targeting anxiety among children with ASD that has shown promising results. However, much is left to be explored in bridging the research-to-practice gap, and delineating efficacy from effectiveness in clinical settings.

Objectives: Our aim was to determine the effectiveness of *Facing Your Fears* group intervention on anxiety symptoms in children with ASD and at least one co-occurring anxiety disorder. We hypothesized there would be significant improvements across the Multidimensional Anxiety Scale for Children, Second Edition (MASC-2; March 2012) domain scores.

Methods: A total of 28 children and their parents received 90 minutes per week of FYF for 12-14 sessions. All patients had a confirmed diagnosis of ASD and an estimated Verbal IQ of 80 or above. Twelve patients (M_{age} = 10.17, SD_{age} = 1.95) were included in this preliminary analysis; those who were not included did not return measures (n = 16). Parent and child ratings on the MASC-2 were collected to determine severity of anxiety symptoms pre- and post-treatment. MASC-2 *T*-scores were assessed across the following scales: Total score, separation anxiety, generalized anxiety disorder (GAD), social anxiety, performance fears, obsessions and compulsions, panic disorder, tense/restless symptoms, and harm avoidance.

Results: Paired-sample t-tests were run to determine whether there were statistically significant mean differences across MASC-2 scores before and after FYF intervention. Among parent-reported child symptoms, results of the paired-samples t-test revealed significant improvement in *T*-scores on the separation anxiety symptom subscale (pre-test: M = 70.75, SD =10.00, post-test: M = 64.67, SD = 11.58; t(11)= 2.69, p = .021). No other significant changes were observed in parent-reported MASC-2 scales.

Among self-reported child anxiety symptoms, paired-sample t-test results also revealed significant improvement in *T*-scores on the following: Total score(pre-test M: 67.00, SD = 9.72, post-test M: 59.83, SD=8.67; t(11)=4.36, p =.001), separation anxiety symptom subscale (pre-test: M = 67.00, SD =9.72, post-test: M = 59.83, SD = 8.67; t(11)= 4.16, p = .002.), and obsessions and compulsions subscale (pre-test: M = 64.33, SD = 8.08, post-test: M = 55.17, SD = 9.72; t(11)=3.665, p= .004). No other significant changes were observed in self-reported MASC-2 scales.

Conclusions: Group CBT is effective in reducing severity of comorbid anxiety symptoms; however, this effect may vary across specific anxiety symptoms. In this sample, reduction in anxiety was demonstrated for separation anxiety (both parent and child report), total anxiety (child report), and obsessions/compulsions (child report). Future research on treatment outcomes should further assess differences in reported anxiety across children with ASD and their parents.

428.034 *(Poster)* Examining the Relationship between Organizational Climate and the Implementation of a CBT Program for Youth with ASD and Anxiety in Public School Settings

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Background: Access to cognitive behavioral therapy (CBT) is critical to support youth with ASD in managing anxiety symptoms that interfere with functioning across home, school, and community settings. Training school providers to deliver CBT may increase access to these programs given the high percentage of youth with ASD who receive services within public schools. “Outer” contextual factors such as school leadership, stress, and communication play an important role in the implementation of a range of evidence-based practices within community and school settings (Damschroder et al., 2009; Lyons et al., 2019). However, to date, we know little about whether these factors also contribute to the successful implementation of CBT programs within public school settings for youth with ASD and co-occurring anxiety.

Objectives: In partnership with school-based key stakeholders, Facing Your Fears (FYF), a clinic-based CBT program for anxious youth with ASD, was adapted as a school-based intervention [FYF-SB; (Reaven et al., 2019)]. This study presents data from a pilot implementation of FYF-SB in three public school districts. Specific aims are to: (1) characterize the sample with regards to organizational climate; and (2) understand how organizational factors are associated with the successful implementation of FYF-SB as measured by (a) early adoption of FYF-SB, (b) the number of FYF-SB sessions implemented, and (c) the perceived feasibility, acceptability, and appropriateness of FYF-SB following implementation.

Methods: Thirty-four interdisciplinary school providers from 10 underserved public schools were trained to implement FYF-SB. To assess organizational readiness, all providers completed the Organizational Readiness for Change scale (ORC; Lehmann, Greener, & Simpson, 2002). The ORC contains a Climate subscale that captures school-level communication, autonomy, stress, cohesion, and leadership. All ORC items are rated on a 5-point Likert scale, with higher ratings reflecting more positive climate. Following training, school providers implemented FYF-SB. Data were collected regarding the speed that FYF-SB was started/adopted, student attendance, session fidelity, and total number of sessions completed. Following implementation, providers completed a measure of perceived feasibility, acceptability, and appropriateness of FYF-SB.

Results: School providers reported positive school communication, autonomy, cohesion, and leadership, with mean item ratings ranging from M=3.42 (SD=0.49) to M=3.78 (SD=0.45). However, high levels of stress were also reported (M=3.69; SD=0.82). The Climate subscale of the ORC was not significantly associated with the number of FYF-SB sessions implemented or the perceived feasibility, acceptability, and appropriateness of FYF-SB following implementation. However, it was marginally associated with the speed of FYF-SB adoption (r=0.34; p=0.07), with better organizational climate being associated with faster adoption. Specific domains of the ORC Climate subscale appeared to drive this relationship, with school leadership and school cohesion being significantly associated with the speed by which FYF-SB was implemented (r=0.45, p<0.01 and r=0.37; p=0.04 respectively).

Conclusions: Results from this study suggest that school climate, leadership, and cohesion may influence how quickly school-based CBT programs are initiated and implemented. These results suggest the importance of proactively capitalizing on school leadership and building school-level communication and cohesion (e.g., provider relationships) during the initial training of school providers. Limitations and future directions will be discussed.

428.035 *(Poster)* Examining the Use of a Virtual Reality Job Interview Tool in Adolescents with Autism in a School Setting: A Randomized Controlled Trial

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Background: Unemployment rates are high in adolescents with ASD. Adolescents within two years of graduating high school are at particular risk of unemployment. Thus, high school represents a critical time in which interventions focused on employment outcomes should be considered. One obstacle for obtaining employment is the job interview, which may be challenging for those with ASD due to social communication difficulties. Thus, treatment aimed at improving job interview skills may be particularly helpful for adolescents, specifically as they prepare to graduate from high school.

Objectives: In the current study, we examined the effectiveness of a Virtual Reality Job Interview Tool (VR-JIT) in adolescents with ASD. While the VR-JIT has been shown to be effective in adults with psychiatric disorders, its utility has not been examined before in adolescents with ASD.

Methods: Fourteen high school students with ASD participated in the current study, which was conducted in a New Jersey school for children with mild special needs. The students (either 11th or 12th graders) were randomly assigned to either the VR-JIT intervention condition (n=7) or a services-as-usual (SAU) control condition (n=7). Participants in the intervention condition participated in 10 hours of VR-JIT during which they practiced simulated job interview skills with a virtual human interviewer, and were provided feedback on social skills. At baseline and following the intervention, all participants performed a video-recorded mock job interview. Following the study, the video recorded job interviews were rated by trained assessors who were blinded to group (intervention vs. control) and time (baseline vs. follow-up). Participants were assessed on their ability to sound professional, honest, and hardworking among other abilities. Repeated-measures ANOVA was performed. Due to the small sample size, effect sizes and p-values were considered.

Results: Compared to the SAU group, the VR-JIT group showed improved job interview performance across several domains including portraying oneself as honest and professional, as well as portraying oneself as a team player. Overall, participants in the VR-JIT group indicated they found the intervention helpful and enjoyable. Moderate to high effect sizes were observed.

Conclusions: Our results indicate that the VR-JIT improved job interview performance in adolescents with ASD. Future directions include examining whether those in the intervention group showed improved ability to obtain job offers. The study also revealed that the VR-JIT can be easily implemented in a school setting, and therefore may be helpful to adolescents with ASD as they prepare to enter the employment world.

428.036 *(Poster)* Exploratory Implementation of an in-Home Exergaming Program for Children with Autism Spectrum Disorder (ASD): Thematic Analysis of Families' Experiences and Views

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Background: Interventions that increase physical activity (PA) have been associated with multiple benefits in individuals with ASD, who tend to be less physically active than their typically developing peers. The Liberi exergames require players to pedal a recumbent bicycle and were developed to promote moderate-to-vigorous PA in children with cerebral palsy (CP). Specially designed controls facilitate gameplay for those with motor impairments. Players access the online games through tablets connected to the bicycles. A variety of mini-games are available for solo or group play. Arm-mounted monitors enable real-time feedback when players reach their target heart rate. Preliminary evidence supports the effectiveness of the Liberi exergames in increasing PA and fitness in children with CP. Children with ASD often have motor and other challenges that may hinder them from participating in team sports, and commercial exergames do not necessarily induce adequate exertion levels. Accordingly, the Liberi exergames could be an effective exercise intervention for the ASD population.

Objectives: Exploratory implementation of an in-home Liberi exergaming program for children with ASD to obtain feedback on the games/program.

Methods: We recruited a convenience sample of five children with ASD aged 8-12 years and one parent per household. Bikes/gaming stations were set up in participants' homes. Children were asked to play the exergames for at least 45 minutes three times per week—the games were available only on/at specified days/times—over a six-week period. A semi-structured interview guide was developed to elicit participants' experiences and views of the exergames/program during a one-hour focus group. Thematic analysis was used to identify salient themes.

Results: Four families (eight participants) attended the focus group. Four themes were identified. Motivation: Earning money to shop in the e-store, winning, playing with others (although four children did not want to use the headsets to communicate while doing so), and having fun contributed to players' enjoyment of and desire to play the games. Benefits: Three parents voiced pleasure at seeing their child engaging in PA. Other positive impacts included greater confidence, more family discussions/socializing, and establishment of a safe space for online play. Frustration: Technical difficulties were a source of frustration. Participants would have liked a larger selection of games (including more challenging/sophisticated ones), disliked the practice of rotating games such that not all were available during every session, and some experienced sensory issues (e.g., one child did not like wearing the heart rate monitor because of the sensation on his arm). Sustainability: Several parents wondered whether their child would continue exergaming once the novelty had worn off. All parents found the limited gaming windows problematic, and suggested the server be open for longer periods and at different times. Participants had mixed opinions about offering exergaming in schools. Two children voiced concerns (others may be careless with equipment, lack of a safe gaming environment), although parents were supportive of the idea (one had already broached the topic with her child's school).

Conclusions: These findings will inform the design of a more rigorous evaluation of the Liberi exergames in children with ASD.

428.037 *(Poster)* Exploring the Therapeutic Effects of a Social Skills Intervention Program Adapted for a Community-Based Children's Hospital.

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Background:

Autism Spectrum Disorder (ASD) is characterized by challenges with social skills that imply need of help in learning how to act in different social situations. Literature suggests that social skills training groups increase social behaviors in children and adolescents with high-functioning ASD, and reduce several mental health related comorbidities. However, there is little evidence on the effectiveness of these treatments in adapted community-based hospital services.

Objectives:

The main objective of this study was to explore the effect of the MIND Social Skills Training Program (MIND-SSTP) adapted with authors' consent from Solomon, Goodlin-Jones & Anders (2004) for children and adolescents with ASD, on social conducts and several comorbid symptoms, such as anxiety, behavioral problems and mood disorders.

Methods:

This study is based on a randomized clinical trial (using a waiting-list as a control group). A total of 79 children (8-12 years old) and adolescents (13-17 years old) were recruited and divided in two groups: experimental group (n=42) and control group (n=37). Inclusion criteria included diagnosis of ASD and verbal comprehension within normal range (based on WISC-V verbal index). Diagnoses were confirmed by ADOS-2 and clinical judgement. Solomon's et al. (2004) MIND-SSTP intervention was adapted for hospital community implementation (i.e., ten consecutive weekly sessions, of 90 minutes duration, and including 15 minutes free play). Free playtime was recorded, and social conducts were codified (Lince software, Gabin et al., 2012) based on an adaptation of Bauminger (2002) observational scale applied to 39 subjects available of the initial 79. We analyzed change in the number of social conducts (coded from recoded videos), comparing experimental and control group. Coders met reliability (within 76 and 89%). Comorbid symptoms were assessed by questionnaires before and after the intervention based on the total sample (N=79).

Results:

Participants included 82,3% males (mean age: 11,92) for questionnaires data and 84,16% males (mean age: 11,39) for observational coded data. Our results showed significant improvements (pre-post coding) in social behaviors only for the experimental group. Specifically, eye contact showed a tendency of improvement ($p = 0.056$), that reached the statistical significance for participants with verbal index > 90 ($p = 0.010$), and a tendency for the sub-group of children ($p = 0.095$), not seen for adolescences. There is also a tendency of improvement in functional communication ($p = 0.057$), being more meaningful for children ($p = 0.050$). Also, children with Verbal Index > 90 showed a decrease in affective symptoms collected through questionnaires; decreasing in internalizing problems ($p = 0.022$) and within the marginal statistical significance decrease for affective problems ($p = 0.089$).

Conclusions:

Our results suggest that children under 13-years old, and participants with higher verbal skills, may be better candidates for low-intensity community social skills programs. We have also learned that by using observational methodologies, more clinically relevant changes might be captured in order to strength the validation of community interventions.

428.038 *(Poster)* Feasibility of a MULTI-Dimensional Coaching Based Intervention for Parents of Adolescents with Autism

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Background: Parents of children with autism face a variety of difficulties, among which are decreased resilience and heightened stress. Recent studies have shown that parental well-being affects the child's well-being, and that parents are primary mediators of their child's development. The ***ParentShip*** protocol is a validated, short-term occupational therapy intervention for parents of adolescents with autism that aims to promote parental resilience and enhance adolescents' participation in daily life.

Objectives: The aim of this study was to examine the ***ParentShip*** feasibility and explore the modifiability of parental resilience following intervention.

Methods: We used a one-group repeated measures pretest – posttest and follow up, mixed-method, research design. Parents (n = 4 - both parents, n = 6 - mothers) of 10 adolescents with autism: five boys (M=14.32 years, SD=1.98), five girls (M=13.95 years, SD=1.06) were recruited using convenience sampling from community based autism centers and social media. Inclusion criteria: Parents - difficulties or unmet functional needs in relation to raising their adolescent; Adolescent- a score indicating non-typical functioning in at least one of the following areas: sensory processing, executive function, or social-communication skills.

An assessment of the adolescent's multi-dimensional profile in the following dimensions: sensory-motor (Sensory Profile 2), cognitive-behavioral (The Behavior Rating Inventory of Executive Function –Parent), social- communicative (Social Skills Improvement System), and motivational (A questionnaire designed for this study) was determined. Each family participated in a series of 13 individual weekly sessions of 90 minutes each. During the sessions parents and therapist analyzed the adolescent's personal profile, examined daily situations and identified barriers and bridges in the parent, the adolescent and the environment. In addition, parents set measurable and functional goals and practiced structured problem solving. Study results were analyzed at three time points: before intervention (time 1), immediately after intervention (time 2), and three months post intervention (time 3), using two outcome measures: The Autism: Parenting Questionnaire (APQ), measuring parental resilience, and the Canadian Occupational Performance Measure (COPM), measuring perception of performance. A semi-structured interview was conducted at time 2 to explore parental experience.

Results: Significant improvement in COPM performance score from time 1 to time 2 for parents (Z= 2.81, p= .005) and adolescents (Z= 2.803, p= .005). Results were maintained three months post intervention for both parents and adolescents. APQ total scores improved from time 1 (M= 98.2, SD=8.9) to time 2 (M= 105.5, SD=10.6; Z=1.582, p= .114) and showed significant improvement from time 2 to time 3 (M= 110.9, SD=8.4) (Z=2.143, p= .032). Large APQ effect size was obtained from time 1 to time 2 (Cohen's d= 1.16) and from time 2 to time 3 (Cohen's d= 1.84). Thematic analysis of qualitative results validate ***ParentShip's*** mechanisms of change.

Conclusions: Results support the ***ParentShip*** as a strength-based parent- centered intervention program that leads to significant improvement in adolescent participation and heightened parental resilience.

428.039 *(Poster)* Feasibility of a Self-Management Physical Activity Intervention with Coaching to Support Adults with Autism Spectrum Disorder and Intellectual Disability

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Background: Individuals with autism spectrum disorder (ASD) often do not engage in recommended levels of physical activity and levels continue to drop as individuals with ASD move into adulthood (Garcia-Pastor, Salinero, Theirs, & Ruiz-Vicente, 2019). Few studies have examined the impact of using family or community members as coaches to promote exercise in this population using evidence-based strategies.

Objectives: To evaluate the feasibility and acceptability of a self-management physical activity intervention with a coaching component to support adults with ASD and accompanying intellectual disability (ID).

Methods: Participants included 18 adults with ASD and ID (ages 18–47). Participants in both groups received a Fitbit Flex 2™, training on using the device, and were instructed to wear the Fitbit daily. Following a week-long baseline period to determine acceptability of wearing the Fitbit, adults with ASD and ID were randomly assigned to the Fitbit +Coaching Group or the Fitbit Only Group. Coaches in the Fitbit +Coaching group were either a family or community member who knew the adult (e.g., parent, respite provider). The coaches participated in a 2-hour web-based training, then trained participants on the project. Once the 12-week intervention began, participants met with their coach each week to determine if the weekly step goal was met, determine the next goal, and schedule exercise sessions. Researchers measured fidelity weekly and provided support as needed. When exiting, participants in both groups completed a feasibility measure and participants in intervention completed an adapted usage rating profile. Coaches also completed a feasibility and usage rating profile questionnaire.

Results: (Note: Results will be updated when 18 currently enrolled participants exit the study- total N of 36). Adults with ASD and ID in both groups reported high acceptability for using the Fitbit. Across the 12 weeks of the intervention, participants in the Fitbit +Coaching group had significantly higher average weekly step counts controlling for their baseline step counts than participants in the Fitbit Only Group, $F(1,15) = 7.55$, $p = .01$, $\eta^2 = .34$. Adults with ASD and ID in the Fitbit +Coaching group reported high ratings on the usage rating profile ($M = 3.5$, $SD = .36$, Max=4.0). Average coach fidelity was 90.0%. Coaches reported high feasibility (Max=5.0) for the coach training ($M = 4.5$, $SD = .25$), athlete training ($M = 4.4$, $SD = .52$), and overall project ($M = 4.5$, $SD = .25$) as well as high ratings on the usage rating profile.

Conclusions: These results provide some support for parents and community members implementing self-management strategies. The intervention improved physical activity outcomes above and beyond the use of the use of the Fitbit alone. High ratings of feasibility and acceptability from both participants and coaches suggest that web-based training is a promising approach to implement interventions in community settings in adulthood. Limitations and challenges that surfaced throughout the study will also be discussed.

Garcia-Pastor, T., Salinero, J. J., Theirs, C. I., & Ruiz-Vicente, D. (2019). Obesity status and physical activity level in children and adults with autism spectrum disorders: A pilot study. *Journal of Autism and Developmental Disorders*, *49*(1), 165−172.

428.040 *(Poster)* Game Day: A Novel Method of Assessing Change in Social Competence in Children with Autism Spectrum Disorder (ASD) Undergoing Social Skills Training Using the School-Based PEERS Curriculum

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Background: Deficits in social communication and social interaction are one of the two defining characteristics of autism spectrum disorder (ASD) and contribute to numerous social difficulties throughout life. Group social skills programs have been developed and a recent systematic review of 19 studies found evidence of a medium overall positive effect but the benefits were limited to improved knowledge rather than improved frequency of enacting new social behaviors. The Program for Education and Enrichment of Relational Skills (PEERS) is the most-studied group social skills program in ASD and has shown very consistent benefits in student-reported social knowledge, parent and teacher-reported ratings of social skills, and the number get-togethers. However, none of the prior PEERS studies included blinded ratings of social interactions occurring during unstructured play times, perhaps the most robust evidence of treatment effects.

Objectives: The primary object of this pilot study was to examine whether students with ASD participating in a school-based PEERS curriculum would demonstrate improved social skills in unstructured play sessions.

Methods: Students attending a local special education school were recruited to participate in a school-based PEERS curriculum delivered in 25-30 minute group sessions four days a week for 16 weeks and delivered by a PEERS certified instructor and two assistant coaches. Students were required to have ASD with or without comorbid mild intellectual disability, be verbal, and be motivated to improve in social skills. Outcome measures included the Social Responsiveness Scale (SRS), the Social Skills Rating System (SSIS), the Test of Adolescent Social Skills Knowledge (TASSK), and a novel evaluation of an unstructured play session ("game day"). Game day occurred once a month and consisted of the instructor placing a set of board games on tables in the center of the room and then leaving the room. Videos of the game day session were rated by three reviewers who were blinded to the sequence of the videos. Raters assessed the social skills of each child using a modified version of the Contextual Assessment of Social Skills (CASS), a previously used instrument to assess social skills in ASD.

Results: Six students (age range 13-22, 5 male) enrolled and completed all PEERS instruction. Inter-rater agreement for change in social skills ratings on the modified CASS was high (0.79) for all items other than counts of initiations and responses to initiations. The total modified CASS score improved from a baseline of 38.5 to a final score of 43.6 indicating a 5.1 point statistically significant improvement ($p = 0.011$) (Figure 1). Survey outcome measures also showed statistically significant improvements in social skills knowledge (TAASK), teacher ratings of the problem behaviors (SSIS), and parent and teacher ratings of autism spectrum behaviors (SSIS).

Conclusions: This small pilot study is the first study to document improvements in social skills in unstructured play sessions for students who complete a school-based PEERS curriculum. This provides important evidence supporting the beneficial effects of PEERS that extend beyond social skills knowledge and survey-based ratings by parents and teachers.

428.041 *(Poster)* Gender Differences in Friendships, Social Behaviors and Intervention Response

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Background: Currently, the literature on both the characterization and treatment of autism largely focuses on males with ASD, whereby females with ASD remain unrepresented in clinical research (Head et al., 2014). As such, it is difficult to gain a clear understanding of friendships and sociability in females with autism. This illustrates a growing need to understand the unique socialization profiles of females on the spectrum and how they may respond differently to social skills treatment.

Objectives: The current investigation seeks to examine gender differences in both coded social behaviors and reported number of friendships before and after the completion of the Social Tools And Rules for Teens (START) intervention program for adolescents with ASD.

Methods: Twenty-nine adolescents (ages 11-16) and their parents participated in the RCT of the START program, a 20-week group experiential social competence and motivation intervention. At pre and post-intervention, adolescents engaged in 5-minute conversations with two unfamiliar, typically developing peers. Video-recorded conversations were coded for various social skills (i.e. questions asked, eye contact). Participants and their parents were asked to report an estimated number of teen friendships at each time-point. Mean number of friendships, pre-intervention social behaviors, and post-intervention changes were analyzed in female and male participant subgroups.

Results: Female participants initially asked significantly fewer questions (mean 6.8, SD 5.8) than males (mean 17.6, SD 18.5). However, both genders asked a similar number of questions post-intervention (female mean 25.9, SD 20.9; male mean 22.3, SD 18.4). Additionally, females made eye contact a mean of 41.0 seconds (SD 18.4) during a 5-minute conversation, while males exhibited a mean of 56.6 seconds (SD 19.0). Both subgroups increased eye contact duration after intervention (female mean 61.2 seconds, SD 20.3; male mean 73.9, SD 15.8). Female participants reported a greater number of friendships (mean 6.7, SD 5.4) at intake than male participants (mean 3.4, SD 4.0). After treatment, females reported a negligible increase in friendships (post mean 7.0 SD 4.5), while males endorsed a greater increase (post mean 5.6, SD 4.5). Parents reported comparable number of friendships for female (mean 1.4, SD 1.3) and male children (mean 1.4, SD 1.3), which was indicative of a greater discrepancy from female self-report. Parents also reported comparable gains in friendships post-intervention across females (mean 2.7, SD 1.5) and males (mean 2.9, SD 2.2).

Conclusions: Female participants experienced a larger gain in questions asked and a negligible change in endorsed friendship, which might be due to a ceiling effect. Furthermore, self-reported number of friendships was consistently higher than parental reports, although this discrepancy was larger for female participants. Overall, the findings of this RCT are indicative of comprehensive social improvements reflected in parent-reported, self- reported and observational social gains for both male and female teens. Additionally, these results add to the growing body of literature exploring differences in male and female presentations of autism (Hiller, Young & Weber, 2014; Lai et al., 2015) and suggest gender adaptations for the START group may be worth examining.

428.042 *(Poster)* Generalization of Clinic-Based Treatment Gains to Parents

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Background: While applied behavior analysis (ABA) as a treatment for individuals with autism spectrum disorder (ASD) has demonstrated effectiveness across a multitude of studies, generalization of gains is an area of concern. It is necessary to consider generalization from clinicians to parents, but it is also critical to program for generalization of skills mastered in a clinic to the home. Clinicians have many options they need to consider when making treatment recommendations to achieve optimal outcomes and deciding between clinic and home-based services can be one major element of a recommendation. Both the clinic and home have several advantages (Leaf et al., 2017) and it has been demonstrated that children learn more in a clinic-based setting (Dixon et al., 2017). When recommending and providing services in the clinic, it is necessary to show that skills are generalizing to the home with parents.

Objectives: The current study examined the impact of the amount of parent training received on the percentage of skills that generalized to the home and to the parent in a within-subject group design.

Methods: The study was conducted in two parts. In the first part of the study, we recruited 13 families of individuals with ASD (2-8 years old) who received the majority of their ABA services in a clinic-based setting (70%+). A retrospective baseline was completed by identifying exemplars that were mastered within the ABA program and indicated as not known by parents via the Skills® Assessment before instruction began. Those exemplars were then probed by the parent at home. In order to control for potential confounds during training in part 1, a second part of the study was conducted. In part 2, we recruited 30 families of individuals with ASD (2-8 years old) who again received the majority of their ABA services in a clinic-based setting (70%+). For each child, 20 exemplars were identified that were not known with the parent at home and were then taught by clinicians to the children at the clinic. After the exemplars were mastered in the clinic, generalization to the children's parents at the home was assessed. Measures of treatment fidelity were scored throughout the study (i.e. pre-treatment, intervention, post-treatment). Additionally, generalization strategies used by clinicians were collected.

Results: In part 1, for all participants at least 80% of the skills generalized from the clinic setting. There was a Pearson Correlation of 0.659 between the amount of parent training and the percentage of skills generalized indicating that the amount of parent training received is significantly correlated with percentage of skills generalized to the parent. Additionally, regression analysis found an r^2=0.4348 between the hours of parent training and skills generalized. In part 2, data are presented on the generalization from the clinic to the home, in correlation with parent training.

Conclusions: The results of this study show that the amount of parent training has a direct impact on the amount of generalization to the home and adds to the growing support for parent training throughout the ABA process.

428.043 *(Poster)* Group Intervention of Social Competence (SOCO) for School-Aged Children with Autism Spectrum Disorder

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Background: Group interventions have been widely used to improve the social skills of cognitively able individuals with autism spectrum disorder (ASD). Instead of targeting of only social skills training, this study aimed to focus on a wider concept of social competence. In addition, a multilevel approach including groups for both children and parents, and the co-operation with teachers, were adopted, and the intervention program was planned to last as long as 9 months.

The Social Competence Group Intervention for Children with Autism Spectrum Disorder (SOCO) was developed and manualised based on approaches of neuropsychological rehabilitation and of cognitive behavioural therapy and the three-component social competence model. The model differentiates social competence in three components: 1) social skills 2) social performance, and 3) social adjustment (Cavell, 1990, Fig 1.). Individual goals are defined according to the analyses of deficits in three components.

Objectives: The aim of this study was to describe the SOCO intervention and examine the feasibility and preliminary efficacy of the SOCO intervention.

Methods: This study was a pilot study with n = 23 boys (n = 16 intervention, n = 7 control) with ASD with a mean age of 10.5 years (SD = 1.3; range 7.9–12.7 years). The participants were drawn from a clinical sample of two different sites and from five different SOCO groups. The parents and teachers evaluated the children's social competence with the Social Responsiveness Scale (SRS) questionnaire in baseline, in short-term outcome (right after the intervention) and in long-term outcome (after 5 months or 2-3 years, depending on the site). The subscales of SRS were divided to present the components of social competence based on clinical and theoretical judgements of the SOCO development team. In addition, observations during the group sessions (in first, second and third trimester), evaluating the overtures and reactions, were administered in two groups (n=8).

Results: In short-term outcome, the parents of the intervention group reported improvements in social skills (social awareness: $Z = 2.007$, $p = .045$; r = 0.410) and social adjustment (social motivation: $Z = 2.249$, $p = .025$, r = .460), while in long-term outcome, they reported improvements in social skills (social awareness: $Z = 2.779$, $p = .005$, r = 0.507; social cognition: $Z = 2.446$, $p = .014$, r = .447). No significant changes were found for control group. The teachers reported increases in social performance (social communication: $Z = 1.978$, $p = .048$, r = .404) in short-term outcome (Fig 2). Findings also indicated the improvement in social overtures and reactions with the peers between the first and second trimester ($Z = 2.197$, $p = .028$, r = .594).

Conclusions: Although the evidence of the pilot study should be considered as preliminary due to small sample size, it gives indications of the feasibility of the SOCO and supports the usability of the social competence model as a theoretical background for group interventions in general. The study also demonstrated how the existing, widely used SRS-instrument can be adjusted to the model of social competence.

428.044 *(Poster)* Help-Move: A Home Exercise Program Led By Parents to Improve Movement in Children with Autism Spectrum Disorder

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Background: Children with Autism Spectrum Disorder (ASD) have clinically-significant gross motor impairments, including poor postural control and coordination (Boyd et al., 2010; Miller et al., 2019), and gross motor development has been shown to predict later expressive and receptive language ability in ASD (Bedford et al., 2015). There is an unmet need for physical therapy (PT) to address motor issues in ASD early in development (Benevides et al., 2016). Exercise programs have been shown to significantly improve motor control (Bremer & Lloyd, 2016; Karanth et al., 2010), quality of life (Toscano et al., 2018), socialization (Boyd et al., 2010), and cognitive skills (Karanth et al., 2010; Sotoodeh et al., 2017). However, most exercise interventions found in the literature are performed in clinic or school settings and require a significant amount of direct interaction with a clinician. Given the time and resource limitations faced by families with ASD (Benevides et al., 2016), new approaches to delivery of motor intervention are needed.

Objectives: We aimed to determine the feasibility and efficacy of a parent-led home exercise program to improve gross motor skills in ASD, as measured by dynamic and static balance, a standardized developmental motor test, and a parent report of functional motor skills.

Methods: This ongoing intervention includes two cohorts of 5 children aged 3-7 years with ASD and an age-matched wait-list control group of children with ASD. All participants had a prior educational or medical diagnosis of ASD were screened for comorbidities related to motor control and excluded if they were taking medications known to affect movement. A standardized developmental motor test and balance tests are administered pre-, mid- (at 2 weeks and 5 weeks), and post-intervention. Parents completed the home exercise program (3 days per week for 8 weeks for a total of 30 minutes. Exercises included warm-ups, strengthening, balance, coordination, and cool down. Parents tracked adherence to the exercise program and reflected on feasibility and progress in a log provided by the research team. Researchers performed fidelity checks at 2 and 5 weeks after the start of the intervention to ensure adherence to the protocol and correct execution of the exercises.

Results: Data analysis is ongoing through completion of the second cohort. We will compare pre- and post-intervention scores on the developmental motor assessment, the balance tests, and the parent-report of motor ability. Outcome measures include postural stability data (e.g., center of pressure sway and variability) collected during balance tests, as well as scores on the developmental motor assessment and parent report of motor ability. We will also evaluate the individual trajectory of motor skills across the study period. We predict improvement across all measures over the course of the intervention, and correlations between postural stability variables and clinical assessment scores.

Conclusions: If results support our hypotheses, this will suggest that a parent-led, PT-mediated home exercise program is an effective method of improving gross motor control for young children with ASD. This approach could reduce barriers to motor intervention for families who have limited time and resources.

428.045 *(Poster)* Impacts of Aerobic Exercise Versus Relaxation on Pivotal Response Training Responder Profiles in Nonverbal and Minimally Verbal Children with Autism

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Background: Approximately 33% of children on the autism spectrum remain nonverbal or minimally verbal throughout their lives—resulting in decreased quality of life, reduced self-determination, and increased costs to society. There are several evidence-based interventions—including Pivotal Response Training (PRT)—for increasing speech-language skills and development for individuals with autism. However, children's responsiveness to these interventions varies. For example, research has identified social-behavioral profiles associated with less responsivity to play-based, naturalistic, behavioral speech interventions, such as PRT. Specifically, less responsive children tend to exhibit high avoidance, low approach, low rates of toy contact, high nonverbal self-stimulatory behavior, and low verbal self-stimulatory behavior. Identifying ways to increase responsiveness for these children might improve speech-language and long-term outcomes.

Objectives: Previous research has demonstrated that aerobic exercise reduces stress and anxiety, improves attentional focus and engagement, and decreases non-verbal self-stimulatory behaviors. The current study is designed to test the hypothesis that aerobic exercise will lead to improved PRT responder profiles and increased communicative acts in nonverbal and minimally verbal children.

Methods: Using a within-subjects randomized controlled trial (RCT) design, PRT response profile behaviors are scored on two separate sessions 7 to 14 days apart. One session is immediately preceded by aerobic exercise; the other is immediately preceded by relaxation in a sensory room. Condition order is randomized across participants. To date, we have completed testing 5 participants, initiated testing of 5 additional participants, and screened 4 additional qualifying participants. We will complete testing of n=24 participants by April, 2020.

Results: Descriptive statistics were conducted for all five profile behaviors across exercise and rest conditions: toy contact (Exercise *M* = 16.80, *SD* = 9.15; Rest *M* = 14.40, *SD* = 9.81), approach (Exercise *M* = 3.00, *SD* = 3.16; Rest *M* = 4.00, *SD* = 3.87), verbal self-stimulatory behavior (Exercise *M* = 16.00, *SD* = 9.62; Rest *M* = 16.40, *SD* = 10.31), avoidance (Exercise *M* = 5.80, *SD* = 6.50; Rest *M* = 9.00, *SD* = 8.54), and nonverbal self-stimulatory (Exercise *M* = 15.60, *SD* = 4.72; Rest *M* = 18.00, *SD* = 10.68). An analysis of variance (ANOVA) including condition (aerobic exercise, relaxation) and the five components of the response profile (approach, toy contact, verbal self-stimulatory behavior, reverse-coded avoidance, reverse-coded nonverbal self-stimulatory behavior) will be conducted using the final sample (n=24), in order to determine whether or not there are any main effects or interactions indicating improvements in PRT responder profiles. Figure 1 presents means and standard errors for each response profile component for the first 5 participants, which reflect non-significant mean differences in avoidant (lower), nonverbal self-stimulatory behavior (lower), and toy contact (higher).

Conclusions: Aerobic exercise has potential to be a supportive, supplementary intervention to accompany PRT. Specifically, exercise might improve responsiveness to play-based speech-language intervention by reducing stress/anxiety, increasing attentional focus, reducing nonverbal self-stimulatory behaviors, and otherwise changing social interactivity. This on-going, within-subjects clinical trial will test the hypothesis that a single bout of aerobic exercise—immediately preceding a PRT session will improve responder profiles and increase communicative acts.

428.046 *(Poster)* Impacts of Job Readiness Skills Training on Young Adults with Autism: A Qualitative Analysis

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Background: Although employment is fundamental to the well-being of individuals with autism spectrum disorder (ASD), less than 20% of young adults with ASD are employed resulting in their limited employment-readiness. While employment-related intervention studies exist that focus on soft and hard skills development across employment preparation, obtainment and retention, there is no intervention that focuses on both soft and hard skill development specifically applicable to employment preparation, obtainment and retention for individuals with ASD. Employment Preparation and Application Skills Support (EPASS) is an employment readiness training program designed to improve the employment-readiness of young adults with ASD. Specifically, EPASS focuses on teaching skills important for obtaining and maintaining employment, including: searching for a job, conducting informational interviews, personal branding, applying for a job, developing a resume and cover letter, pre-employment screenings, developing job interview skills, practicing mock interviews, learning disability law and accommodations, and maintaining a job. The 12-session EPASS intervention was delivered during spring semesters at a community center conference room to three cohorts of eligible participants over the course of three years.

Objectives: The purpose of this study was to understand the experiences of transition-aged youth with employment readiness pre and post participation in the three-year pilot EPASS intervention. We explored participants experiences to assess the impact of the pilot EPASS intervention on their employment readiness.

Methods: Following approval from the university's Institutional Review Board, convenience sampling was used to recruit transition-aged youth with ASD (17-25 years of age) from a university disability resource center and a local school district. A qualitative descriptive design (Sandelowski 2010) was employed with 25 transition-aged youth with ASD and data were collected using semi-structured interviews.The data were analysed to identify themes as they emerged.

Results: Using Braun and Clark's (2006) thematic analysis, five major themes were identified: (a) Experiences with Employment pre EPASS Intervention; (b) Expectations of the EPASS Intervention; (c) Experiences with the EPASS Intervention; (d) Future Application of Acquired EPASS Skills; and (e) Recommendations for the EPASS Intervention. Overall, transition-aged youth with ASD reported significant improvement in both soft and hard skills for employment readiness post-intervention. Participants also provided recommendations that might further advance the impact of the EPASS intervention.

Conclusions: Employment-related interventions such as EPASS is significant to the employment achievements of transition-aged youth with ASD. Future intervention studies could focus on applying experiential learning strategies and video-based instruction to address additional work related and training gaps for transition-aged youth with ASD (e.g., managing personal expenses; conflict management in the workplace; securing volunteer, internships and actual job opportunities). In addition, developing instruments that measure work-related social function, job readiness and performance-based skills could assist professionals in making placement decisions relating to participation in EPASS or other employment related interventions. Finally, encouraging families and caregivers to support the employment and training needs and programs for transition-aged youth is significant to their optimal quality of life.

428.047 *(Poster)* Individualized Learning with Video-Based Instruction When Teaching How to Solve Fractions to Middle School Students on the Autism Spectrum

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Background: Students with autism spectrum disorder (ASD) commonly exhibit challenges with mathematics, which is a necessary skill for not only college and career readiness, but also for everyday independent living skills. There is limited research in this area among students with ASD, with much of the literature focusing instead on strategies for students with high-incidence disabilities, e.g., learning disabilities. With the increasing number of students with ASD included in general education settings, it is necessary to determine effective mathematics support strategies that can be individualized for each student's needs and can be feasibly used in inclusive settings.

Objectives: The purpose of this study was to evaluate the effects of an individualized intervention package including point-of-view video modeling (POVM), concrete manipulatives, guided practice, and a self-monitoring checklist, on the fraction problem-solving accuracy of three middle school students with ASD.

Methods: A multiple probe across students design of single-case research design (SCRD) consisting of baseline, intervention, and generalization phases, was used to identify the effects of the intervention package on the fraction problem-solving accuracy of three students with ASD. One female and two male students, ages 12-13, who were each diagnosed with ASD and performed well below grade level in mathematics, participated in this study. During each session, students were evaluated on their accuracy on a 5-question worksheet, which included questions on adding and subtracting simple proper fractions. Baseline sessions consisted of students completing a worksheet with no instructor assistance. During intervention, students watched the POVM which demonstrated how to solve the type of fraction problems on their worksheets using concrete manipulatives (fraction tiles). After watching the POVM, students completed a guided practice session with the instructor using fraction tiles and a self-monitoring checklist that listed the problem-solving steps used in the POVM clip. Then students used the fraction tiles and self-monitoring checklist to independently complete a worksheet with different fraction problems each time. Once students reached the mastery criterion of 100% accuracy for two consecutive sessions, they completed generalization probes which followed the same conditions as baseline. The generalization probes evaluated whether students would generalize solving simple proper fractions to solving whole proper fractions.

Results: All three students improved their accuracy of fraction problem solving from baseline to intervention, and two of three students demonstrated generalization of the skills to whole proper fractions. The weighted average Tau-*U* for baseline/intervention phases was Tau-*U*= 1.0, $p<0.0001$, 90% CI= [0.6418,1], demonstrating the overall positive effect of the intervention across students. The weighted average Tau-*U* for all phases (baseline/intervention and baseline/generalization) resulted in 0.785, $p<0.0001$, 90% CI= [0.4756, 1].

Conclusions: The intervention package consisting of POVM, concrete manipulatives, guided practice, and a self-monitoring checklist was effective in improving the accuracy of fraction problem-solving among three students with ASD, suggesting that this may be an effective individualizable strategy for teachers to support students with ASD in a variety of settings.

428.048 *(Poster)* Ipads for Teaching Graphic Symbols to People with ASD

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Background: Individuals with autism spectrum disorders (ASD) who demonstrate significant cognitive and communication needs (CCN) have been found to benefit from interventions using augmented aids such as graphic symbols for enhancing participation. Augmentative and alternative communication (AAC) has been considered to be effective for individuals with ASD and CCN as they have been considered to have enhanced visual perception. However, recent research has demonstrated differences in the process of learning graphic symbols, such as recognizing abstract similarities, that may contribute to their difficulties in their ability to use AAC successfully and in the development of social skills. Most of the studies incorporating learning of graphic symbols among individuals with ASD with CCN was conducted with children. In light of emerging research suggesting increased cognitive abilities along life trajectory, there is still little knowledge relating to learning of graphic symbols by individuals with ASD and CNN who have the potential for using AAC. Technology may enhance graphic symbol learning and participation among individuals with ASD who have CCN.

Objectives: The purpose of the study was to investigate if using an iPad equipped with an app created for the study, that included explicit strategies aimed for increasing learning of graphic symbols would increase learning of graphic symbols by children and adults with ASD, who have CCN.

Methods: 25 adults (age 18-40) and 25 children (age 7-12) with ASD, who demonstrate significant CCN were presented with a set of tests and an application for learning graphic symbols. Fifteen sets incorporating various types of symbols were presented in the application. Each symbol was presented using several screens incorporating a process developed for enhancing recognition of the symbols using various processes of symbol identification such as matching to sample and video-clips, a passive and a dynamic presentation of symbol parts, and an active assembly of the symbol.

Results: The participants were able to use the iPad with little to no assistance to learn graphic symbol recognition. All participants were able to focus for the duration of the educational software for the 30 minutes required for the fulfillments of the activity. Participants in both groups, adults as well as the children were able to identify the meaning of many of the 15 symbols by the end of the task.

Conclusions: The use of the iPad as a technology enabled control of the stimulus and the distractors, and removal of some of the communication barriers, thus, increasing the participants' ability to learn the symbols. Even participants reported to have significant limitations in their ability to sit and focus, were able to participate in the educational task presented on the iPad for 30 minutes and complete the whole activity. Results of the study demonstrate an increase in the ability to identify the meaning of new symbols learned using the iPad. The use of the iPad for learning symbols enabled participants to improve their learning of symbols though the application created for them.

428.049 *(Poster)* Job Interviewing and Vocational Outcomes Among Autistic Youth

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Background: Vocational outcomes among autistic youth are critically low. Job interviews are a particularly difficult component of the job seeking process that require complex social communication ability. Moreover, few studies highlight whether interviewing may be critical to obtaining vocational outcomes such as competitive employment or internships. Here we report on whether autistic youth have ever had a competitive job during their lifetime and if they recently interviewed for a job. Second, we will report on whether autistic youth currently have a competitive job, unpaid internship, or paid internship and whether the autistic youth completed an interview to obtain this job or internship. Third, we report on the mean hours worked and wages earned. Last, we report on the types of competitive jobs they obtained.

Objectives: Our study sought to discover whether autistic youth are participating in job interviews to secure vocational outcomes such as jobs and internships.

Methods: We conducted an open trial to evaluate the effectiveness and implementation of a virtual reality job interview training (VR-JIT) tool. This study is an evaluation of the data collected at baseline that represent student-level vocational interviewing and outcomes among the n=44 high schools that implemented VR-JIT within employment-related transition services. School staff (n=29 teachers, n=35 administrators) completed surveys reporting on the backgrounds and employment history of n=138 autistic students compared to n=518 students with non-autistic educational disabilities. Diagnoses were established using individualized education plan (IEP) classification. School teachers or administrators completed surveys assessing background characteristics (e.g., age, race, reading level, educational disability category) and employment and internship history (e.g., current and lifetime employment, interviewing history, hours worked per month).

Results: Results suggest 17.5% of autistic youth were currently employed (compared to 21.7% of non-autistic youth), and 91.7% of the employed autistic youth interviewed prior to obtaining their job (compared to 88.8% of the non-autistic youth). We also observed that autistic youth, as compared to non-autistic youth, had a lower lifetime employment rate (29.2% vs. 43.3%; X2=8.9, p=0.003) and trended towards working fewer hours (m=48.5 [sd=31.0] vs. 62.2 [sd=34.5], T=1.8, p=0.078). We observed that autistic youth, as compared to non-autistic youth, worked fewer hours at their paid internship (m=11.6 [sd=6.0] vs. 24.5 [sd=15.3], T= -4.1, p<.001); earned a lower hourly wage at their paid internship (m=4.92 [sd=0.9] vs. 6.36 [sd=2.3], T= -3.0, p=0.005); and trended towards working fewer hours per month at their unpaid internships (m=15.4 [sd=20.2] vs. 23.8 [sd=24.4], T= -1.7, p=0.092).

Conclusions: In summary, our results revealed that autistic youth receiving employment-focused transition services had a current employment rate of 17.5%. With respect to autistic youth in this study who were currently employed, we observed that the vast majority of them interviewed prior to getting hired (91.7%). It appears that the rate of participating in a job interview speaks to the importance that training in job interview skills is a critical target for transition services. The delivery of evidence-based job interviewing training is a major gap in transition services for autistic youth.

428.050 *(Poster)* Kneuroknits: Evaluating Social Participation and Anxiety Response Associated with Participation in a Knitting Group for People with Neurological Conditions (Pilot Study)

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Background: Knitting as a creative practice has a reputation for being therapeutic. There are many programs that use crafts as a method of creating social community and reducing anxiety for youth; however, there is no existing research that demonstrates these benefits. We designed a novel study to explore the benefits of a social skills knitting group on engagement and anxiety for youth with neurodevelopmental disorders.

Objectives: 1. To evaluate the social engagement experience of youth with neurological conditions participating in the KneuroKnits program.

2. Evaluate the impact of KneuroKnits intervention on anxiety levels of participants.

Methods: We designed a 4-week knitting group for youth with neurodevelopmental disorders and acquired brain injuries. Each session included a lesson involving a knitting skill and a social skill. To evaluate social engagement, we used the Self-reported Experience of Activity Settings (SEAS) questionnaire at the first and final sessions. The five subcategories of the SEAS (Personal Growth, Psychological Engagement, Social Belonging, Meaningful Interactions and Choice & Control) were analyzed following the first and the last session. Qualitative interviews were conducted with participants, parents, and facilitators in the month following the final session and were analyzed using an interpretive phenomenological approach to outline commonly occurring themes in social engagement. To evaluate anxiety levels, participants completed the State-Trait Anxiety Inventory (STAI) at the beginning and end of the first and final sessions, respectively, and the Symptom Checklist-90-R (SCL-90) anxiety subscale; qualitative analysis included themes involving levels of anxiety from the interviews.

Results: There were 14 total participants with a mean age of 17.4 ± 2.2 years. Participants had primary diagnoses of ASD (n=9); acquired brain injury/concussion (n=4), and developmental coordination disorder (n=1). Social engagement results for the SEAS questionnaire showed a general increase in mean scores of all subcategories with a significant increase in the category of "Meaningful Interactions (p=0.02). This quantitively demonstrated that the group had an impact on creating meaningful social connection. Qualitative analysis of the interviews revealed three commonly occurring themes: The balance of organic and facilitated social interaction, a sense of community from shared experience, and direct benefits of knitting (pride, productivity, relaxation, a choice to be social). For the evaluation of anxiety levels, the STAI demonstrated a significant decrease in anxiety following both Session 1 (p=0.02) and Session 4 (p=0.006). The SCL-90-R Anxiety subsection scores significantly decreased between the first and final session (p=0.01). Participants voiced that the sessions made them feel calmer.

Conclusions: This knitting group merged a creative skill and social skill, and was novel in its approach to studying social engagement and anxiety within this population. Our study found that participants, their families and facilitators found KneuroKnits to be a valuable and rewarding program. Further study is needed in a larger sample to confirm our findings.

428.051 *(Poster)* Learning to Play and Emote: A Pilot Intervention for High-Functioning School-Aged Children with Autism Spectrum Disorder

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder marked by socio-emotional deficits beginning in early childhood, greatly impacting functioning throughout development. Pretend play abilities in childhood are indicative of adaptive functioning and emotion regulation skills in later life (Russ, 1998; 2014), and the use of a pretend play intervention with typically developing children has shown to significantly increase cognitive and affective skills in play (Hoffman and Russ, 2012). Research has demonstrated that preschool-aged children diagnosed with ASD have impaired play skills compared to typical peers, but following a play intervention are able to execute improvements in these skills that generalized to increased social functioning at follow-up (Kasari, 2006; 2012).

Objectives: The present pilot study implemented an in-person pretend play intervention to a stratified sample of school-aged children diagnosed with high-functioning ASD (HF-ASD), with the goals of increasing children's cognitive and affective skills in play, while examining if these changes generalized to their learned emotional understanding abilities and social skills.

Methods: The present study involved a play intervention administered in-person to high-functioning children diagnosed with ASD, ages 6 to 9. Twenty-five children were recruited (intervention group = 18, waitlist control group = 7). Baseline and outcome visits were completed to obtain measures of cognitive and affective play skills, emotional understanding abilities, and social skills, as measured by the Affect in Play Scale (APS; Russ, 1993;2014), the Kusche Affective Inventory, Revised (KAI-R; Kusche et al., 1988), and the Social Skills Inventory System, Parent and Teacher Forms (SSIS; Gresham and Elliott, 2008), respectively. Intervention sessions were 15-20 minutes in length, administered weekly for 5 weeks. The play intervention was adapted from a validated method for typically developing children (Russ, Moore, and Farber, 2004), wherein the play facilitator uses pretend story stems to play with the child individually, employing techniques such as modeling, scaffolding, praising, reflecting emotions, and following the child's lead.

Results: A series of mixed factorial repeated measures ANOVAs were used to evaluate within and between group differences from baseline to outcome. Results indicated that children in the intervention group significantly increased their cognitive skills in play, while the waitlist control group made no changes on these variables. Additionally, the intervention group significantly increased in their ability to describe personal emotional experiences, while the waitlist control group did not demonstrate any changes. Neither group exhibited any meaningful changes in affective skills in play nor general social skills (per teacher report) from baseline to outcome.

Conclusions: Findings from the present pilot study demonstrate the positive impact of a play intervention on cognitive play skills and emotional understanding abilities in children with HF-ASD, while affective skills in play and social skills (per teacher report) were not influenced. Limitations included the small sample size for the comparison control group, as well as lacking parent report on children's social skills. Results have important implications for the efficacy of a short, easily facilitated play intervention for children with HF-ASD, indicating that increasing their play abilities can generalize to increases in children's emotional understanding abilities.

428.052 *(Poster)* Mental Health Interventions for ASD: A Systematic Review of Intervention Adaptions and Community Implementation Outcomes

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Background: Co-occurring psychiatric conditions that necessitate mental health (MH) treatment are common among youth with ASD. There has been an increasing emphasis on MH treatments for ASD over the past two decades, and data supporting the efficacy of such interventions (Vasa et al., 2018; White et al., 2018). The need to adapt or modify existing interventions prior to implementation for use with youth with ASD is common (Moree & Davis, 2014). However, the nature of such adaptations and associated impact on implementation outcomes (e.g, acceptability, feasibility, fidelity) is unknown. Further understanding of the nature and type of adaptions and key community implementation outcomes is critical to responding to calls and efforts to improve the translation of evidence-based interventions (EBIs) for ASD in the community (Wood et al., 2015).

Objectives: This systematic review examines the existing research testing intervention targeting MH outcomes for children with ASD to characterize the nature and types of adaptions to existing EBIs prior to delivery, including in the community, and implementation outcomes examined.

Methods: A systematic review was preformed to identify published articles testing interventions targeting MH systems specifically for youth ASD, including efficacy and effectiveness trials. Web of Science, Scopus, PubMed, PsychINFO, and CINAHL Plus databases were searched. Data extraction included a) study setting, design, and methodology; b) intervention target, participants, format; c) whether the intervention was developed or adapted for ASD; d) the nature and function of adaptions; e) implementation outcomes (e.g., appropriateness, feasibility, fidelity). Child, family, and provider characteristics were also extracted.

Results: 5629 articles were screened by five reviewers, resulting in inclusion of 121 articles, representing more than 35 unique or name-brand MH interventions primarily examined as part of an efficacy (67% of articles) or effectiveness (33% of articles) trial. Quantitative, qualitative, and mixed-method approaches were used in 53%, 2%, and 35% of studies, respectively. Results indicated that 38% and 30% of included articles examined an intervention with anxiety or disruptive or challenging behaviors as the primary MH target. The majority (79%) of the interventions targeted school-age youth, with 50% and 10% of interventions targeting adolescents and transition age youth, respectively. Forty-eight percent of articles included interventions that were originally developed for ASD whereas 54% examined existing MH interventions adapted for youth with ASD. The majority of adaptions were designed to make interventions more appropriate for ASD (e.g., more visuals, emphasis on generalization). Within community effectiveness trials, few of the specified adaptations aimed to improve the fit of the intervention with provider training needs or service settings. The use of existing theories or frameworks to guide these adaptations was rare. Finally, fidelity was the most commonly examined implementation outcome, with feasibility and acceptability less commonly examined.

Conclusions: This systematic review enumerated the ways in which MH interventions are adapted for ASD, and the nature and types of implementation outcomes examined. Findings point to key recommendations for future research, including further specification, reporting, and application of existing theory during intervention adaptation and examination of key implementation outcomes beyond fidelity.

428.053 *(Poster)* Mixed Martial Arts Training Improves Social Skills and Lessens Problem Behaviors in Children with Autism Spectrum Disorder

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Background: Difficulties with social functioning are a defining feature among children with Autism Spectrum Disorder (ASD). However, adaptive social skills can be acquired, and problematic social behaviors can be lessened through the use of interventions within the community.

Objectives: The present study evaluated the effectiveness of a mixed martial arts (MMA) intervention for improving social skills and lessening problematic social behaviors in a sample of school-aged (8-11 years) children with ASD.

Methods: Children with ASD were randomly assigned to either a MMA intervention or a waitlist control (WLC) condition after an initial lab visit where parents reported on child social functioning (pre-test). Children in the MMA group then began the intervention at a local martial arts studio. The intervention ran about 13 weeks (26 sessions) and included typically-developing peers who assisted by interacting with the children with ASD and modeling appropriate social behaviors. The WLC group did not participate in any martial arts between pre- and post-test assessments. After the intervention completed, both groups returned to the lab where parents reported on social functioning again (post-test).

Results: Results indicated that the MMA group had significantly higher social skills and lower problem behaviors as reported by parents at post-test compared to the WLC group and compared to pre-test scores.

Conclusions: The peer-mediated intervention appeared to be successful in improving the social functioning of children with ASD. Implications and future directions for peer-mediated martial-arts interventions for children with ASD will be discussed.

428.054 *(Poster)* National Clearinghouse on Autism Evidence & Practice (NCAEP): Examining the Participation of Individuals with ASD across Racial and Ethnic Groups and Gender in High Quality Intervention Studies

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Background: The National Professional Development Center on ASD (NPDC) completed a review of literature published between 1990-2011 and identified 27 evidence-based practices (EBPs) for individuals with ASD from birth through age 22. A team of researchers analyzed data reported about race, ethnicity, and nationality (REN) from articles included in the previous review (West et al., 2016) and found that few articles reported information on REN (17.9%). The National Clearinghouse on Autism Evidence & Practice (NCAEP) is in the final stages of updating the previous review of literature to include articles published from 2012-2017. In addition to determining any new and emerging EBPs, it is also important to assess the reporting and inclusion of individuals with ASD across different REN, as well as examine the representation of participants across gender and/or sex.

Objectives: The objectives of this session are to (1) determine the proportion of studies that reported data on REN and sex and/or gender, and (2) examine the proportions of studies and participants within studies based on these characteristics.

Methods: The NCAEP team used the same search strategy as the 1990-2011 systematic review, using key search terms related to autism (e.g., ASD, Asperger, autistic) and intervention (e.g., education, treatment, strategies). The inclusion criteria are experimental or quasi-experimental studies that examine behavioral, educational, or developmental (i.e., non-medical) interventions with participants with ASD from birth through 22 years of age. The research team followed a rigorous systematic review process including initial search, screening, full-text reviews, quality reviews, and data extraction. During data extraction, the research team used the procedures of West et al. (2016) to extract data REN and gender/sex from all high-quality studies. Research assistants were trained to reliability. Over 90% of the articles have been coded for the REN and gender/sex data, and 25% of those articles have been coded for reliability. Coding will be complete in late fall 2019.

Results: Of the 580 articles currently coded for participant information, 530 of all articles report information on gender or sex (91.4%), including 92.5% of single-case design (SCD) studies and 87.6% of group studies. The proportion of participants who were reported as male was 84.6% overall, and 82.6% and 85.0% for SCD and group studies, respectively. Only 179 of 580 articles report information on REN (30.9%), with reporting of 25.2% in SCD studies and 48.9% in group studies. The proportion of participants who were reported as non-white was 38.0%. Table 1 has additional information about the studies and participants reporting of REN data for participants.

Conclusions: Overall, there has been an increase in the reporting of REN data between the 1990-2011 and 2012-2017 reviews, moving from 17.9% to 30.9% . However, the proportion of articles reporting REN data is still strikingly low. Notably, the reporting has greatly improved in group studies, moving from 28.2% to 48.9%.There was little difference in the proportion of non-white participants included in research between the original review (36.5%) and the recent update (38.0%).

428.055 *(Poster)* National Clearinghouse on Autism Evidence & Practice (NCAEP): Identifying New Evidence-Based Practices for Children and Youth with ASD

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Background: The National Professional Development Center on ASD (NPDC) completed a review of literature published between 1990-2011 and identified 27 evidence-based practices (EBPs) for individuals with ASD from birth through age 21. These findings have had a broad impact on the field since their publication in 2015 (e.g. most cited manuscript in JADD in 2017; identified by IACC as one of the top 20 scientific advances in ASD research). These findings are dated, however, and the National Clearinghouse on Autism Evidence and Practice (NCAEP) conducted an updated review of the literature and new findings related to the identification of EBPs will be available for IMFAR 2020.

Objectives: The objectives of this session are to (1) identify new practices that have met the criteria for identification as an evidence-based practice, and (2) identify for what outcomes the practices have an effect.

Methods: The NCAEP team used the same search strategy as the 1990-2011 systematic review, for peer-reviewed articles using variations of the terms (1) autism(e.g., ASD, Asperger) and (2) intervention (e.g., treatment, program, education). The inclusion criteria are experimental or quasi-experimental studies (single-case design and group design) that examine a behavioral, educational, or developmental (i.e., non-medical) intervention for individuals with ASD from birth through 22 years old. The following steps were completed for the systematic review: (1) search of 9 databases, (2) deduplication of results, (3) title/abstract review, (4) full-text review for inclusion, (5) quality review, determination of effects, and preliminary data extraction by trained external reviewers, and (6) consensus decision for quality and presence of effects as needed. The NCAEP team is currently in the process, of reviewing and finalizing the data extraction, which is combining the information about effects, interventions, outcomes, and participants across the 1990-2011 and 2012-2017 reviews.

Results: The 2012-2017 review started with over 31,000 articles in the initial search. Currently, 631 articles have met quality criteria and demonstrate at least some positive effects. The participant data indicates that more studies include 6-11.9 year-olds (59%) and 3-5.9 year-olds (45%) participants, with fewer studies including 12-14.9 year-olds (27%), 15-18 year-olds (18%), and the fewest studies including children under 3 years old (9%) and 19-22 year-olds (5%) . The data also shows that social (26%), communication (29%), and challenging behavior (20%) domains are the most common intervention targets.

Ongoing analysis indicates the identification of at least two new EBPs (behavioral momentum and Self-Regulated Strategy Development) and the reorganization and reclassification of three more (including Augmentative and Alternative Communication). Additional “named” interventions (e.g. Reciprocal Imitation Training, PEERS) that have met a threshold for evidence have been identified as well.

Conclusions: The updated systematic review of behavioral and developmental interventions is an important step as research and practice continue to move forward to facilitate the best outcomes for children and youth with ASD. New evidence will provide additional data related to the efficacy of new interventions, better identify practices that are effective with young adults with ASD, and highlight outcome areas with limited research investment (e.g. mental health, vocational).

428.056 *(Poster)* Navigation-Guided Repetitive Transcranial Magnetic Stimulation (rTMS) over Ventral Attention Network of Neurodevelopmental Disorders.

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Background: Attention is the initial phase of information processing and thus a neural basis of flexible behavioral adaptation. Neurodevelopmental disorders such as autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) exhibit distinct and shared attentional deficits. However, neuromodulation of the attention networks has not been sufficiently established in these neurodevelopmental disorders.

Objectives: The present preliminary study was aimed to explore any changes in attention shift, following a single session of navigation-guided repetitive transcranial magnetic stimulation (rTMS) over the ventral (bottom-up) attention network in healthy adults of typical neurodevelopment (TD), ASD adults, and ADHD adults.

Methods: As a prior brain information, structural MRI, functional MRI (fMRI), resting-state fMRI, and diffusion tensor imaging (DTI) were scanned before rTMS session. Based on structural MRI data, rTMS was navigated to right anterior temporoparietal junction (TPJ) (55, -44, 18 in MNI coordinates), a hub of the ventral attention network. rTMS protocols were intermittent theta burst stimulation (iTBS), continuous theta burst stimulation (cTBS), and sham stimulation with a sham coil. Neuropsychological test battery, including attention shift, processing speed, continuous performance test, face recognition, and spatial working memory, was evaluated before and after a rTMS session.

Results: In TD adults (n=16), attention shift scores got worse following both iTBS and cTBS, as compared with sham stimulation. In contrast, adults (N=13) with ASD and/or ADHD showed improvement of attention shift scores following iTBS and cTBS. Moreover, it should be noted that some adults responded to facilitatory iTBS, while some others responded to inhibitory cTBS. In terms of the pre-existing functional connectivity between right anterior TPJ and right middle frontal gyrus (MFG) within the ventral attention network, there was a tendency that subjects with the stronger connectivity responded to inhibitory cTBS and subject with the weaker connectivity responded to facilitatory iTBS. Neuropsychological tests of continuous performance test, face recognition, and spatial working memory did not change after any rTMS protocol over right anterior TPJ in both study groups.

Conclusions: The worsening of attention shift observed in TD adults could be attributable to a potential destabilizing effects of facilitatory and inhibitory rTMS protocols on the ventral attention network, because the network of TD adults seems to be tuned and optimized for attention shift. On the other hand, the ventral attention network of adults with ASD and/or ADHD may not be properly tuned and thus facilitatory or inhibitory rTMS could adjust the network into a normal range, resulting in improvement of attention shift scores. It could be speculated that prior MRI information may be useful to optimize and personalize rTMS protocol over the ventral attention network of neurodevelopmental disorders.

428.057 *(Poster)* Observed Effects of the PEERS Social Skills Intervention for Adolescents with ASD: A Predominantly Latinx Sample

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Background: Adolescents with ASD have difficulty initiating and maintaining conversations with peers, affecting their ability to develop friendships (Reichow & Volkmar, 2010). Social skills interventions targeting conversational skills have demonstrated effectiveness (Laugeson et al., 2009, 2012), but few studies have utilized objective behavioral outcome measures. Using behavioral measures to assess treatment outcome can provide better evaluation of skill generalization and overcome biases in parent- and self- report (Lord et al., 2005). The Contextual Assessment of Social Skills (CASS; Ratto et al., 2011) is a commonly used observational measure of conversational skills following the PEERS social skills program (e.g., Dolan et al., 2016; Rabin et al., 2018), but its specificity to the skills targeted has been under-examined.

Objectives: The purpose of this study is to evaluate the utility of an adapted version of the CASS to measure changes in conversational skills following a social skills intervention with a Latinx sample of adolescents with ASD.

Methods: Participants included seven adolescents with ASD (six males; 71% Latinx), ages 11-16 (*M*=13.3, *SD*=1.9) with average cognitive abilities (WASI-2; *M*=104.1, *SD*=17.4). Adolescents and parents attended concurrent but separate weekly 90-minute PEERS sessions over 16 weeks. Adolescent groups were held in English; parent groups were conducted in English and Spanish simultaneously. Participants had 3-minute filmed interactions with an unfamiliar peer (i.e., a research confederate) at pre- and post- intervention, and were rated on the original nine CASS items by two blind independent raters. Seven additional items were added to coding to better represent the specific skills taught, including the number of open-ended questions and follow-up questions asked, and the appropriateness of questions and comments. Average inter-rater agreement for the combined 16 items was 0.76. Filmed interactions for a second cohort of eight adolescents (currently underway), as well as follow-ups with the first cohort, will be coded using the adapted CASS.

Results: Though paired samples t-tests revealed parent-perceived improvements in social skills (SSIS; $p<.01$) and social responsiveness (SRS-2; $p=.02$) following treatment, preliminary analyses did not demonstrate significant changes in observed conversational skills. Although the small sample size in this preliminary study limits conclusions, we offer two interpretations. First, the original CASS scores may not capture the specific skills that would be expected to change following PEERS. Second, for the newly added items, group level analyses may not reflect meaningful change in a heterogeneous group. For example, an increase in the number of questions asked may reflect an improvement for some, while a decrease may reflect a positive change for others, as their baseline levels of question asking may have been inappropriately high.

Conclusions: Informant reports of social skills gains after intervention are prone to bias, and may differ from actual performance (Mcdonald, 2008). Integrating behavioral measures with parent- and self-report provides the best evidence of treatment effectiveness. Meaningful behavioral measurement following group-based social skills intervention is challenging, due to the heterogeneity of social errors among participants. With follow-up data and a larger sample size, observed conversational improvements will be analyzed in the context of individual social needs.

428.058 *(Poster)* Open Trial of College Success Intervention: Increasing Executive Functioning and Social Skills in College Students with ASD

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Background: About 50,000 students with autism spectrum disorder (ASD) exit high school annually. Unfortunately, the outlook for the transition to adulthood is bleak, with over 66% of young adults with ASD failing to transition into postsecondary educational (PSE) institutions or employment shortly after leaving high school. For those who do participate in PSE, approximately two thirds do not obtain a degree. As the neurobiological basis of autism is further investigated, new interventions are focusing on remediating the core deficits specific to social and cognitive dysfunction in ASD. Impairments in executive functioning are considerable in individuals with ASD , and it is likely that these impairments are a leading cause of disability in ASD.

Objectives: A new, innovative program was developed, College SUCCESS to teach cognitive executive functioning and social cognitive functioning skills that are often referred to as “soft skills” necessary to succeed in college. This open trial research study investigated college students cognitive and social skills, functional ability and education outcomes as a result of receiving the College SUCCESS curriculum. Feasibility, acceptability and satisfaction data were collected.

Methods: A total of 25 students (μ= 22.6 SD=4.1 yrs; range 18-34yrs) participated. The participants were male (76%), race/ethnically diverse (64%), average IQ ((μ= 64.6 SD=15.6), 72% participated on University and 28% on Community College campuses, 76% receiving Disability Services. 32% received MH counseling and 13% on medication. The College SUCCESS curriculum was delivered 1-2xs totaling 90-180minutes per week (differing for quarter vs semester campuses) via an active group. Skills taught include executive functioning: attention, learning, memory, prospective memory, cognitive flexibility, problem solving, goal oriented thinking and contextual awareness and social cognition: social conversation (giving and receiving compliments, feedback and help), social relationships, initiations, social media, social networking and self-advocacy. Pre and post assessments included a full battery of assessments including 1) cognitive skills: self-, parent-report (BRIEF-A) & observation (Challenge Task-CT); 2) social skills: self-, parent-report (SRS-2), & observation (Social Skills Performance Assessment-SSPA); 3) academic functioning skills and 4) satisfaction. Data was gathered from standardized measures (participant and parent report) and college staff ratings.

Results: Two students had perfect attendance; average # of missed groups=3.67. Outcome analyses used paired sample t-tests. Findings reveal significant differences on cognitive (ES=.20-.63), social (ES=.30-.67) and functioning measures (ES=.37-2.05) indicating medium to large effects across informants. (Refer to Tables 1 & 2 & 3). Also, 70-75% students improved academic skills and 100% were observed by the facilitator to use new skills in course. Further, 100% of participants and 100% of parents reported the SUCCESS program overall was excellent and 92% students reported it helped them and 100% parents reported it helped their young adult.

Conclusions: This study demonstrates that a College soft skills intervention positively impacts students with ASD. This College program revealed high satisfaction and promise towards improving academic outcomes for adults with ASD.

428.059 *(Poster)* Outcome Comparison for Individual Versus Group-Based Aquatic Therapy for Treatment of Autism Spectrum Disorder: A Randomized and Controlled Clinical Trial.

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Background: There are many newly emerging therapeutic options in the treatment of Autism Spectrum Disorder (ASD). Recent studies have shown promising outcomes with regards to aquatic therapy. In this study, we aim to explore aquatic therapy strategies and compare their ability to improve pediatric quality of life.

Objectives: To compare the outcomes of an individualized, one-on-one aquatic therapy approach versus a group setting aquatic therapy approach in the treatment of ASD.

Methods: An IRB-approved prospective, randomized and controlled clinical study design was used to recruit children ages 3 to 15 presenting with DSM V diagnosis of ASD that were treatment naïve to previous aquatic therapy. Using simple randomization technique, all enrolled participants were assigned to receive standardized intervention with either one-on-one aquatic therapy (the control cohort) or group setting (consisting of 2-5 children) aquatic therapy (the study cohort) while both continuing on with any existing land-based therapies. The aquatic therapy was given forty five minutes weekly for a total of 10 weeks. Study population characteristics and various outcome measures were collected and compared among both arms of the trial at baseline and at the conclusion of the 10 week intervention period. The main outcome variable consisted of change in the PedsQL^{TM} pediatric quality of life inventory. Standard deviation of the Global PedsQL^{TM} for our study population was determined to be 12 by a pre-treatment sampling of the first five enrolled children. Using power of 90%, alpha of 0.05 and difference to detect of 20 (33% difference from the sampling mean), the sample size was calculated to be 20 total patients.

Results: The study enrolled a total of 28 children of whom there were 22 that completed the 10 week treatment regimen: fourteen children in the control cohort that received individual aquatic therapy and eight children in the study cohort that received group aquatic therapy. There were no significant differences in any of the study population demographics or baseline PedsQL^{TM} scores among the two cohorts ($p>0.05$ for all). After the intervention, both cohorts combined showed statistically significant improvement from baseline by 7.6 points in the Global PedsQL^{TM} ($p=0.0464$), with the most improvement in the Emotional ($p=0.0148$) and Social ($p=0.0201$) Functioning but not in the Physical ($p=0.2203$) or School ($p=0.6643$) Functioning. But there were no significant differences ($p=0.3962$) among the individual versus the group-based aquatic therapy cohorts when comparing change in Global PedsQL^{TM} score over the 10 week study period (+9.1 [+3.2 to +15.0] versus +5.1 [-2.7 to +12.8]; [95% Confidence Intervals]).

Conclusions: Aquatic therapy continues to show promising outcomes as an adjunctive treatment for children with ASD with respect to pediatric quality of life. Emotional and social functioning demonstrate the greatest improvement. There is no distinct clinical advantage for using either an individual versus a group-based aquatic therapy program, but it is more cost-effective for therapists to treat multiple children simultaneously as in a group setting. Future investigations with longer term follow-up are necessary to validate these findings and to determine the optimal treatment strategy when using aquatic therapy for ASD.

428.060 *(Poster)* Outcomes of the PEERS Social Skills Program in Clinical and School Settings

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Background: Many teens with autism spectrum disorder (ASD) experience increased social challenges in adolescence as the social environment becomes more complex, which can persist into adulthood (Bauminger & Kasari, 2000; Constantino, 2005; Orsmond et al., 2004). Due to the wide-reaching and long-lasting impact of social challenges, it is important to provide evidence-based interventions to minimize poor quality friendships, social isolation, peer conflict, peer rejection, as well as academic and occupational underachievement. Social skills training can occur in both regular and special education classrooms as well as in clinical settings. The Program for the Evaluation and Enrichment of Relational Skills (PEERS; Laugeson & Frankel, 2010), a curriculum using a cognitive-behavioral approach to teach age-appropriate social skills, attempts to address the social difficulties observed in teens with ASD and teaches ecologically valid social skills.

Objectives: To investigate the results of the PEERS program when implemented in a clinical and school-based setting.

Methods: The PEERS program includes 16 90-minute weekly sessions focused on teaching skills needed to make and maintain friendships. Initial descriptive analyses included 30 adolescents (ages 10-18) enrolled in PEERS an outpatient clinical setting and 40 high school students enrolled in PEERS in a charter school for students with ASD. Within the clinical sample, 90% were male and all demonstrated broadly average language and IQ. Most participants (83%) had a primary diagnosis of ASD, and over half had comorbid diagnoses of ADHD and/or anxiety. Analyses include pre- and post-test comparisons of mean scores on outcome measures, including the Social Skills Improvement System (SSIS), the Social Responsiveness Scale, 2nd Edition (SRS-2), the Test of Adolescent Social Skills Knowledge (TASSK), and the Stress Index for Parents of Adolescents (SIPA). Qualitative data gathered from educators and facilitators via brief interviews were also collected to evaluate barriers and generalization of instruction. Additional pairwise comparisons will be conducted with a larger sample when the next phase of data is collected this winter.

Results: Preliminary analysis shows increases in social skills, improvements in social communication, and improvements in emotional and behavioral outcomes as reported by parents and adolescents. Participants also showed a significant increase in social skills knowledge on the TASSK ($p=0.003$). While parents reported stable, slightly elevated levels of parenting stress, they did report improvement in parent-child relationships. See Table 1 for a summary of mean scores. Challenges within both educational and clinical settings included matching participants to appropriate groups given the heterogeneity of ASD and maintaining attendance and motivation over the course of the intervention; however, facilitators in both settings reported that the curriculum is appropriate for the large majority of participants, suggesting that PEERS can be useful as a universal intervention for students with social challenges. The clinical setting offered more flexibility for intentional group placement, while the school setting offered increased access to students who may not be able to travel to the clinic.

Conclusions: The PEERS Program shows positive outcomes when delivered in practical, real-life settings. Results are promising, as previously reported PEERS outcomes were primarily obtained within clinical research labs.

428.061 *(Poster)* Parent Training to Improve Dental Care in Underserved Children with Autism Spectrum Disorder: A Randomized Controlled Trial

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Background: Dental care is a common unmet healthcare need of children with ASD, a group vulnerable to excessive plaque, caries, and oral infections. Relative to other populations, children with ASD exhibit heightened distress during dental care and experience increased difficulty participating in home dental hygiene and dental office visits. Multiple factors impede routine dental care for children with ASD, including ASD symptoms and associated comorbidities. Demographic and systemic barriers further compound risk for children from underserved, low income, and economically marginalized families.

Objectives: To test the efficacy of a novel parent training (PT) intervention designed to improve daily home dental hygiene and oral health outcomes in underserved children with ASD.

Methods: Efficacy of our PT intervention was compared to an active Toolkit condition in a multi-site randomized controlled trial. All families received the AS-ATN/AIR-P Dental Toolkit, an electric toothbrush, a six-month supply of dental hygiene materials, and preventive dental visits at baseline, three months (immediate follow-up), and six months (maintenance). Manualized PT included seven in-person sessions and four booster sessions. Participants included 119 families of children with ASD (age *M*=7.4, *SD*=2.6; 55% Caucasian; 38% Hispanic/Latino) reporting difficulty with dental care. Families were all underserved (Medicaid-eligible). Most children presented with comorbid intellectual disability (85%), clinically-elevated behavior problems (61% CBCL Total *T*>63), and significant ASD symptoms (ADOS-2 *M*=7.3, *SD*=1.8). Parents reported on dental history and in-home dental hygiene. A blinded dental visit yielded standardized ratings of plaque (Visual Plaque Index—VPI), caries (Decayed, Missing, and Filled Teeth Index—dmft/DMFT), and gingival health (Gingival Index). Co-primary intervention targets were increased twice-daily home tooth brushing and decreased plaque. Analyses were intent-to-treat using linear and logistic mixed models.

Results: Retention of our underserved sample was high (90%). Baseline characteristics were similar between groups except that PT primary caregivers were more often female and PT families reported less frequent baseline dental hygiene, which was accounted for in analyses. Only PT significantly improved oral health as indexed by decreased plaque at three months (VPI change -0.16, 95% CI -0.29 to -0.03, *p*=.015). Relative to the Toolkit, PT led to a greater decrease in plaque (relative VPI change -0.19, 95% CI -0.36 to -0.02, *p*=.027) and caries (relative mean dmft/DMFT change -0.86, 95% CI -1.61 to -0.11, *p*=.026) at three months. Intervention-dependent oral health improvements lessened during maintenance and were not significant at six months. Frequency of twice-daily tooth brushing improved significantly within each group, but participation in PT led to greater gains at both three (ratio of OR=2.82, 95% CI 1.71 to 4.65, *p*<.001) and six months (ratio of OR=2.21, 95% CI 1.33 to 3.66, *p*=.002). See Figures 1 and 2.

Conclusions: The Toolkit and our novel PT intervention each significantly increased dental hygiene in children presenting with ASD and substantial developmental and behavioral comorbidities. Gains in daily hygiene were greater for PT and only PT enhanced oral health. Efficacy of our short-term PT program suggests avenues for promoting dental care in this high-need population. Successful study recruitment and retention demonstrates the feasibility of engaging underserved families.

428.062 *(Poster)* Physical Contact Via Hugging a Hugvie Can Reduce the Stress of Calling an Unfamiliar Person on the Phone.

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Background: Recent technological advancements have had a dramatic impact on the way individuals communicate, influencing how we communicate in daily life through the increasing presence of electronic devices and remote communication options, such as mobile phones. To participate in society today, it is necessary to use mobile phones to communicate with unfamiliar people in a variety of situations. Individuals with autism spectrum disorders (ASD) are not good at talking on the mobile phone to unfamiliar people. The "*Hugvie*", a cushion with a human-like shape, was designed to provide users with the tactile sensation of hugging during phone conversations to improve positive feelings (e.g., comfort and trust) toward phone partners. When hugging a Hugvie, users can strongly experience the presence of remote partners. Given the difficulty individuals with ASD have with talking to unfamiliar people on mobile phones and the social dysfunction that characterizes ASD, a Hugvie could be effectively used to decrease stress.

Objectives: The primary objective of this study is to examine whether physical contact via hugging a *Hugvie* can reduce the stress of calling an unfamiliar person on the phone.

Methods: In the present study, 24 individuals with ASD were randomly assigned to two groups. The participants in the first group (n = 12) called an unfamiliar person on the phone while hugging a *Hugvie* (Hug course) on day 1, followed by a phone call without a *Hugvie* (mobile phone-only course) on day 2. The participants in the second group (n = 12) underwent a phone-only course on day 1 and Hug course on day 2. After each phone conversation using only a mobile phone or the mobile phone plus the *Hugvie*, all participants completed questionnaires regarding their self-confidence regarding talking on the phone. In addition, they provided salivary cortisol samples four times each day.

Results: The self-confidence ratings after the Hug course was significantly greater than those reported after the Mobile phone-only course. The salivary cortisol levels of those participating in the Hug course were significantly lower after talking on the phone than the salivary cortisol levels of those participating in the Mobile phone-only course.

Conclusions: Individuals with ASD who talked on the phone with an unfamiliar person while hugging a Hugvie showed better self-confidence and decreased stress compared to those who used only a mobile phone. It is difficult for individuals with ASD to talk on the phone with an unfamiliar person. Given the results of this study, we recommend that huggable devices be used as adjunctive tools to support individuals with ASD when calling unfamiliar people on mobile phones. The findings of this study represent a meaningful contribution to the literature on interventions for communication difficulties among individuals with ASD.

428.063 *(Poster)* Pilot Implementation and Evaluation of Healthcare Transition Curriculum on Adults with ASD

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Background: Individuals with autism spectrum disorder (ASD) often have complex healthcare needs persisting into adolescence and adulthood (Perkins & Berkman, 2012; Seltzer et al., 2004). Many individuals and their families struggle to transition from pediatric to adult care due to the lack of support and preparation (Cheak-Zamora & Teti, 2015). Despite their strong desire to be independent and efforts made to manage their own healthcare, many adults with ASD do not have adequate knowledge and have limited skills confidence in navigating the complex healthcare world (Cheak-Zamora et al., 2017).

Objectives: The current study aims to evaluate the effects of a healthcare transition (HCT) curriculum on adults with ASD's understanding, skills, and confidence in healthcare management.

Methods: Six adults with ASD (22-35 years old) were recruited to participate in eight one-hour weekly sessions facilitated by two mental health and medical professionals. The intervention curriculum was adapted from the state Department of Public Health's published HCT information workbook designed for general youth to focus on the specific needs of individuals with ASD. It was modified to include lesson plans with learning activities, simulated practices, and homework for explicit teaching and modeling of the skills needed to independently manage healthcare. It also included instructional materials (e.g., visual supports) that can be differentiated to meet a range of learning needs. Lessons included topics such as roles of healthcare providers, preparation for a medical emergency, scheduling and attending an appointment, information about prescriptions and insurance plans, and goals or plans for achieving a healthy lifestyle.

This intervention is currently in the implementation phase. A mixed method evaluation approach is being used to collect data from participants with ASD pre- and post-intervention. Qualitative interviews are conducted to assess changes in participants' understanding of HCT, perceptions of their skills, and confidence in managing healthcare, and feedback about the curriculum. The Transition Readiness Assessment Questionnaire (TRAQ; Sawicki et al., 2011) is administered to measure participants' self-report skills for managing and advocating their healthcare. Follow-up TRAQ data will be collected following participants' first post-intervention doctor's appointment.

Results: Based on our initial engagement with the participants, the following observations emerged as important issues to be addressed. Participants reported being accompanied by parents in healthcare visits and not having the opportunity to speak with medical professionals directly. Participants were unaware of what to say or ask during medical appointments and had limited skills in taking charge of their own healthcare. We expect the participants will learn critical HCT knowledge and information and become more empowered to assert themselves in future healthcare tasks.

Analysis of pre- and post-data will be available for this presentation. Wilcoxon signed-rank test will be performed on TRAQ scores. Thematic analysis (Braun & Clarke, 2006) will be used to identify and compare themes pre- and post-program.

Conclusions: Findings of this pilot implementation will demonstrate the importance to address HCT needs by teaching the relevant skills and knowledge to adults with ASD. Participant feedback will assist further refinement of the curriculum and future research needs.

428.064 *(Poster)* Preliminary Results from an Online Social Media Skills Intervention for Adults with ASD: Socialization and Education Learning for the Internet (SELFI)

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Background: Currently, little is known about how individuals with ASD interact with peers on social media platforms. Previous research has highlighted that social media can be a useful tool for those with social challenges and/or limited confidence because online social expectations and asynchronous text-based exchanges generate less pressure and anxiety than face-to-face interactions (Goby, 2006). Additionally, online social media communication has been associated with increased quality of friendships, decreased loneliness, and benefits for individuals with social anxiety (Mazurek, 2013). These data suggest that proper social media use should be targeted in social skills interventions. Although social skills interventions are growing in popularity, no interventions have been developed specifically for social media skills. The Socialization and Education Learning For the Internet (SELFI) program was developed to evaluate and improve the online social skills and etiquette of adults with ASD in an increasingly digital world.

Objectives: The objectives of this study were to (a) gain an understanding of baseline social media activity in ASD and TD young adult populations and (b) test the feasibility and preliminary efficacy of an eight-session intervention targeting online social skills, specifically for adults with ASD.

Methods: In this pilot study, six participants with ASD (mean age: 21.12 years, 78% female) completed SELFI, an 8-week socialization intervention aimed at systematically improving individual's positive online social impression by targeting their social media interactions, responses, and initiations. To compare baseline social media experiences, social media activity samples were taken from a comparison sample of typically developing peers. The intervention package placed a specific focus on modeling, teaching, and reinforcing skill use, common strategies that are often employed in in-person autism social skill interventions. To better understand the online social experiences of participants, screenshots of their Facebook activity over the previous 7 days were collected, de-identified, and analyzed. To better understand the *quantity* of social media interactions, Facebook actions were coded either as "active" (posting, commenting, sharing) or "passive." (liking a post). Individual posts were also qualitatively rated by masked coders for overall appropriateness. To assess treatment efficacy, appropriateness scores were compared pre- and post-intervention.

Results: At baseline, individuals with ASD had fewer social media interactions than typically developing peers, with an average of 7.00 (SD = 14.75, 2.84 active, 4.16 passive) social media interactions, compared to 25.65 (SD = 28.42, 8.13 active, 25.90 passive) from TD peers. After intervention, those with ASD increased their weekly online interactions to a mean of 13.16 (SD = 16.27). Appropriateness scores also increased from 3.50 (SD = .16) to 3.68 (SD = .26) post-intervention. SELFI fidelity of implementation was 85%.

Conclusions: Preliminary SELFI outcomes are indicative of increases in social media activity and post appropriateness. This innovative format of this social media intervention has the potential to target a crucial area of social functioning that has not yet been targeted in individuals with ASD. Future directions include a randomized controlled trial to systematically test the intervention and its long-term impacts on online communication and friendships.

428.065 *(Poster)* Process Evaluation of a Randomised Controlled Trial Evaluating an Autism-Specific Workplace Tool for Employers

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Background: Many adults on the autism spectrum have both the desire and ability to work, yet they continue to experience many barriers in their attempts to secure and maintain employment. A variety of environmental factors may influence the employment process, particularly employers with their attitudes, management practices and policies critical in facilitating or hindering work participation for individual on the autism spectrum. Yet, few studies exist exploring employers' capacity in hiring and supporting employees on the autism spectrum, and even fewer have considered interventions and strategies targeting employers' skills, abilities and knowledge in enhancing employment opportunities. In response to this need, the Integrated Employment Success Tool (IEST^{TM}) was developed specifically for employers. The effectiveness of the IEST^{TM} was established in a randomised controlled trial (RCT). While the RCT was useful in evaluating the effectiveness of the IEST^{TM}, it predominantly focused on pre-specified outcomes and not on the process involved in implementing the intervention. As such, a process evaluation was conducted to determine the fidelity and quality of the implementation of the IEST^{TM}.

Objectives: The primary objectives of the process evaluation were to: i) describe employers' experiences of using the IEST^{TM} in their workplace; ii) describe employers' perceptions of the usability of the IEST^{TM}; iii) explore the features of the IEST^{TM} contributing to change in the workplace, including recommendation for improvements; and iv) identify the perceived barriers and enablers in using the IEST^{TM}.

Methods: A process evaluation was conducted to obtain feedback from employers (N=29) via an online questionnaire. Of these, 11 participants were interviewed, further exploring their experiences of using the IEST^{TM} in their specific work environment. Data were analysed via descriptive statistics and thematic analysis.

Results: Descriptive statistics revealed that while participants' usage of the IEST^{TM} varied, 65% were satisfied to very satisfied using and implementing it in their workplace. More than 60% of employers had recommend the IEST^{TM} to either another manager, supervisor or co-worker in their workplace, with 14% further recommending it to a vocational rehabilitation service provider. Due to the IEST^{TM} only being a paper-based intervention, more than 60% of employers indicated a need for both a paper-based and online version. Thematic analysis revealed that participants' experiences using the IEST^{TM} could be described according to the three major themes: A 'go-to guide' empowering employers; seeing the workplace from a different perspective; and a structured approach to supporting employees on the autism spectrum.

Conclusions: The process evaluation revealed that the main benefit of the IEST^{TM} was in increasing employers' knowledge and understanding of autism in the workplace, providing clarity in relation to autism-related traits and associated workplace behaviours. It was evident that the more employers knew about autism, the more confident they felt about approaching their employee to discuss their needs. The process evaluation was a critical step in understanding *why* the IEST^{TM} was effective, and how it could be further optimised for prospective employers.

428.066 *(Poster)* Provider Perspectives on the Echo Autism: Transition to Adulthood Program

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Background: Each year, 50,000 youth with Autism Spectrum Disorders turn 18 years old. The current healthcare system is not equipped to care for the increasing number of transition-aged youth diagnosed with autism spectrum disorder (TAY-ASD). Despite their complex healthcare needs, TAY-ASD receive few transition services and describe difficulty finding adult providers. Pediatric and adult health care providers alike lack training in autism and report low confidence in caring for TAY-ASD.

Objectives: The current project developed and tested an adaptation of the Extension for Community Healthcare Outcomes (ECHO) model to train and mentor Primary Care Providers (PCP) in providing best-practice care for transition-age youth and young adults with ASD. The ECHO Autism: Transition to Adulthood program consisted of 12 weekly 1-hour sessions connecting PCPs to an interdisciplinary expert team via multi-point videoconferencing. Training included brief didactics, case-based learning (during which PCPs presented their cases for discussion), and guided practice.

Methods: This qualitative study aims to understand the provider's experiences while participating in the ECHO Autism: Transition to Adulthood program and better understand the healthcare providers' motivations and subsequent applications of the ECHO model training. We recruited 10 PCPs who completed the ECHO Autism: Transition to Adulthood program to participate in follow-up focus groups. Three one-hour focus groups were conducted within one month of the completion of the program utilizing a synchronized videoconferencing system. The semi-structured interview guide including questions about the participants experiences in the program, perspectives on key components of the program (e.g. case presentations, hub team recommendations, etc.), the impact of the program on provider willingness to care and confidence in caring for TAY-ASD, barriers and challenges to participating in the program, and suggestions for improvement to the program. All focus groups were recorded and transcribed verbatim by a contracted agency.

A fundamental qualitative description method was used by 3 team members with expertise in qualitative data analysis to analyze the qualitative focus group data. Each team member completed all stages of the data analysis process independently, followed by a consensus and refinement process at every level.

Results: Three unique themes arose from the PCP focus group discussions included (1) beneficial and influential aspects of the program, (2) perceived challenges within the program, and (3) suggestions for improvements and adjustments to the program. Each theme included four subthemes that further described the participants' experiences within the program. The benefits of the program included the sense of community, hub team expertise, a feeling of increased comfort, and program structure. Challenges included scheduling, session time management, access to resources, and participant characteristics. Finally, suggestions include structure adjustments, regional resources, additional technology, and formalizing acknowledgments and incentives.

Conclusions: The qualitative results indicate that the program is acceptable to provide and seems to improve PCP confidence and practice behavior. These results will be used to refine and ensure the success of the broader implementation of the ECHO Autism: Transition to Adulthood program. Further, these results can inform the development and revision of future ECHOs.

428.067 *(Poster)* Psychological Correlates of Positive Affect in Parent-Child Relationship Quality As Experienced By Parents of Children with Autism

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Background: Parent-child relationship quality is an important aspect of both parent and child well-being. Parental positive affect, defined as the expressions of trust, affection, and respect that are expressed from parents to children, and from children to parents, is a significant contributor to parent-child relationship quality (Orsmond et al., 2006). Parental positive affect has been previously examined in relation to family characteristics (Orsmond et al., 2006); however, more studies are needed to explore how parental positive affect may be related to other psychological variables among families with autism.

Objectives: To explore how parental positive affect to and from their child are related to parent and child characteristics in families with autism.

Methods: Data were collected from 44 parent-child dyads participating at the baseline visit prior to being involved in cognitive behavioural therapy. Parents were 33 to 54 years of age (86.4% Female; M = 44.41 years, SD = 5.35), and children were 8 to 13 years of age (81.8% Male; M = 9.48 years, SD = 1.54). All children had autism and were referred as a result of difficulties managing their emotions. All measures were completed at program screening, prior to any involvement in the intervention. Parental positive affect was measured using the 10-item PAI (Bengtson & Schrader, 1982), which provides a total score and two summary scores examining: 1) positive affect *towards* their child and 2) positive affect *from* their child. Higher scores reflect more positive relationship quality. Measures of parent mental health (DASS-21; Lovibond & Lovibond, 1995), mindful parenting (BMPS; Jones et al., 2014), child autism severity (SRS-2; Constantino & Gruber, 2012), and child psychopathology (BASC-3; Reynolds & Kamphaus, 2004) were also collected at baseline.

Results: PAI total scores were negatively related to poor parent mental health (r = -.34, p = .03), and positively related to mindful parenting (r = .61, p < .001). PAI total scores were negatively related to child autism severity (r = -.44, p < .01), and child psychopathology (internalizing behaviour, r = -.36, p = .02; externalizing behaviour, r = -.47, p = .002). This poster also presents on the associations among the parent directed and child directed components of affect.

Conclusions: Greater parental positive affect is associated with better parent mental health and mindful parenting skills. Lower parental positive affect was associated with higher reports of child psychopathology and severity of autism symptoms. Future studies can investigate the directionality of these associations to further understand mechanisms of change and possible targets for interventions.

428.068 *(Poster)* Randomized Controlled Trial (RCT) of a Naturalistic Parent Training Program

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Background: Parent training can have many benefits for families of individuals with autism spectrum disorder (ASD), most notably in improving parent-child interactions. However, treatment gains noted in the research vary greatly. Naturalistic developmental behavioral interventions (NDBIs) combine the principles of applied behavior analysis (ABA) and child development with an emphasis on creating learning opportunities for the individual with ASD in the natural environment. The inclusion of NDBIs into parent training has the potential to improve outcomes for children and parents as well as increase parent involvement in their child's treatment.

Objectives: The current study expanded upon past research on the NDBI, Project ImPACT, by assessing parent-child interactions in a randomized controlled trial including clinicians with a range of experience located at a community-based ABA organization.

Methods: For the study, 36 families of individuals with ASD (2-8 years old) and 36 credentialed clinicians (i.e. Board Certified Assistant Behavior Analyst, Board Certified Behavior Analyst) with varying years of experience were recruited to participate in the study. Each clinician was paired with one family and the pairs were then randomly assigned to the active treatment or the treatment as usual control group. Clinicians assigned to the active treatment group were instructed in the study procedures using behavioral skills training (BST). For both groups, twelve weekly sessions (1.5 hours total per week) were implemented for children and their parent(s). For the active treatment group, each week the clinician reviewed the target skill(s) with the parent during a 1-hour session and then used BST to support the parent in demonstrating the target skill(s) with their child during a subsequent 30-minute session. Measures of parent-child interaction were scored by individuals blinded to group assignment and condition (i.e. pre-treatment, post-treatment, generalization to home) from a video of interaction with their child. Additionally, measures of parental self-efficacy, parental stress, and social validity were collected.

Results: Data are presented on the difference in scores of parent-child interactions, parental self-efficacy, and parental stress for each group. Additional data on social validity are compared for each group.

Conclusions: The results of this study add to the growing support for the use of naturalistic parent training strategies, specifically Project ImPACT.

428.069 *(Poster)* Reducing Physical Management in School-Age Children with ASD

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Background: Children with disabilities including children with ASD are significantly more likely to experience the use of restraint in settings such as schools. The necessity of restraints are often justified by safety concerns, though restraints present inherent safety risks. The identification of de-escalation strategies effective in school-age children may increase safety for children and staff. The APEX Summer Camp program serves children with autism spectrum disorders (ASD), attention-deficit/hyperactivity disorder (ADHD), and comorbid ASD and ADHD. Physical management protocols are a component of timeout procedures, designed to maintain safety and mitigate risk. Behaviors that result in a timeout include intentional aggression, intentional destruction of property, or repeated non-compliance.

Objectives: To examine the impact of adjusting timeout procedures to include a home consequence on incidences of physical management.

Methods: The APEX program has historically implemented the timeout protocol manualized in the Summer Treatment Program (Pelham et al., 2012), but with reduced intervals starting at 2.5 minutes, and then escalating based on additional negative behavior to 5, 10, and 15 minutes (fully escalated). In 2019, we shifted to implement a “drop-the-rope” option, which coordinated a consequence at home for not serving a timeout. When a home consequence was initiated, the timeout was automatically concluded with the child being given the immediate option to return to group activities. Staff consulted with parents regarding reasonable home consequences such as losing 10 minutes of screen-time. Timeouts were categorized as requiring no physical management, minor physical management (physical guidance), and significant physical management (any use of a therapeutic hold). The number of timeouts assigned and the level of physical management required to maintain safety were examined across the summers of 2018 and 2019 respectively.

Results: No significant differences were indicated in diagnosis, age, gender, or number of participants based on Fisher’s exact test between our 2018 (n=124) and 2019 (n=136) samples. In 2018, 543 timeouts were assigned with no physical management, 106 required minor physical management, and 101 required significant physical management. In 2019, 564 timeouts were assigned with no management, 58 required minor physical management, and 30 required significant physical management. Fisher’s exact test for the 2 (years) X 3 (level of physical management) yielded a $p < .0001$.

Conclusions: Our results indicated a significant reduction in the use of physical management from 2018 to 2019. The adoption of our "drop-the-rope" procedure involving a home consequence may be a useful de-escalation strategy in school-age children. Our findings may have applicability in other settings where the use of home consequences could potentially reduce the use of physical restraints. Further replication is needed in other settings including schools.

428.070 *(Poster)* Reducing Physiological Measures of Stress through Yoga for Individuals on the Autism Spectrum

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Background: Many people with Autism Spectrum Disorder exhibit symptoms of stress and anxiety. While not every person with Autism Spectrum Disorder (ASD) is anxious, many of autism’s challenging symptoms relate to anxiety (Gillott, Furniss, & Walter, 2001; Richey et al., 2015; White, Oswald, Ollendick, & Scahill, 2009). There is a great need for effective techniques for managing anxiety in those with ASD, and the present study examines YogAutism, a Yoga-based intervention for individuals with ASD, and its short-term and long-term impact on the physiological responses that are associated with anxiety.

Objectives: The purpose of this study was to evaluate the efficacy of the YogAutism intervention in reducing the physiological correlates of stress and anxiety. Additionally, use of Wavelet Transformation was investigated as an alternative to the Short Time Fourier Transform as a means to analyze power spectra within ECG signals.

Methods: Twenty-three participants with ASD were evaluated, 10 in the YogAutism intervention group (ages 5 - 35 years, M= 13.42), and 13 in the wait-list control group (ages 6 - 20 years, M= 12.10). Each group contained participants who were identified as minimally-verbal. Salivary cortisol, salivary a-amylase and Heart Rate Variability were measured as indices of activation of the hypothalamic-pituitary-adrenal axis, sympathetic nervous system and parasympathetic nervous system, respectively. YogAutism participants received the intervention in the lab once per week over the course of 6 training weeks, and control participants viewed a nature video twice over the 6-week duration. For all participants, measurements were taken twice; before and after the intervention/video in the first 3-weeks of the study period, and again in the second 3-weeks of the study period.

Results: We found decreases in salivary cortisol in the YogAutism group at the level of medium effects ($h_p^2 > 0.059$). Levels of salivary a-amylase increased with the YogAutism intervention. This unexpected result supports observations that indices of hypothalamic-pituitary-adrenal axis and sympathetic nervous system activation may behave unexpectedly in people with autism. Heart Rate Variability was calculated from the raw ECG using Wavelet Transformation and Short Time Fourier Transform. Wavelet Transformation data were more correlated with cortisol data than were Short Time Fourier Transform data, which provided some evidence supporting the use of Wavelet Transform for calculating HRV in a sample with ASD. However, neither analysis showed significant differences in the levels of Heart Rate Variability between groups.

Conclusions: This pilot study suggested that the YogAutism intervention had a limited short-term and long-term impact on the physiological responses that correlate with anxiety. However, this was in the presence of substantial heterogeneity and potential decoupling of physiological responses. Future research would benefit from limiting the age range of participants, collecting parent/caregiver report measures and further exploration of the use of Wavelet Transform for calculating HRV in a sample with ASD.

428.071 *(Poster)* Research-Supported Intervention Strategies for Treating Externalizing Behaviors in Youth with Autism Spectrum Disorder: Implementation and Perceived Usefulness Among Community-Based Providers across Disciplines

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Background: Externalizing behaviors are among the most common and serious problems in youth with autism spectrum disorder (ASD; Carroll et al., 2014). More than half of youth with ASD exhibit externalizing behaviors (e.g., aggression; Kanne & Mazurek, 2011), and such behavior is linked with significant impairment across multiple domains of functioning (Brown et al., 2019; Mazurek et al., 2013). Though empirically-supported interventions do exist to treat externalizing symptoms in ASD (National Autism Center, 2015), little is known about the use and perceived usefulness of such interventions among providers who treat this population, and whether use and usefulness of these strategies varies across the range of professional disciplines these providers represent.

Objectives: The primary aim of this study was to examine the use and perceived usefulness of four research-supported intervention strategies for treating externalizing behaviors among youths with ASD by usual care providers in the community throughout the United States. The secondary aim was to compare self-reported use and usefulness of these strategies across provider discipline.

Methods: Participants were 581 community-based providers across 5 clinical sites who reported working with youth with ASD between 7-22 years of age with co-occurring externalizing problems. The Usual Care for Autism Survey (Wainer et al., 2017) was used to assess providers' self-reported frequency of use and perceived usefulness of four research-supported strategies: functional behavioral assessment (FBA), visual tools/supports, functional communication training (FCT), and token economy. These strategies were selected because they showed a high degree of consensus (i.e., 90% agreement) among ASD experts (Kerns et al., 2018) as demonstrating strong research support for treating externalizing symptoms. Generalized estimating equations were used to evaluate differences across discipline in use and usefulness while accounting for nesting of data within sites.

Results: Across disciplines, the four strategies were used "very commonly" and perceived as "very useful" by over 50% of providers. Token economy was used "very commonly" by the most providers (57.2%), and FCT was perceived as "very useful" by the most providers (71.7%). The highest proportion of "not at all" and "not at all useful" responses were for FCT (8.4%) and token economy (1.7%), respectively. Behaviorists used all strategies significantly more often than other providers across almost all comparisons (Table 2). Regarding perceived usefulness of strategies, behaviorists perceived FBA and Visual Tools as most useful. FCT was rated as most useful by "other" providers, and Token Economy was rated as most useful by allied health professionals.

Conclusions: Across disciplines, results suggest that providers report often using research-supported strategies and perceive these strategies as useful for treating externalizing behaviors in youth with ASD. Even so, there exists significant variability between disciplines regarding use and usefulness. Behaviorists used all strategies more frequently than other providers, but reported the most usefulness for FBA and visual tools/supports only. These findings are promising inasmuch as they support dissemination of key research-supported practices to address this area of challenge in the United States, and highlight extant gaps for targeting provider training in use and understanding of these practices.

428.072 *(Poster)* Self-Identified Strengths and Positive Self-Talk in Pre and Post Assessments of an Employment Skills Training for Individuals with Autism Spectrum Disorder

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Background: Individuals with autism spectrum disorder (ASD) often struggle with obtaining and maintaining employment, making interventions that target employability for these individuals crucial (Roux, Rast, Rava, Anderson, & Shattuck, 2015). However, little research focuses on the ways that these programs help to foster awareness of strengths and positive self-talk. Our research uses a qualitative approach that allows for in-depth exploration of perceived strengths and self-talk in pre and post assessments for an employment skills training program for individuals with ASD. Research in this area is needed to better understand how trainings like this can affect awareness of strengths and self-talk language.

Objectives: To examine awareness of strengths and self-talk language in individuals with ASD before and after an employment skills training program.

Methods: To explore the study objective, we analyzed qualitative pre and post interviews of individuals with ASD who participated in an employment skills training program. We collected 26 pre and post interviews. All individuals were verbally-competent. In the interviews, individuals were asked questions related to the program (e.g., what do you expect to learn, what did you learn), themselves (e.g., what are your strengths, what are your challenges) and about their needs (e.g., how do you learn best, what do you need from a group). Interviews were semi-structured, audio-recorded, transcribed verbatim, and were analyzed using multiple coders. Although self-talk was initially not a factor of the interviews, it emerged as a theme. Interviews were thematically coded and categorized to identify perceived strengths and self-talk.
Results: Initial examination suggests that participants in the program are more likely to identify strengths following participation in an employment skills training program. These strengths are likely to be more specific and clear than those identified at the pre-assessment. Further, participants were more likely to engage in positive self-talk in the post-assessment than the pre-assessment.
Conclusions: The results of this qualitative analysis suggest that interventions focused on improving job skills may help foster an awareness of strengths and increase the frequency of positive self-talk in individuals with ASD. Job skills interventions could benefit from a focus on awareness of strengths and positive self-talk as important tools for healthy independent living in individuals with ASD. Although each individual presents with unique strengths, awareness of these strengths can enhanced job readiness and self-esteem. Future research can focus on specific techniques to increase awareness of strengths with targeted interventions.

428.073 *(Poster)* Social Validity of the Autism Mentorship Program (AMP): A Mentorship Program for Adults and Adolescents with Autism

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Background: Relationships with caring, non-parental adults (i.e., mentors) are critical to healthy development (Rhodes, 2002, 2005) and can positively influence a range of outcomes, such as peer and parent-child relationships, identity development, academic achievement, self-confidence, and prevention of problem behaviors (DuBois et al., 2011). While youth and adolescents with autism spectrum disorder (ASD) often experience challenges related to communication, social relationships, and co-occurring emotional and behavioral concerns, there are limited mentoring opportunities available for youth with ASD, and there are currently no mentoring programs that pair youth and adults with autism in mentoring relationships. Additionally, youth with ASD rarely have opportunities to form meaningful relationships with adults with ASD who can share their experience with youth during an important developmental period in their lives. The Autism Mentorship Program (AMP) was designed to meet this need.
Objectives: The aim of this study was to examine the social validity of the Autism Mentorship Program.
Methods: AMP involves one-to-one mentorship of youth with ASD by adults with ASD. Mentoring sessions consisted of 12 weekly 60-minute meetings within the teens' local high school. Pairs participated in semi-structured activities centered around common interests. Participants included 7 mentees (ages 14-17), 7 mentors (ages 19-33), 8 parents of the mentees, and 8 AMP staff. Mentees were recruited from a local high school, and mentors were recruited from a local community transition program for young adults with ASD. All participants had a diagnosis of ASD without co-occurring intellectual disability or language impairment. Multi-informant data was collected through interviews, standardized questionnaires, and focus groups to determine the acceptability and feasibility of the AMP intervention. Program data regarding attendance and satisfaction with weekly sessions were also collected.
Results: AMP was highly acceptable to all participants. Participants demonstrated a high level of attendance (92-100% for all participants). All participants (100%) reported feeling satisfied with the mentoring relationship and agreed that their participation in AMP was meaningful. Most mentors and mentees (85.7%) reported feeling satisfied with their participation in the program and the level of support they received. During interviews and focus groups, mentees described quality relationships, progress toward personal goals, learning about people and communication, learning what it is like to grow up with ASD, and gaining a better understanding of what it is like to grow up with ASD. Mentors described greater confidence, more patience, and better leadership skills as a result of participating in AMP. Parents described improvements in communication, motivation, attention, confidence and friendships for their children. AMP staff reported high satisfaction with the program (100%), and indicated that the program was able to be implemented successfully within the school setting.
Conclusions: Results from this initial pilot of AMP indicated that the program is highly acceptable to participants and feasible to implement as an after school program. In addition to enthusiastic support and acceptance for AMP, results suggest mutual benefit for both mentors and mentees. A full pilot will take place during the 2019-2020 school year with 14 mentee-mentor pairs to explore additional outcomes.

428.074 *(Poster)* Stacking the Deck to Help Adolescents with Autism Better Balance Their Group Participation

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Background: In classroom and group settings, adolescents with autism may not know how to participate in socially acceptable ways. They may talk too much (over-participating), or go silent (under-participating). Current strategies include cold-calling on under-participators as well as occasionally ignoring over-participators. Both may lead to increased anxiety, frustration, and "meltdowns" in students with ASD.
Objectives: Our goal is to create a socially acceptable self-monitoring system for adolescents with autism to help individuals balance comment levels in classroom settings and decrease disruptive group behaviors (e.g. talkouts).
Methods: Our sample consisted of males (n=25) and females (n=7) ages 11-17. All had preexisting ASD diagnoses and/or preexisting social skills difficulties; age appropriate language skills; a lack of significant classroom behavioral issues; and no more than a two years academic delay behind their age group.

During direct instruction in PEERS® (Laugeson and Frankel, 2010) sessions, the "*Stack the Deck*" intervention was used for self-monitoring participation. A differential reinforcement for high or low rates of behavior (DRH/DRL) using an existing token system with backup reinforcers allowed participants to control how many *bonus* points they receive based on their own "budgeting" of their participation behaviors using a visual, tactile system (colored slips of paper) for marking their own "turns." Some tokens (e.g., green slips of paper) are more valuable if used (answering a question). Others (e.g. red slips of paper) are more valuable if kept (refraining from answering to give someone else a turn). All participants received points for participation, but could strategize for *more* points with the intervention. The aim was to balance verbal participation in classroom settings by allowing more opportunities for students with low rates of participation to respond. Each participant was given 10 slips of paper each session "stacked" with "use" and "keep" cards as incentives to keep participation in the target (average) range.

Data were collected from videos of sessions, coded by reliable researchers, recording both group and individual behavioral trends. Variables were attempted comment frequencies (hand raises), completed comment frequencies, and talk out frequencies.

Results: *Stack the Deck* was *most effective* when it came to students with the target behavior of reducing participation. Those who were over-participators at baseline were able to keep their participation rates more consistently within the average range. Under-participators, on the other hand, did not increase their participation as much. No change was observed in participants already within the target range. Talk outs decreased overall. Therapists reported the intervention as beneficial from the viewpoint of the "teacher," waiting anxiously for each baseline completion so they could have a better group experience with the intervention in place.

Conclusions: *Stack the Deck* lowered talk outs and balanced participation during direct instruction time for adolescents, and has potential for similar effects for elementary age groups and in classrooms. It is very low cost and low effort, easy to learn, and provides opportunities for more reinforcement for self-balancing participation than current methods. Participants have complete control over their participation and choose to regulate their own behavior with minimal teacher management.

428.075 *(Poster)* Supporting Newly Identified or Diagnosed Autistic Adults: An Initial Evaluation of an Autistic-Led Programme

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Background: An increasing number of adults are identifying that they are autistic later in life. This process of identification (which is sometimes, but not always, accompanied by a clinical diagnosis) can have a huge impact: contributing to feelings of relief and providing an explanation for feelings of difference. However, this can also raise the question "where to from here?" (Hearst, 2019, p.5).

Following identification/diagnosis of autism there is a lack of post-diagnostic support for adults (Crane et al., 2018). The limited services that do exist tend to be provided by non-autistic professionals. Building on the evidence that peer support might be beneficial for autistic children (Gordon et al., 2015), and a community desire for autistic-led initiatives that are "nothing about us without us" (Shaprio, 1994), the current study presents an initial evaluation of an autistic-led education and peer support programme for autistic adults.

Objectives: To conduct an initial evaluation of an autistic-led post identification programme for autistic adults. The evaluation aimed to provide an evidence base upon which future such programmes can be developed.

Methods: *Exploring Being Autistic* was designed to enable autistic people to: learn about autism and discover if/how it affects them; process emotional response to identification/diagnosis; consider disclosing they are autistic; develop strategies to capitalise on the strengths and mitigate the challenges associated with autism; and socialise with peers. The autistic developer of *Exploring Being Autistic* worked with a team of researchers to conduct a preliminary, qualitative evaluation of the programme.

Sixteen participants took part in one of two iterations of the *Exploring Being Autistic* programme (iteration one: n= 9; iteration two: n= 7). Participants completed a pre-course questionnaire to gather information about their motivations for taking part in the programme. Participants were also interviewed immediately after the programme, and again six months later. Three researchers independently reviewed these data in line with an essentialist framework for thematic analysis (with no pre-existing codes), for an in-depth qualitative analysis.

Results: Questionnaire data showed that participants were motivated to take part in the *Exploring Being Autistic* programme to learn more about the associated areas of strength and difficulty in autism, become more empowered and to develop practical strategies and coping mechanisms. Three key themes were identified from the interview data. The first theme was an appreciation of the autistic-led nature of the programme: participants felt they were really understood by the autistic group facilitator. The second theme was unity in diversity: participants reported feeling a sense of belonging with the group and valued the group's diversity. The third theme was developing a positive, practical outlook on autism: better appreciating how autism made a tangible difference to participants' everyday lives, and how to use that knowledge in a tangible way.

Conclusions: This initial evaluation showed that an autistic-led post identification/diagnosis peer support programme was well received and beneficial for participants in many ways. These findings provide an important insight into aspects that could be useful for future autistic-led, peer support programmes

428.076 *(Poster)* The Development of an Interactive Musical Device for Individuals with Autism As Home-Based Sensory Integration Intervention and First Proof of Efficacy

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Background: Music therapy and sensory integration interventions are frequently utilized to reduce sensory processing deficits and show a range of benefits. However, there are only few therapeutic tools targeting sensory stimulation in combination with music – particularly as home-based intervention.

Objectives: The goal of this project was to develop an interactive musical device in the form of a cushion that serves as a therapeutic tool. It combines both music and sensory experiences, thereby providing parents with autistic children a simple but effective way to incorporate music and sensory experiences at home. Furthermore, a pilot study attempted to assess whether the prototype might positively impact particular areas commonly affected in a negative way by high-arousal, stress, or self-stimulatory behaviour.

Methods: Eleven participants (four females, seven males), between two and a half and thirteen years, participated in the study. During a five-week period, parents were asked to integrate the device into everyday life. Before, during and after the study, parents filled out questionnaires to evaluate whether the device could be used as a tool to reduce, redirect or entirely eliminate certain symptoms and achieve positive effects.

Results: The results provide preliminary evidence suggesting that the device has great potential to be an effective and easily accessible tool for parents and individuals to positively influence certain areas that are commonly impaired or predisposed to negative outcomes in the autistic system. The findings show that the device was particularly beneficial as coping strategy for the participants to be used for stress management and as a 'mental space' in which to retreat to reduce overstimulation. Furthermore, the data indicate beneficial effects such as relaxation or distraction from negative stimuli. More than half of the test participants who showed self-stimulatory or auto-aggressive behaviour were able to redirect it during engagement with the sound cushion. In addition, the findings show that common symptoms such as sleep problems, poor concentration span or hyperactivity could be reduced by the application and thus led to a general improvement in quality of life of the participants.

Conclusions: In the treatment of autistic individuals, it is important to have access to therapeutic aids that can help to better manage the stimuli, allowing the autistic individual to experience the world on his or her own terms. Research shows that music has a positive impact on particular aspects of autistic experience, and especially on those areas in which new and alternative treatments are sought. This emphasizes the importance of including music interventions in the treatment of autism and develop new methods for therapy, such as this device. The device design makes it possible to merge many aspects of sensory integration into a new experience engaging auditory (music and sound), tactile (texture and vibrations), visual (colours and patterns) and kinaesthetic senses (movement). While the music calms and distracts, the multi-sensory experiences may be simultaneously processed more easily by the autistic system, making it possible to achieve therapeutic goals, and furthermore to improve the lives of people with autism and by extension the whole family.

428.077 *(Poster)* The Effect of Exercise on the Anxiety Levels of Children with Autism Spectrum Disorder

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Background: Anxiety is a common comorbidity in children and adolescents with Autism Spectrum Disorder (ASD), with nearly 40% of youths with ASD meeting the diagnostic criteria for at least one anxiety disorder (van Steensel et al. 2011). Treatments for anxiety are severely lacking, particularly for children with severe ASD. Exercise has been proven to have a beneficial effect on decreasing anxiety symptoms in typically developing children (Ahn and Fedewa 2011; Jayakody et al. 2014) and may also have similar effects in anxiety in children with ASD. However, there is very limited research into this topic. Only one study to date has investigated the impact of exercise in ASD (Hillier et al. 2011). They found that an 8-week exercise and relaxation programme resulted in a significant reduction in salivary cortisol levels and self-reported anxiety after the exercise sessions, however this reduction was not maintained over time (Hillier et al. 2011). This shows the possible potential exercise has at decreasing anxiety in children with ASD but more studies are required.

Objectives: Therefore, the aim of this study is to assess the effects of exercise on anxiety in children with ASD.

Methods: Fourteen children (5-18 years), with moderate to severe symptoms of ASD were included in the study. A 16-week school-based exercise programme was implemented three days a week for 60 minutes per session. Parents and teachers assessed anxiety using a standardised measure, Anxiety Scale for Children with ASD (ASC-ASD) (Rodgers et al. 2016). Anxiety was measured before the programme, at week 8 and at the completion of the programme at week 16. Data was analysed using a repeated measure of variance (ANOVA) or non-parametric equivalent as appropriate.

Results: For the teacher scales, total ASC-ASD scores decreased significantly between the start and end of the program ($p = 0.001$, $h^2 = 0.42$). Analysis of individual subscales showed a significant reduction in performance anxiety ($p = 0.001$, W = 0.01), anxious arousal ($p = 0.000$, W = 0.07) and uncertainty ($p = 0.002$, $h^2 = 0.39$), but not separation anxiety ($p = 0.282$). However, total parent reported anxiety did not decline significantly, and there was a non-significant reduction in subscales.

Conclusions: The results of this study show the potential beneficial effects that exercise may have on reducing anxiety in children with ASD in a school setting. As higher anxiety levels were reported at school than at home, this may explain the greater impact of exercise seen at school. The results of this research are positive and suggest that exercise may be a beneficial treatment for anxiety in children with moderate to severe symptoms of ASD.

428.078 *(Poster)* The Effectiveness of Preventive Disclosure in Influencing Peer Engagement for the Child with Autism in Summer Camps: A Within-Case Mixed-Methods Study

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Background: Children with autism are at high risk of experiencing social exclusion, especially in community programs. Planned sharing of a child's diagnosis and information about behaviours (preventive disclosure + explanation) might be one way to reduce stigma and increase social inclusion by increasing peers' understanding of the child. All studies evaluating preventive disclosure to date have been based on hypothetical vignettes. No study has evaluated the effects of preventive disclosure in real life contexts, including community programs.

Objectives: To evaluate the influence of preventive disclosure on peer engagement and inclusion of a child with autism in a summer day camp. We hypothesized that peer engagement would increase following disclosure for a child in the disclosure condition, and decrease over the week for the same child in the non-disclosure condition.

Methods: This poster presents a sub-analysis of data from a larger mixed-method study evaluating outcomes of preventive disclosure on peer engagement and inclusion of children with autism in one type of community program, inclusive week long summer camps. This in-depth evaluation compares outcomes for one child who participated in two different summer camps, one in which he disclosed and one in which he did not disclose. For both conditions, 15-minute videos were collected on the first (baseline; pre-disclosing for that condition), second (post-disclosing for that condition) and last day of the program (follow-up). The primary outcomes were peer engagement states and reciprocal interactions (initiations and responses) for the child with autism and his peers, coded by a blinded observer using a time-interval behavioral coding system, the Playground Observation of Peer Engagement (POPE). Parents' completed the Adaptive Behavior Assessment System, third edition (ABAS-3) to describe the functional abilities of the child. Semi-structured interviews about perceived outcomes of disclosure were completed with the camp leader, the child with autism, and five peers (disclosure condition only). These data were thematically analyzed.

Results: Our participant was a 9-year-old boy with autism. He communicated verbally in full sentences. ABAS-3 scores indicated adaptive functioning in the extremely low to borderline range across domains. Peer engagement for the child in the disclosure condition increased over the week (20% of intervals jointly engaged at baseline, 30% post-disclosure/day two, 80% follow-up). Reciprocal interactions between the child with autism and peers also increased throughout the week. In the nondisclosure condition, peer engagement rates decreased over the week (60% intervals jointly engaged at baseline, 53% day two, 27% follow-up). Similarly, peers' initiations and positive responses towards the child with autism decreased over the week. Overall, interview participants indicated positive experiences related to the disclosure. Thematic analysis of interview data revealed four themes: (1) changed behavioral attribution, (2) unconditional inclusion by some peers, (3) improved inclusion for some peers, and (4) disclosure is good, autism is a part of who I am.

Conclusions: This study provides preliminary data to support the hypothesis that preventive disclosure and explanatory information may be a useful component of processes meant to improve peer engagement and inclusion of children with autism in community programs.

428.079 *(Poster)* The Effects of Creative Movement Interventions on the Motor and Social Skills of Children with Autism Spectrum Disorder (ASD)

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Background: Children with Autism Spectrum Disorder (ASD) often receive Applied Behavior Analysis (ABA) interventions that are predominantly sedentary and primarily focus on improving the child's language, behavioral, and academic skills. Our lab has focused on the effects of various creative movement interventions using rhythmic movement, yoga, or dance-based activities to promote social and motor skills of children with ASD (Srinivasan et al., 2015a,b; 2016a,b; Peace et al., 2019; Kaur & Bhat, 2019).

Objectives: In the past studies, we investigated the impact of different creative movement approaches on the social communication and motor skills of children with ASD. These studies reported improvements in social skills (i.e., smiles, verbalization quality/quantity of responses), as well as motor performance (i.e., movement accuracy), post-intervention. In this talk, we will report the differential effects of the various Creative Movement approaches on the social communication and motor skills of children with ASD.

Methods: School-age children with ASD between 5.5 and 14 years of age participated. Each intervention (seated play/ABA, rhythm, yoga, or dance) was implemented over 8 weeks, with two weekly, expert-led sessions and additional parent sessions at home. Each session involved a hello song/game, warm-up/reading, 2-3 themed activities, and a farewell song/reflection. Variables coded include balance and bilateral coordination scores, praxis scores, imitation accuracy, and rates of smiling and verbalization.

Results: Our results show that post-intervention, social skills (smiles, verbalization rates) and motor skills (movement accuracy and praxis scores) improved with specific differences across groups that will be further discussed in the talk.

Conclusions: Based on our findings, we propose combining therapeutic activities across the different themes into one complex/blended intervention to maximize the positive effects on social and motor skills in children with ASD. We are now implementing a pilot randomized controlled trial (RCT) of such a complex intervention and hope to maximize the therapeutic benefits on both, social communication and motor abilities of children with ASD.

428.080 *(Poster)* The Efficacy of a Brief Career Development Program for Young Adults with Autism

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Background: The transition to adulthood is a critical and stressful time period for individuals with autism and their families. Young adults with autism face many challenges that can make it difficult to plan for a career or find and maintain a job, which often leads to un- and under-employment. Therefore, there is a critical need for services that can aid in post-secondary employment and education. However, only a few evidence-based transition programs exist for young adults with Autism Spectrum Disorder (ASD), though they are longer term and are not designed for higher functioning individuals nor do they use individual strengths and weaknesses profiles for matching skill level with postsecondary vocational planning.

Objectives: The objective of this study was to close this gap in knowledge and services by studying the efficacy of a brief career development program that includes an individualized strengths and weaknesses profile, which is commonly used with neurotypical young adults, in combination with a short term (i.e., 12-week) educational transition training program for young adults with ASD.

Methods: Twenty-one young adults, ages 16-22 years with ASD (Mean IQ Composite = 94.43, SD = 14.68), participated in two intervention modules: (1) an individualized strengths and weaknesses profile using the Strong Interest Inventory and Myers-Briggs Type Indicator and (2) a 12-week transition skills training, which included instruction in goal setting, organization, time management skills, resume building, interview skills, mock interviews, social skills in the workplace, career interests, and choosing a career path. The Vocational Index Scale, which is a broad and reliable measure of vocational and educational activities in young adults with ASD, was administered before and after the intervention. Secondary outcome measures were cognitive task performance on the Stroop Color-Word Test and the Wisconsin Card Sorting Test (WCST).

Results: Results showed significant increases in the vocational index score ($t = 2.73$, $p = 0.014$) and Stroop Color-Word Test performance ($t= 2.39$, $p = 0.027$ for color–word t score and $t = 2.61$, $p = 0.017$ for word t score) from before the intervention to post intervention. No significant differences were found in the WCST.

Conclusions: The findings of this study suggest preliminary efficacy of a brief career development program combining career counseling tools commonly used with neurotypical adults with an educational 12-week transition training program for individuals with ASD.

428.081 *(Poster)* The Impact of Training on Law Enforcement Officers' Preparation for Calls Involving Autism

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Background: Exposure of problematic interactions between law enforcement officers (LEOs) and individuals with autism spectrum disorder (ASD) in the media has resulted in increased attention to the need of ASD-specific training for law enforcement officers (LEOs). Given ASD affects an estimated 1 in 59 individuals 8 years and older in the US, it is likely that LEOs interact with individuals with ASD on a fairly regular basis; however, LEOs report limited knowledge, confidence, and prior training for working with individuals with ASD.

Objectives: The primary author created a bi-monthly training program for LEOs that prepares officers to recognize signs and symptoms of ASD and adapt their responses in crisis situations to meet the needs of individuals on the spectrum. The purpose of the present study was to determine if there were changes in knowledge of ASD, confidence, and self-monitoring following ASD-specific training in a sample of LEOs from the police and sheriff departments in the Tampa Bay area of the state of Florida.

Methods: One-hundred and fifty-seven LEOs attended four separate training sessions. LEOs were 66.2% male with a mean age of 39.99 years (SD = 10.1) and 12.58 years of law enforcement experience (SD = 8.9). LEOs completed a four-hour training session focused on: (a) identifying behaviors associated with ASD, (b) adapting behavior for successful resolution to calls, and (c) introduction to communication tools and strategies for use with individuals with ASD. Participants completed demographic information at pretest, and, at pretest and posttest, a 16-item measure of autism knowledge and a six-item measure of confidence in responding to an ASD-related call.

Results: For LEOs responding to calls involving ASD, those with ASD-specific training and Crisis Intervention Training (CIT) were no more likely to report feeling prepared to respond to the call. Compared to LEOs without ASD-specific training, those with prior training were equally likely to: (a) use physical force during the call, χ^2 (1, N = 95) = 0.82, p = .78, (b) use handcuffs, χ^2 (1, N = 94) = 2.13, p = .15, and (c) have the call result in involuntary hospitalization, χ^2 (1, N = 94) = 0.22, p = .64. Two, 2 (Time) x 2 (ASD Training status) x 2 (CIT Training status) mixed design ANOVAs resulted in significant main effects for Time. For *knowledge*, scores improved, F(1, 122) = 100.37, p < .001, from pretest (M = 12.28, SD = 1.9) to posttest (M = 14.16, SD = 1.3). For *confidence in responding*, scores improved, F(1, 122) = 64.15, p < .001, from pretest (M = 15.56, SD = 4.0) to posttest (M = 18.90, SD = 3.1).

Conclusions: Findings provide initial support for the value of LEO training to respond to ASD-related calls. Our design did not include a control group; therefore, we cannot conclude that gains in knowledge and confidence resulted from the training. Future work should include a control group to establish causal evidence in support of LEO training

428.082 *(Poster)* The Program to Assist Social Thinking (PAST): A School-Based Socioemotional Intervention for Children with Autism

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Background: It is particularly important to understand how socioemotional interventions can assist children with autism within the school setting. Many existing mental health interventions for children with autism are provided in clinical settings; however, the importance of targeting socioemotional interventions in contexts where youth spend much of their time – which is with their peers and where they typically learn – is critical. Innovations are occurring in the school system, but work is needed to understand their impact.

Objectives: The purpose of this study was to explore the experiences of students with autism who attended a school-based socioemotional intervention, the *Program to Assist Social Thinking* (PAST). The PAST program is a school-based intervention. Registered students attend the PAST program one day each week from October to June. The focus of this 3-year curriculum is on incorporating behavioural and cognitive-behavioural strategies in the context of a Social Thinking approach (Winner, 2007) to support the socioemotional development of students with autism.

Methods: A qualitative methodology was used consisting of focus groups conducted with 10 PAST students (grades 3 to 6) and individual interviews with eight parents of PAST students. Questions focused on how the program helped students with various social, emotional, and academic needs in the school setting. Interviews were audio-recorded and transcribed verbatim. All data were organized using NVivo 11. Braun and Clarke's (2006) thematic analysis was used to analyze the focus group and interview data.

Results: A description of the PAST program and findings from the qualitative analyses will be presented. Preliminary results from the parent interviews yielded 3 major themes: (1) Connection and Belonging (forming friendships and meaningful bonds with PAST students and teachers), (2) Managing Stress (learning to cope with difficult situations), and (3) Positive Changes in Social Interest and Engagement (positive interactions with others). Preliminary results from the child focus groups yielded the following themes: (1) Friendship (social relationships with other PAST students), (2) Cooperation (learning to work together to solve social problems), and (3) Socioemotional Skill Building (learning to identify emotions in self and others, using skills to manage emotions).

Conclusions: The current findings highlight the perspectives of students with autism and parents of students with autism in a school-based supportive skill-building program. Participants described a variety of social benefits of the program. Future work examining the effectiveness of PAST as a school-based socioemotional intervention is warranted.

428.083 *(Poster)* Therapist Experiences of Psychological Treatment for School Attendance Problem and Psychiatric Comorbidities in Children and Adolescents with ASD: A Qualitative Study

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Background: school attendance problem (SAP) is common among children and adolescents with autisms spectrum disorder (ASD). Patients with ASD with SAP is an increasing group within Child and adolescent mental health care centres in Sweden, but there is a lack of guidelines for treatment or interventions targeted to this group.

Objectives: the objective of this study was to investigate therapists' experiences of psychological treatment of SAP and comorbid psychiatric disorders in children and adolescents with ASD. The question the study addressed was the therapists' perception of treatment outcome and their view of favourable factors as well as the barriers in the treatment.

Methods: twelve therapists were interviewed using a semi-structured interview. Interviews were audiotaped, transcribed verbatim, and initially independently coded by two coders. The interviews were analyzed according to thematic analysis and using the program software N-Vivo11.

Results: the majority of therapists reported that a frequent group that they delivered psychological treatment was children and adolescents with ASD with a prolonged SAP. Insufficient adaptations in response to core impairment of ASD and lack of support in their daily life could be factors to develop the SAP. Prolonged social isolation in combination with severe psychiatric comorbidities was reported as a treatment barrier. In addition, unclear assignments and insufficient coordination between Child and adolescent mental health centres and school-services obstructed returning to the school of this group. Favourable factors to positive treatment outcome were: an accurate and sufficient survey, coordination between mental health care and schools and environmental adaptation at school as well as at home, parent support and sometimes change of schools. Concerning useful therapeutic technics behavioural activation and applied exposure from cognitive-behavioural treatment was reported. The goals for treatment when treating absence is >1 year should be carefully evaluated and restricted to the assignment at Child and adolescent mental health care centre.

Conclusions: according to therapist experiences important factors that impact the outcome of treatment was the length of the school absence and the severity of psychiatric comorbidities in patients with ASD. This entails more resources at home, school and mental health care are needed as well as better cooperation between these. According to the therapists' experiences, children and adolescents with ASD with limited societal support tends to develop SAP. We suggest that more research about SAP in children and adolescent with ASD and psychological treatment for this group is needed.

428.084 *(Poster)* Training Workplace Social Skills for Adolescents with ASD

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Background: Researchers have reported low rates of employment of individuals with ASD, with a failure to obtain employment after educational training being associated with lack of employment throughout the lifespan (e.g., Cimera & Cowan, 2009). Often, these challenges are directly associated with deficits related to social communication. More specifically, poor attendance, abusive behaviors, refusal to accept feedback, antisocial behavior, and physical appearance have been identified as social behaviors related to limited employability of individuals with ASD (Olson, Cioffi, Yovanoff, & Mank, 2001). Recent research has indicated that having well-developed social skills is predictive of employment following educational training—an unsurprising finding given that employers have rated effective social skills as one of the most important traits of employees with disabilities (Ju, Zhang, & Pacha, 2012). Despite the importance of social functioning, few interventions exist to address social skills necessary for vocational success for individuals with disabilities–with most research instead focusing on developing vocation specific behaviors.

Objectives: The purpose of the study was to evacuate an intervention package containing evidence-based strategies that school personnel can use to promote social skills in the workplace setting. Whereas a previous pilot study (Authors, 2019) had indicated the utility of such procedures in promoting social skill acquisition, this study sought to provide a systematic replication with participants with varying levels of cognitive functioning.

Methods: Five students with ASD participated in this study. All students were between the ages of 18 and 21 and were participating in a transition program. As a part of program requirements, each participant rotated across three internships during the school year where they were employed at various sites (i.e. food pantry, recreation center, dining, and child care centers). Target skills were selected via teacher interview and included Asking Questions, Following Multi-step Directions, Multitasking, Interacting with Someone Unfamiliar, and Interpreting Others Intentions. Training sessions were conducted once a week in the participants classroom and lasted an hour. The primary dependent variable was skill acquisition in the training setting with a secondary dependent variable of generalized skill acquisition to the workplace setting.

A multiple baseline design across skills was utilized to evaluate the effects of the social skills intervention package on the participants skill acquisition. Probes of skill accuracy were given across all phases of the study. Data were analyzed using visual analysis and Baseline Corrected Tau, a single case effect size estimate.

Results: Increases in level and trend were observed across participants, skills, and settings following the introduction of the intervention. Further, accurate demonstration of skills was maintained following the termination of training. Overall, this packaged intervention was effective in promoting vocational social skills.

Conclusions: Results of the study provide additional evidence of the effect of the program in promoting social skills in the workplace. Findings are of particular importance, as improvements in skill use were found to generalize to non-training settings. As such, practitioners and researchers may consider utilization of such procedures as a component of vocational preparation and transition programming for individuals with ASD.

428.085 *(Poster)* Training in-Vivo Social-Emotional Attention Improves Social Cognition: RCT of a Low-Cost EMA-Delivered Intervention.

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Background: Evidence suggests that deficits in attention to social emotional stimuli in one's environment may underlie social challenges associated with autism spectrum disorder (ASD; Jones & Klin, 2013; Lerner et al., 2012). Interventions designed to facilitate social-emotional attention (SEA; e.g., by utilizing activities that require attention to/interpretation of faces) have elicited improvements in social connection and emotion identification (Lerner et al., 2011; Goldstein & Winner, 2012). While it has been hypothesized that this represents an "active ingredient" in such interventions, it is unknown whether simply potentiating alone SEA in everyday life can yield similar effects. Given challenges in these domains for those with ASD, it is likely that such changes would be greatest for those with higher ASD symptoms; if so, this could advance a low-intensity intervention for those with ASD.

Objectives: To test whether prompting SEA to interlocutors in daily life increases psychological and behavioral indices of social cognition, empathy, and prosociality, and whether autism symptoms moderate these effects.

Methods: Participants were 78 adults (M_{age}=22.35, SD_{age}=5.47) with IQ>70 (Table 1). They were randomized into one of two conditions and asked to log their social interactions via smartphone over 7 days. Those in the active condition were asked to pay attention to and report on the emotion of their interlocutor, while those in the control condition were asked to either pay attention to the hair color of their interlocutor or proceed with interactions as usual. Participants completed a variety of psychosocial measures related to social cognition and empathy pre- and post-intervention (MPDQ [Genero et al., 1992], SEIS [Schutte et al., 1998], BESA [Carré et al., 2013], DANVA-2 [Nowicki, 2004]) as well as reported how often they logged their social interactions during the intervention (i.e. compliance).

To determine whether condition predicted change in identified outcomes, we used an ANCOVA of change model, with condition moderated by compliance (to ensure participants actually engaged in SEA). Finally, we tested whether ASD symptoms as measured by the Adult Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001) further moderated the compliance x condition interaction.

Results: As compliance increased, SEA 1) marginally decreased MPDQ scores (b = -.0044, p = .0615) 2) marginally decreased total facial emotion identification errors on the DANVA-2 (b = -.0375, p = .0761) and 3) significantly decreased facial emotion identification errors for low-intensity (subtle) emotions (b = -.0375, p = .0320). AQ did not further moderate these effects.

Conclusions: Our results suggest that simply utilizing SEA in everyday life may lead people to more accurately process facial emotions, particularly subtle ones. They also appear to self-report marginally less connection to others, including the ability to pick up on their emotions. This is somewhat consistent with the Dunning-Kruger effect (Dunning, 2011) – that is, self-reported ratings of ability may actually decrease as actual performance improves via greater attunement to one's own abilities. Importantly, the effects of practicing attending to others' emotions held regardless of ASD symptoms, suggesting those with ASD may benefit equally from this approach.

428.086 *(Poster)* Translating Neuroprediction into Precision Medicine Via Brain Priming

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Background: Pivotal Response Treatment (PRT) is an evidence-based intervention for individuals with ASD; it was specifically designed to improve social communication by addressing core deficits in motivation. The neuropeptide oxytocin (OXT) plays a critical role in social functioning. Behavioral studies demonstrate that in children and adults with ASD, a single administration of intranasal OXT leads to increased willingness to interact socially, a better comprehension of affective speech, reduced repetitive behaviors, an increased understanding of others' mental states, and improved social cognition.

Objectives: The present study examines the impact of OXT and PRT on the development of language, social, and play skills in young children with ASD, specifically exploring OXT as an enhancer of response to PRT. The trial methods as well as the preliminary data are presented here.

Methods: To date, three children with ASD have fully completed the trial, ages 81, 92, and 81 months, (M= 84.67 months, SD= 6.35 months). The trial is open to children ages 5-9 years and is currently enrolling. All children have ASD as confirmed by the ADOS and expert clinical judgment. Participants complete 3 1.5- hour sessions weekly for 16 weeks. In addition, parents receive parent guidance and PRT training by a licensed clinician 1.5 hours weekly. Participants are randomly assigned to either oxytocin or a placebo and receive an intranasal spray before each PRT session. Clinical outcome measures include: SRS-II-Parent Version, Vineland-III, and ADOS. Children complete an fMRI and eye tracking at both pre- and post-intervention to assess for change in biologically-based preparedness for learning social communication skills. The fMRI task is a well-studied task of biological motion. fMRI data will be analyzed using two different machine learning algorithms to identify the regions of the brain that respond to improvement in social communication skills and predict the response to intervention. The eye tracking paradigms were developed specifically to assess changes in social attention and motivation and include clips from naturalistic social scenes.

Results: The clinical outcome measures are presented in case series format for the first 3 subjects. Specifically, Vineland-III, SRS-2, ADOS-2 scores are summarized. Please refer to Table 1.

Conclusions: This study is the first to combine oxytocin with a naturalistic behavioral intervention to determine if oxytocin has an added effect to PRT alone, at both the behavioral and neural systems-level. As seen by the Vineland-III scores, there were notable improvements in adaptive functioning. The current sample remained constant in their ADOS scores. A decrease in Child 2 and Child 3's SRS-2 scores are indicative of a decrease in ASD-related symptoms pre- to post-intervention. While the study is in its preliminary phase, it is highly novel and innovative in design and the initial findings are promising.

428.087 *(Poster)* Understanding the Daily Activities of Adolescents with Autism Spectrum Disorder and Intellectual Disability Receiving Group CBT Treatment for Anxiety

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Background: Adolescents with Autism Spectrum Disorder (ASD) and Intellectual Disability (ID) are at risk for significant anxiety and behavioral challenges (Helverschous & Martinson, 2011). Additionally, research suggests that teens with ASD and ID spend less time with peers and spend more time with paid professionals than teens without ID (Orsmund & Kuo, 2011). However, it is important to better understand the daily activities that this highly understudied and underserved population are engaging in, and how activities may be related to anxiety treatment outcomes.

Objectives: The purpose of the present study is to 1) identify the amount and frequency of daily activities that adolescents with ASD and ID engage in outside of school, and 2) to determine if there are changes in the total number and frequency of engagement in these activities following participation in anxiety treatment.

Methods: The present study involves data analyses from pre-intervention measures collected in an initial study that examined adolescent treatment outcomes in response to a modified group CBT program for youth with ASD, ID and co-occurring anxiety, derived from the Facing Your Fears program (FYF) (Blakeley-Smith et al.,INSAR presentation 2019; Reaven et al. 2011). A sample of 23 adolescents (*M* = 15.9, range: 12-18) with ASD and ID were included. Participants had a mean Full Scale IQ of 58.3 (SD = 12.1, range: 40-79) and a mean Adaptive Behavior Composite of 57.45 (SD= 13.2, range: 40-79). Anxiety was assessed via parent report on the SCARED (Birmaher et al. 1999) and Anxiety Depression and Mood Scale (ADAMS; Esbensen et al. 2003). Participants' parents completed the Children's Assessment of Participation and Enjoyment (CAPE; King, et.al. 2004) to measure teens' participation in recreation and leisure activities outside of mandated school activities. Dependent t-tests were conducted to examine pre-post differences in activity engagement.

Results: Results suggest that participants engaged in an average of 24.32 activities of the possible 55 on the CAPE (SD=6.61, 44.21% of activities). On average, as reported in the CAPE, participants engaged in activities with low intensity (less than 1 time per month), with a family member in their neighborhood, and with moderate enjoyment at pre-intervention (see Table 1). As previously reported in a prior presentation, there were significant decreases in anxiety as measured by the SCARED and ADAMS (Blakeley-Smith, et. al. INSAR presentation, 2019). However, there was not a significant change in the total activities endorsed on the CAPE (Diversity) from baseline (M=22.56, SD=8.04) to post-intervention (M=23.39, SD= 7.52) time points, t(18)=-0.52, p=0.61. Additionally, there were no significant changes in the frequency of activities (CAPE Intensity) from baseline (M=1.90 SD= 0.63) to post-intervention (M=1.93, SD=0.64) t(18)=-0.24, p=0.81.

Conclusions: These results suggest that while anxiety symptoms decreased following intervention, no changes were noted in engagement in recreational activities. Additional research is needed to understand factors that influence activity engagement in this population. Future research should include a larger sample size, and consider intervention components that may increase family access to recreation and leisure activities.

428.088 *(Poster)* Use of Multisensory Environments to Improve Outcomes for Individuals with Autism Spectrum Disorder: A Systematic Review

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Background: The sensory environment of education and healthcare settings have the potential to impact patient, caregiver, and provider outcomes. The Multisensory Environment (MSE) manipulates sensory features of the environment, often including adaptations to visual, auditory, tactile, and olfactory stimuli. Providing these stimuli, MSEs are reported to promote relaxation and engagement, and reduce aggression and self-injurious behaviors in users, including individuals with ASD. MSEs are popular in Europe and have been increasingly incorporated within the United States and Canada in hospitals, airports, and schools in the last decade. Despite this enthusiasm, criticism continues regarding the quantity and quality of existing MSE research.

Objectives: To systematically review available literature regarding the impact of MSEs on outcomes in individuals with ASD.

Methods: Seven databases were searched using the keywords "Snoezelen/Multisensory Environment," "sensory room," "autis*." Experimental studies utilizing an MSE, written in English, including individuals with ASD, and published from 1990 to October 2019 were included. Study characteristics, methods, and outcomes were organized and reported in tabular form. Studies wereappraised for methodological quality using a checklist with a maximum score of eight (Jinks, Cotton, & Rylance, 2010) and level of evidence via The Oxford Levels of Evidence 2 , a five-level study design rating matrix (OCEBM, 2011) by two independent researchers.

Results: The search produced 19 articles that met inclusion criteria. Of these, 11 were quantitative, 6 qualitative, and 2 mixed methodology. Of the quantitative studies the majority (82%) were non-randomized or single-subject research and 2 were randomized control trials. Participant ages ranged from 1 – 71 years, with the majority of articles focusing on a pediatric population (n=11). Studies were conducted in a variety of settings, including schools (n=9), adult day centers (n=2), residential settings (n=4), other community sites (n=3), and a dental clinic (n=1). Studies were conducted across a variety of continents including North America (n=9), Europe (n=5), Asia (n=3), and Australia (n=2). The majority of studies examined behavioral outcomes such as stereotypy, active engagement, and disruptive behaviors. Other commonly examined outcome measures included caregiver/provider and participant perceptions and anxiety, via electrodermal activity and caregiver report. Study results ranged from null to positive. Most studies reported mixed results (70%), with no negative outcomes reported. The average methodological quality score was 5 with a range of 3-8 points, indicating the majority of articles demonstrated at least two methodological issues. Based on OCEBM levels, 5 studies met a relatively high level of evidence (Levels 4-5), 6 met a moderate level of evidence (Level 3), while 8 demonstrated a lower level of evidence (Levels 1-2).

Conclusions: Based on our findings, there is preliminary evidence for the use of MSEs with individuals with ASD to promote engagement and reduce disruptive behaviors and anxiety symptoms. Despite this emerging evidence, many studies reported mixed results and few reported carryover effects beyond the MSE highlighting the need for further research. Additionally, the relative low number of randomized control studies highlights the need for more rigorous research into the efficacy and effectiveness of MSEs for individuals with ASD.

428.089 *(Poster)* Use of a Latest-Generation Multi-Sensory Interactive Room in the Intervention with Children and Adults with Autism Spectrum Disorders

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Background: Considering the sensory peculiarities in Autism Spectrum Disorders (ASDs), some experiences with Multi-Sensory Interactive Rooms (MSIRs) have been reported over the last 20 years. These environments provide sensory stimulation calibrated on the users and the possibility to interact with the stimuli, experiencing a sense of control over the environment. According to the few studies conducted so far, MSRIs seem to favor a positive emotional state in users with ASD, a decrease in problem behaviors and longer attention spans. However, the possibility of working in MSIRs also on functions that are compromised in ASDs has not been investigated. Moreover, in the latest-generation MSRIs, physical objects have been completely replaced by digital projections, more varied and engaging but also more abstract and therefore potentially more difficult to understand for users with intellectual disabilities.

Objectives: The aim of this study was to establish whether a latest-generation MSIR is suitable for intervention on cognitive functions in ASDs, with respect to different age and functioning levels of users.

Methods: 27 subjects (18 children, mean age 5.57 years ± 1.11, 9 high- and 9 low-functioning, and 9 adults, 24.8 years ± 7.01, 3 high- and 6 low-functioning) underwent 5 sessions of 30 minutes in the MSIR. Intervention on the following functions was performed using protocols calibrated for sensory stimulation and difficulty level on the characteristics of the single participant: Maintaining instruction, Selective attention, Looking at and doing, Verbalization, Receptive communication, Turn, Memory, and Inhibition. During each session, a score (from 1 = not performed to 5 = autonomously performed) was assigned to each function in each activity that included it, calculating the average score at the session end. Wilcoxon signed-rank test on repeated measurements was conducted on the differences in performance in each function between session 1 and session 5, in the whole sample and in the subgroups Low-/High-functioning and Children/Adults.

Results: Performing the protocol has been impossible with 6 low-functioning subjects because of their difficulties in understanding the MSIR and regulating themselves inside it. Nevertheless, a reduction of the sensory stimulation and an approach based on subjects' personal exploring initiatives have allowed engaging them in some activities. For the others (13 children and 8 adults), statistically significant increases were detected in all functions, both in the whole sample and in the subgroups High-functioning and Children. In particular, in the entire sample and in the High-functioning subgroup the greatest increase was recorded for Verbalization (1.33 ± 0.75, p-value = 0.001 and 1.63 ± 1.18 p-value = 0.03 respectively) and Turn (1.30 ± 1.03, p-value = 0.002 and 1.87 ± 1.01, p-value = 0.001 respectively). Instead, for the Children subgroup in Verbalization (1.73 ± 1.22, p-value = 0.001) and Memory (1.65 ± 1.68, p-value = 0.018).

Conclusions: MSIRs solely based on interaction with digital projections seem suitable for intervention on cognitive functions in ASDs. However, possible difficulties with low-functioning subjects should be considered. Further studies are needed to fully explore the potential of MSIRs, also concerning other aspects (e.g. social interaction with peers).

428.090 *(Poster)* Utilizing Compass Supervision to Improve Intervention Plan Quality for Students with Autism

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Background: The Collaborative Model for Promoting Competence and Success (COMPASS) is an evidenced-based, child-centered intervention that has been tested in three RCTS and improves educational outcomes for children with autism spectrum disorder (ASD). COMPASS starts with a parent-teacher consultation designed to create a holistic picture of the child at home and school. This shared understanding is then used to identify and develop personalized goals and intervention plans in the domains of social, communication, and learning skills. COMPASS is complex because the intervention plans developed are personalized based on an evidence-based practice in psychology (EBPP) approach that takes into account the specific contexts, strengths, and challenges of the student, teacher, and environment. Thus, a question concerns whether school-based ASD consultants are able to develop high quality and impactful intervention plans.

Objectives: The primary goal of this study is to describe the impact of supervision on changes in intervention plan quality over time.

Methods: School-based ASD consultants completed 16 hours of COMPASS training, then conducted consultations with 4 teacher-parent dyads. After each consultation, consultants were provided with supervision by the researchers who evaluated the quality of the intervention plans and provided qualitative feedback.

The study was conducted using an iterative design over two waves. Wave 1 included two consultants who worked with eight caregivers and special education teachers. A 16-item intervention plan quality checklist (α = .795) based on a dichotomous scale (yes/no) was developed by the researchers to assess items such as quality of the goals, inclusion of evidence-based practices for children with ASD, clarity and specificity of intervention plans, and common elements of effective teaching. This checklist was completed both by consultants and researchers. Wave 2, currently in progress, includes seven consultants and 28 dyads of parents and teachers. In addition to the 16-item consultant and researcher-rated intervention plan quality checklist developed in Wave 1, a six-item rating scale was also developed for teachers to complete after receiving the intervention plans developed during the consultation. This scale asks teachers to rate how clear, relevant, realistic to implement, appealing, consistent with values, and effective the intervention plans are from their perspective. This will also be shared with consultants as a part of supervision.

Results: Preliminary results from Wave 1 indicate that intervention plan quality improved from the first to the fourth consultation 51%, 60%, 69%, and 84% respectively. Wave 2 data is currently being collected, and will be reported in the final presentation. Once full data are available, repeated measures ANOVA will be used to evaluate the impact of supervision and teacher feedback on changes in intervention plan quality.

Conclusions: COMPASS is an EBPP intervention that has promise of widespread impact on educational outcomes of children with ASD. But the complexity of interventions may keep empirically-supported interventions from being adopted and sustained. Initial data indicate that despite the complexity with COMPASS, our supervision, feedback, and support provided to consultants enhances intervention plan quality.

This work was supported by Grant R34 MH111783-02 from the National Institute of Mental Health

428.091 *(Poster)* Virtual Reality and Video Modeling Interventions Improve Self-Reported Knowledge/Comfort during Police Interactions for Autistic Adolescents and Adults

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Background: Individuals with Autism Spectrum Disorder (ASD) often have difficulty with novel problem solving and rapidly processing social situations in real time (Channon et al., 2001; Vanmarcke et al., 2016). Interactions with police officers are unique, unscheduled, and unplanned social situations that can introduce a high level of stress and are experienced by individuals across a wide range of functioning (Rava et al., 2016). Therefore, it is important to prepare individuals for this type of interaction. Virtual reality (VR) can be a useful training tool as it provides individuals with the opportunity to practice something multiple times under simulated conditions. In the current preliminary analysis, we compare the effectiveness of an immersive VR-based intervention versus a video-modeling intervention to teach police safety skills to adolescents and adults with ASD.

Objectives: Compare the effectiveness of two different intervention formats by assessing (1) live ratings of participant behavior during police interactions (or simulated interactions), and (2) participant self-reports of police interaction knowledge/comfort pre-/post-intervention.

Methods: Thirty-nine verbally fluent adolescents and adults with ASD were randomly assigned to complete either three sessions of the immersive VR-Based Police Safety Module (PSM) or a video modeling-based intervention (BeSAFE). To measure change in behavior and knowledge/comfort, participants engaged in a 3- to 5-minute live interaction and completed a questionnaire pre- and post-intervention. At baseline, participants interacted with a study staff member who presented as a police officer. After completing the intervention, participants interacted with an actual police officer or a uniformed security officer. During the interactions, experimentally blinded staff members and police officers completed a series of ratings on a six-point Likert scale (strongly disagree–strongly agree) about the participant's behavior. Ratings included questions about appropriateness of the participant's verbal responses, nonverbal behavior, and eye contact. The police knowledge and comfort questionnaire included questions such as, "I feel I know how to act around police officers," and "I feel comfortable being interviewed by police officers." Two generalized linear mixed effects models (lme4 in R) were used to predict (1) behavioral ratings, and (2) police knowledge scores from the interaction between condition and time (pre/post intervention).

Results: Preliminary analyses of 39 participants indicated a significant main effect of time on police knowledge and self-reported knowledge and comfort (Estimate: 10.25, SE: 1.86, t=5.50, p<.001), and no significant interaction between time and intervention format (VR vs. video modeling; p=ns). Live interaction assessment scores (conducted by staff and officers) did not significantly change from pre- to post-intervention, and there was no significant interaction between condition and time (all ps=ns). These results are preliminary and data collection is on-going (final sample N=48; complete by May 2020); final results may differ.

Conclusions: It is important to equip individuals with ASD with social skills in a format that is comfortable, motivating, and effective. In this preliminary analysis, participants reported improved police knowledge and comfort interacting with officers after completing VR-based and video modeling-based interventions. The present study is ongoing and we anticipate reporting results from the complete sample (N=48) by May 2020 (clinicaltrials.gov=NCT03605368).

428.092 *(Poster)* Vitamin D3 Combined with ABA Therapy for Treatment of Children with Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social interaction and communication, repetitive and stereotypic behaviors, and restricted interest. It has been regarded due to genetic and environmental risk factors. Vitamin D deficiency has recently been proposed as a possible environmental risk factor for ASD. ABA has been reported in improving social interactions of children with ASD for the last decades.

Objectives: To study the clinical effect of vitamin D3 (VitD3) combined with ABA in the treatment of children with autism spectrum disorder (ASD).

Methods: A total of 90 ASD children with VitD3 deficient, aged 7 to 12 years, were recruited and divided into three groups: ABA group (n=30), VitD3 group (n=30), and ABA+VitD3 group (n=30). Autism Diagnosis Observation Scale (ADOS), Social Communication Questionnaire (SCQ) and Childhood Autism Rating Scale (CARS) were used to evaluate social communication skills before and after 12 weeks of treatment.

Results: The ABA group had significant reductions in the total score and the scores on social communication in ADOS after 12 weeks of treatment (P<0.05) as well as a significant reduction in the total score of the SCQ and CARS (P<0.05). After 12 weeks of treatment, the ABA+VitD3 group had a significant increase in the level of 25(OH)D and significant reductions in the total score and the scores on social communication subscales of ADOS (P<0.05), as well as a significant reduction in the total score of the SCQ and CARS (P<0.05). The ABA+VitD3 group had a significantly greater reduction in the score on social interaction subscale than the other two groups (P<0.05).

Conclusions: ABA can effectively improve the clinical symptoms of toddlers with ASD, with a significantly better clinical effect in improving social interaction. ABA combined with VitD3 has a significantly better clinical effect in improving social communication skills and may be one of the best strategies for improving the clinical symptoms of toddlers with ASD.

428.093 *(Poster)* "Snack Talks": Effects of a Visual Communication Support on Increasing Conversation Engagement for Adults with Autism

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Background: Rates of autism spectrum disorder (ASD) diagnoses continue to rise, challenging adult service providers to support a growing number of adults with autism. Yet reviews of extant literature indicate that social outcomes for adults with ASD are typically poor. Further, few evidence-based social interventions exist for adults. As most social skills interventions are developed with children, these interventions may not be aligned with the social needs of individuals with ASD when navigating adulthood settings. Thus, targeted social skills and social communication interventions that are aligned with the needs of adults are warranted.

Objectives:

1. Describe the development and implementation of "Snack Talk", a naturalistic visual communication support used to increase social communication during mealtimes.
2. Examine potential social outcomes of mealtimes, as individuals are included in a naturally occurring routine with numerous social opportunities to build social relationships and increase overall quality of life.
3. Report findings from the implementation of "Snack Talk" with five adults with ASD and other developmental disabilities.

Methods: This intervention utilized single case research methodology. A reversal design across participants was employed to analyze the effectiveness of the intervention. Prior to intervention, participants were interviewed to identify common interests and preferences. Next, "Snack Talk" supports were developed, including a topic question and multiple visual/text possible answers in this support. Baseline conditions consisted of typical mealtimes, with no intervention implementation. Intervention conditions consisted of implementation of "Snack Talk" intervention procedures. Mealtimes were video recorded and coded to identify conversation engagement using 10-second partial interval recording. Percent of intervals engaged in conversation was reported. Upon completion of intervention, social validity surveys were distributed to interventionists and study participants.

Results: Implementation of "Snack Talk" supported increased conversation engagement across all participants during intervention and generalization phases as compared to baseline. Generalization phases indicated all participants either maintained or engaged in higher levels of conversation engagement with peers and staff. A functional relationship was established for four of the five participants. For one participant, stability was variable throughout intervention phases. This is attributed to consistent changes in medication and attendance. Social validity findings indicated staff felt the intervention was acceptable, sustainable, and effective. All participants indicated that they enjoyed participating and using "Snack Talk" cards and identified strong interest in continuing using these supports outside of intervention.

Conclusions: Targeted interventions aligned with the social needs of adults with ASD are essential to support individuals with ASD entering adulthood. "Snack Talk" is easily implemented and can be adapted to meet the individual interests and needs of adults with ASD. As a low-cost and low-tech intervention with simplistic procedures and high social validity, "Snack Talk" is a sustainable intervention that can be implemented with few resources to support social engagement. Engagement in strong social skills during naturally occurring routines, such as mealtimes, is meaningful, as it fosters peer relationships. Ultimately, these increased relationships play a large role in reducing feelings of isolation and instead ensure adults with disabilities have access to community membership.

428.094 *(Poster)* "We Can See a Bright Future": Parents' Perceptions of the Outcomes of Participating in a Strengths-Based Program for Autistic Adolescents

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Background: Despite autistic individuals commonly possessing specific strengths, skills and abilities, young autistic people often experience poor outcomes in education, employment and community engagement. Interventions targeting the strengths and talents of autistic adolescents may improve their transition and outcomes in adulthood, building pathways to employment and further education.

Objectives: This study examines the first wave results of a three-year longitudinal survey evaluating the long-term outcomes in sense of belonging, self-esteem, health and well-being, social interaction, and activities and participation of autistic adolescents participating in a strengths-based program. This baseline study explores the principal components contributing to the success of a community strengths-based program and the outcomes for the autistic adolescents as a result of participating in the program as perceived by their parents.

Methods: An online survey was conducted with parents of autistic children who had previously or were currently participating in a strengths-based program that supports the development of special interests in Science, Technology, Engineering, Arts and Mathematics (STEAM). Activities include coding, Lego robotics, Arduino, digital media, music, visual arts and mathematic enrichment class. The survey includes both closed and open-ended questions, which will be circulated online for three consecutive years in 2018, 2019 and 2020. Fifty-two parents participated in the first year survey representing 53 autistic adolescents, with one parent reporting for her two attending children. Exploratory factor analysis was undertaken to identify the principal components of the strengths-based programs, while thematic analysis exploring parents' perceptions of the outcomes of participating in a strengths-based program for autistic adolescents was performed.

Results: Exploratory factor analysis of parents' viewpoints revealed three main factors underlying the strengths-based programs explaining a total of 64.03% of the variance: feeling accepted and engaged (37.98%), feeling at ease (16.52%), and improving social and coding skills (9.53%). Following participation in the program adolescents were more confident in asking for help, communicating and sharing what they had learnt with their autistic peers and mentors, and experienced the strengths-based program in a safe and informal learning environment. Parents perceived a positive impact on their autistic children's sense of belonging, self-esteem, health and well-being, social relationships and interactions, and activities and participation. Results demonstrate the importance of a supportive social environment in fostering adolescents' feelings of acceptance and in harnessing their unique skills and talents.

Conclusions: This initial study highlights the positive impact of strengths-based programs on participants' sense of belonging, self-esteem, health and well-being, social relationships and interactions, and activities and participation from their parents' perspectives. Understanding the strengths and abilities of autistic adolescents, and developing programs targeting and leveraging the skills, abilities and special interests of autistic adolescents is likely to improve their transition outcomes to adulthood. The principal components underlying the strengths-based programs provide a preliminary framework that may underpin future strengths-based interventions.

Interventions - Pharmacologic

PANEL SESSION — **INTERVENTIONS - PHARMACOLOGIC**

215 - Randomized Clinical Trials of Repeated Intranasal Oxytocin Treatment to Enhance Social Functioning in ASD

Panel Chair: Linmarie Sikich, *Department of Psychiatry and Behavioral Sciences, Duke Center for Autism and Brain Development, Durham, NC*

Discussant: Jeremy Veenstra-Vander Weele, *Psychiatry, New York State Psychiatric Institute / Columbia University, New York, NY*

This session will bring together investigators from around the world who are conducting randomized clinical trials of repeated doses of intranasal oxytocin in individuals with ASD. Each investigative group has taken a somewhat different approach in terms of the study population, outcome measures, context of treatment and examination of biologic factors that might inform the apparent lack of treatment response to repeated administration of intranasal oxytocin.

215.001 *(Panel)* Randomized Controlled Trial of Intranasal Oxytocin in Autism Spectrum Disorder

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Background: Recent evidence suggests that oxytocin (OXT) may have therapeutic potential in Autism Spectrum Disorder (ASD). Specifically, neuroimaging studies have reported that OXT enhances connectivity in the neural networks that support social functioning, with subsequent improvements in corresponding social behaviors. There has been growing interest in assessing the effectiveness of OXT treatment in ASD, although several methodological limitations exist, including sample size, varying measures of sociability and, lack of consensus on dosing, administration method and frequency of administration.

Objectives: The primary aim of this study was to examine the effect of OXT versus placebo on a measure of social function, specifically social withdrawal. A secondary aim of this study was to examine the effects of OXT on social cognition, repetitive behaviors, anxiety and, quality of life as well as assess the tolerability and safety of OXT in youth with ASD.

Methods: 60 children and adolescents (mean age: 12.4 +/- 1.8 years) participated in a 12 week, randomized, double-blind, placebo-controlled trial of OXT at 0.4 IU/kg twice a day. Participants completed: (1) the Aberrant Behavior Scale – Social Withdrawal subscale; (2) the Let's Face It! Skills Battery as a measure of social cognition; (3) The Child and Adolescent Symptom Inventory – Fourth Edition Revised (CASI-4R) as a measure of anxiety; (4) The emotional functioning subscale of Pediatric Quality of Life Inventory (PedsQL) and; (5) the Safety Monitoring Uniform Research Form (SMURF) to assess adverse effects.

Results: 54 patients completed the trial. Six patients withdrew from treatment early (5 active, 1 placebo), 1 due to adverse events and 5 due to the withdrawal of consent. There were no significant differences between active and placebo groups on social withdrawal (ABC-SW: $p = 0.60$). However, participants taking oxytocin did show significant improvement in social recognition (Let's Face it Battery: $p = 0.03$) as well as on the emotional functioning scale of the PedsQL ($p = 0.04$). A decrease in CASI anxiety scores was significantly associated with an increase in quality of life (PedsQL scores, $p < 0.001$). The effect of change in social cognition on change in quality of life was not significant. Oxytocin was overall well tolerated, with no serious adverse drug reactions reported. Furthermore, participants in the active group showed significant changes in plasma levels from week 12 to baseline ($M_{change} = 14.2$, $p = 0.03$) relative to those in the placebo group ($M_{change} = 1.5$). Preliminary results from the 30 participants who participated in an eye-tracking sub-study suggest emotion-based differences with oxytocin versus placebo on face processing tasks.

Conclusions: In our sample, oxytocin was not superior to placebo in the reduction of social withdrawal. However, participants taking oxytocin did show nominally significant improvement in social recognition and emotional functioning on the quality of life instrument. Improvements in anxiety but not social cognition partially accounted for improvements in quality of life, providing some mechanistic understandings.

215.002 *(Panel)* A Large, Heterogenous Ouble-Blinded Trial of Oxytocin to Enhance Social Behaviours in ASD

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Background: Preclinical evidence from some animal models with features of autism has demonstrated that exogenous oxytocin may improve social communicative functioning, albeit with differences in the timing and magnitude of such changes in different strains and sexes. In humans with Autism Spectrum Disorder (ASD), single doses of intranasal oxytocin have improved objective measures of social cognition as compared to placebo. However, placebo-controlled studies of repeated dosing with oxytocin have failed to demonstrate consistent improvements in social functioning of individuals with ASD. However, most of these trials have been small and relatively short. In addition, optimal dosing of intranasal oxytocin has not been established.

Objectives: The primary aim of the Study of Oxytocin in ASD to enhance Reciprocal Social Behaviors – SOARS-B was to examine the safety and therapeutic effects of oxytocin compared to placebo in a large, heterogeneous sample of children with ASD over a sufficiently long period of time to demonstrate meaningful changes in social functioning. In addition, the large sample, biologic and genetic/epigenetic measures collected were expected to facilitate identification of factors associated with oxytocin responsiveness..

Methods: 290 children and adolescents between 3 and 17 years were randomly assigned to twice daily treatment with oxytocin or placebo for 24 weeks. Randomization was stratified by the presence/absence of fluent speech. Dosing was titrated from 8 IU daily to a target of 24 IU twice daily with further increases after 8 weeks of the target dose to as much as 80 IU total daily dose. The primary outcome measure was the Aberrant Behavior Checklist – Social Withdrawal subscale (ABC-SW). Key secondary outcomes were the Social Responsiveness Scale, 2nd edition (SRS-2) and caregiver-completed Vineland Adaptive Behavior Scales, 2nd edition. The Reading the Mind in the Eyes Task was completed by subjects who verbally demonstrated understanding of different emotions. Plasma oxytocin levels were obtained prior to treatment and after 8 and 24 weeks of treatment. Adverse events were systematically elicited.

Results: The oxytocin and placebo groups were well matched. 16 participants withdrew prior to the first post-baseline assessment leaving 274 participants available for efficacy analyses. 253 participants completed the 24 week treatment period with more early withdrawals due to adverse events or clinical worsening in the oxytocin group (7) than in the placebo group (3), although more participants were lost to FU or noncompliant in the placebo group. There were 3 serious adverse events during double-blind treatment, including sedation leading to a car accident in a participant receiving oxytocin. There was no difference in the reduction in the ABC-SW or the SRS-2 total score between groups ($p=0.619$ and $p=0.595$) respectively. There was no correlation between the pretreatment plasma oxytocin level and treatment response.

Conclusions: In our sample, intranasal oxytocin was well tolerated and was not associated with significant laboratory abnormalities. However, oxytocin did not separate from placebo on multiple measures of social functioning. Further, response to oxytocin treatment was not related to pretreatment plasma oxytocin level.

215.003 *(Panel)* Randomised Controlled Trials of Oxytocin Therapy to Improve Social Learning in Young Children: Two Clinical Trial Approaches.

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Background: Early life social experiences shape neural pathways in children to develop lifelong social skills. While there have been investigations targeting social learning opportunities, and separately, neurobiological systems that underpin social development, there has been a limited number of studies that have combined both approaches. Such approaches may be important for two reasons. First behavioral social learning supports, such as the Early Start Denver Model (ESDM), show efficacy in improving social learning outcomes. There is, however, a need for better outcomes that positively impact a broader population. Second, while there is growing evidence for the potential benefits of neurobiological interventions, such as oxytocin based therapies, there have been mixed findings for efficacy. Recent studies have highlighted the importance of context and, in particular, the provision of social learning, to augment therapeutic effects.

Objectives: The aim of this talk is to present a novel approach for using behavioural and neurobiological approaches to augment social learning early in life. This talk discusses pharmacological and non-pharmacological strategies that could augment outcomes. Clinical trials are then presented that aim to improve social outcomes for children using different clinical trial designs and with social learning therapies in young children diagnosed with ASD. The role of objective and caregiver/clinician ratings in these trials are also investigated.

Methods: Two placebo controlled clinical trials are presented. The first trial presents the first trial we are aware to ultilise placebo lead designs with oxytocin and then provides 12 weeks of oxytocin treatment randomized to a placebo. In the second trial, we combine parent-led ESDM therapy with oxytocin treatment, or a placebo, to facilitate social learning in young children. A range of biomarkers were collected to evaluate the link between caregiver reports and physiological, imaging and cognitive biomarkers.

Results: Results show a very strong placebo response during placebo lead-in phase that was reported by caregivers on social responsiveness measures (Cohen's $D = 3$). Results confirm the expectation of large placebo influences on outcome measures. The presentation then examines the relationship of caregiver reports with other caregiver/clinician reports and objective markers. Results show placebo responses are not consistently reported across all measures. The presentation then focuses on the tolerability, acceptability and efficacy of oxytocin as a therpauetic on its own and when combined with behavioural therapies. Implementation, efficacy, acceptability and tolerability are discussed. Results of the trial available at the time of presentation will be presented.

Conclusions: This work highlights a novel approach to improve social learning supports for young children with ASD. This approach shifts the focus from applying possibly-related broad treatments, to specifying and targeting the relevant circuits, at the right time of learning, to optimize outcomes. It also highlights the critical importance of controlling for placebo response biases in clinical trials to improve the opportunity to demonstrate efficacy and highlights the potential impact of biases across measures.

215.004 *(Panel)* Neurobiological Mechanisms of Oxytocin's Efficacy and Its Diminishment during Repeated Administrations

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Background: Autism spectrum disorders (ASD) currently have no established pharmacological treatment for its core symptoms. Oxytocin is expected as a novel therapeutic for the core symptoms. The speaker has conducted several independent clinical trials to test oxytocin's efficacy on the core symptoms or their neural and behavioral underpinnings. These trials have revealed oxytocin-induced improvements of autistic behaviors such as difficulty in judging other's friendship based on non-verbal communicative information (JAMA psychiatry 2014), deficits in understanding other's social emotion (Brain 2014), less facial expressivity during social interaction (Brain 2019) and the core symptom itself (Brain 2015; Mol psychiatry 2018a) in adult males with ASD. Furthermore, neural effects of oxytocin were demonstrated such as enhancing activity in the medial prefrontal and anterior insular cortices during resting or conducting the tasks (JAMA psychiatry 2014; Brain 2014; 2015). In addition, a new method to predict therapeutic responses to oxytocin by utilizing information of variants in oxytocin receptor gene was developed (SCAN 2017). Although these findings have supported the potential of oxytocin as a novel therapeutic for the core symptoms of ASD, it has also been suggested that repeated administrations of oxytocin induce diminishments in the efficacy (Brain 2019) and changes in glutamatergic neural transmission (Mol psychiatry 2015; 2018b).

Objectives: To clarify the neurobiological mechanisms of oxytocin's efficacy and their decrement during repeated administrations at molecular level, the metabolomic, proteomic, and genomic data collected from these clinical trials were analyzed.

Methods: The participants with ASD of our previous clinical trials (total N=146) were genotyped using SNP arrays. Genomic data were analyzed to identify genes coding oxytocin's efficacy. The current study also examined proteomics in the plasma using Liquid Chromatography–Mass Spectrometry and metabolomics utilizing capillary electrophoresis time-of-flight mass spectroscopy in these participants with ASD. To identify metabolites and proteomics characterizing ASD individuals at baseline, plasma metabolites and proteomics levels were compared between 106 adult males with ASD and 26 age, intellectual level, parental socio-economic background and body-mass-index matched men with typical development. Furthermore, in a randomized, double-blind, parallel-group, placebo-controlled, multi-center clinical trial data, effect of 6 weeks intranasal oxytocin (48IU/day) on the metabolomics and proteomic levels was tested in 106 men with high-functioning ASD. Sub-analyses stratified with efficacy of oxytocin or its diminishment during repeated administrations were also conducted. The study protocol was approved and registered (UMIN000002241/ 000004393/ 000015264). Written informed consent was obtained from all participants.

Results: A gene was identified to be significantly associated with oxytocin efficacy indexed with neuroimaging and autistic behaviors consistently in two independent clinical trials. Furthermore, several molecules were found to be significantly associated with ASD diagnosis. The sub-analyses demonstrated a molecule showing a significant association with efficacy of oxytocin especially with its diminishment during repeated administrations.

Conclusions: The findings suggest potentials of the metabolomics and proteomics for providing surrogate markers of ASD diagnosis as well as those of oxytocin's efficacy, and also suggest that the identified genes and molecules can elucidate neurobiological mechanism of clinical improvement in individuals with ASD induced by oxytocin.

POSTER SESSION — INTERVENTIONS - PHARMACOLOGIC
429 - Interventions - Pharmacologic Posters

429.001 *(Poster)* Altering Gut Microbiota May Benefit Children with Autism Spectrum Disorder: Results from Lactobacillus Plantarum PS128 for ASD Trial

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Background: *Lactobacillus plantarum* PS128 (PS128), a reported psychobiotic, improved behavioral disorder in several animal models, including depression, Parkinson's disease, Tourette syndrome, and irritable bowel syndrome. A randomized, double-blind, placebo-controlled trial investigating the effects of PS128 on children with autism spectrum disorder (ASD) in Taiwan was finished recently. The results showed that PS128 benefit younger children with ASD, especially the symptoms related to anxiety, hyperactivity, and opposition.

Objectives: Gut microbiota composition was reported to be different between children with ASD and neurotypical ones. In this study, we aim to investigate the gut microbiota charcteristics in the PS128 for ASD clinical trial.

Methods: Stool sample obtained from subjects in the PS128 for ASD clinical trial were used for microbiota analysis. Total fecal DNA was extracted and the V3-V4 region of 16S rRNA was amplified by 16S amplicon PCR primers 314F' and 805R'. The amplified PCR products with Illumina adapter overhang sequences were then indexed for library construction. The sequencing was conducted with Illumina Miseq sequencer using v3 reagents (MiSeq paired-read sequencing 300 bp) in the Sequencing Core Facility of National Yang-Ming University Genome Center (YMGC). The sequencing data was analyzed on QIIME2. The LEfSe method and PICRUSt method was applied to identify the differentially abundant taxa and to predict involved functional pathway.

Results: PS128 intervention for 28 days altered the gut microbiota composition of subjects. In younger subjects, aged 7-12, increase of *Bifidobacterium* and improvement in Clinical Global Impress-Improvement (CGI-I) showed positive correlation. Results obtained from LEfSe showed that PS128 ingestion for 28 days elevated the abundance of *Lactobacillus plantarum*, Lachnospiraceae UCG_008 and Lactobacillaceae.

Conclusions: Up to date, psychological testing is the only way to diagnose ASD. Biological characteristics for ASD diagnosis and therapy are still lacking. Biomarker molecules or even specific bacterial taxa in gut are expected to be the targets for ASD therapy. In this study, we found the microbiota composition was altered by PS128 intervention and the alterations are correlated to CGI-I. Based on the results obtained from the PS128 for ASD trial, we speculated that PS128 may benefit children with ASD at least partially by gut microbiota alteration.

429.002 *(Poster)* Bumetanide Improves Social Behavior in the BTBR Mouse Model of Autism

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Background: Bumetanide is a selective sodium-potassium-chloride (Na^+-K^+-$2Cl^-$) co-transporter inhibitor known to modulate neuronal transmembrane Cl^- gradient which drives neuronal excitatory or inhibitory function of γ-aminobutyric acid (GABA) in the brain. Previous studies in two animal models of Autism Spectrum Disorder (ASD) (fmr1 KO mice and pregnant mice treated with valproic acid) have shown the ability of a prenatal treatment with bumetanide to attenuate autism-relevant behaviors in the offspring. However, no postnatal effect of bumetanide in a relevant ASD animal model has been investigated to date. These data could be useful in the context of ongoing phase III clinical trials where a bumetanide paediatric liquid formulation is assessed for the treatment of children and adolescent with ASD.

Objectives: The present study was aimed to investigate the effect of bumetanide on social and repetitive behaviors in young BTBR T+ Itpr3tf/J (BTBR) mice, an inbred strain with high face validity for autistic-like symptoms.

Methods: Juvenile (6 week-old) male C57BL6J (B6) mice as control animals or BTBR mice received an acute intraperitoneal injection of vehicle (VEH) or bumetanide at three doses (0.3, 3 or 30 mg/kg; 8 groups; N=15 per group). After dosing, mice were tested in the 3-chamber and self-grooming/digging assays to evaluate social and repetitive behaviors respectively. The different parameters were scored by automated videotracking method and by manual scoring by a trained observer unaware of drug treatment.

Results: Both VEH- and bumetanide-treated B6 control mice exhibited a normal social behavior and a usual grooming/digging behavior in a novel environment at all tested doses. As compared to VEH-treated B6 control mice, VEH-treated BTBR mice showed a significantly impaired sociability and deficit in social novelty preference, decreased exploratory behavior and increased repetitive behaviors (grooming and digging time). Bumetanide dose-dependently attenuated the social deficit in BTBR mice in the 3-chamber test, an effect that reached statistical significance at the highest dose ($p<0.05$). However, bumetanide at tested doses did not improve exploratory behavior or deficit in social novelty preference and did not reduce the increased grooming/digging time in BTBR mice. There was no significant difference between VEH- or bumetanide-treated BTBR and B6 mice for the distance travelled in the experimental apparatus during the test session.

Conclusions: Acute bumetanide administration dose-dependently attenuated the deficit in sociability, an autism-relevant symptom, displayed by BTBR mice. Globally, the present study shows for the first time a postnatal effect of bumetanide in a relevant ASD animal model, supporting its use in clinical trials and suggesting bumetanide as a promising drug to enhance sociability deficits in ASD patients.

429.003 *(Poster)* Clinical Response to Mitochondrial Cocktail in Patients with ASD and Mitochondrial Dysfunction: A Case Series

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by social, verbal and behavioral impairment which has been increasing in prevalence. Currently the cause of ASD is unknown, but the disorder is thought to be due to an interaction of environmental, biologic and genetic predisposing factors. There is a growing body of evidence showing an association between autism spectrum disorder and mitochondrial dysfunction. There is literature suggestive that children with known dual diagnosis of ASD and mitochondrial dysfunction are often difficult to distinguish phenotypically from children with idiopathic ASD. A small population study suggested that mitochondrial dysfunction may be the most common disorder associated with autism. Currently the only recommended treatment for children with ASD is ABA therapy. While the evidence regarding treatment of mitochondrial disorders with vitamin and cofactor therapy continues to be unclear, recent consensus guidelines from the Mitochondrial Medicine Society do recommend offering supplements to all patients with mitochondrial dysfunction, including Cofactor Q10 and riboflavin. While there is a significant number of publications investigating treatment for patients with mitochondrial dysfunction, there is limited research investigating the utility of and response to treatment in patients with concomitant ASD and mitochondrial dysfunction.

Objectives: This case series outlines the medical history of three patients who were diagnosed with ASD and mitochondrial dysfunction, and were subsequently treated with vitamin and cofactor therapy. We seek to demonstrate clinical improvement and regression with withdrawal of treatment through chart review and phone surveys.

Methods: Retrospective chart review was performed to identify patients being treated with vitamin and cofactor therapy who were definitively diagnosed with ASD and mitochondrial disorder. Medical records were obtained from the parents of these patients. The records were reviewed for neuropsychiatric testing and metabolic testing. Progress notes following treatment were also obtained and reviewed. A scripted phone survey was conducted with the parents of each patient to acquire current history for each case. The phone surveys conducted contained questions regarding initial symptoms prior to diagnosis, how the decision to treat was made, and what clinical response was seen with treatment.

Results: Each case included in this series outlines the onset of symptoms for each child, along with the process they underwent to be given a diagnosis of ASD and mitochondrial dysfunction. We then detail the decision to initiate therapy, and subsequent response as detailed through progress notes and medical records that were reviewed. Each case demonstrates both clinical response to treatment either in autism symptoms or mitochondrial dysfunction symptoms, as well as regression when treatment was delayed or withheld.

Conclusions: This review seeks to demonstrate that treatment of mitochondrial dysfunction with vitamin and cofactor therapy has a clinically significant impact on patients. Given the limited adverse effects of this treatment and significant potential benefit, we suggest that based on observational evidence of response, there is evidence to suggest benefit in treating patients with ASD and either diagnosed or suspected mitochondrial dysfunction.

429.004 *(Poster)* Deprescribing Benzodiazepines in ASD/IDD: Examination of Success Rates, Diagnoses and Treatment Responses in Inpatients Versus Outpatients.

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Background: Prescription of maintenance benzodiazepines (BZPs) in autism spectrum disorders (ASD) and intellectual disabilities (ID) is common. BZPs may produce disinhibition, tolerance and withdrawal, and sedation exacerbates cognitive impairments. Physicians are often presented with BZP deprescribing in such patients who also manifest ongoing aggression and self-injury.

Objectives: To examine success rates of BZP deprescribing attempts, using retrospective chart review examining demographics, diagnoses, and treatment responses in successive inpatients and outpatients with ASD/ID.

Methods: Following IRB approval, we extracted data from clinic charts of 29 consecutive patients receiving maintenance BZPs, and compared a group of chronic inpatients (IP) with outpatients (OP) for success of taper. Data extracted included IP/OP status, race, gender, age, ASD and/or ID diagnosis, presence of aggression, self-injury, and treatment resistance. Follow-up duration, DSM-5 diagnoses, attention deficit hyperactivity disorder (ADHD) history, and medications tapered were also extracted. Outcomes were measured at clinic visits using the Clinical Global Impressions (CGI) scale (Guy, 1976); with treatment response of final CGI-Improvement subscale Much Improved (2) or Very Much Improved (1).

Results: In the chronic IP group (n=15) there were 13 males, 2 females, and in the OP group (n=14) 9 males and 5 females. IP mean age was 46.7 years, and OP 27.2 years. All subjects in each group had an ASD and/or ID diagnosis, as well as often treatment-resistant (14 of IP, 10 of OP). A significant number in each group was minimally verbal (9 of IP, 4 of OP). Maintenance BZPs most commonly prescribed in IP were clonazepam (n=8), lorazepam (n=5), clorazepate (n=1), diazepam (n=1). OP received clonazepam (n=6), diazepam (n=2), and lorazepam (n=4). Two OP received BZPs as antiseizure treatment. All subjects received other medications in addition to BZPs, both psychotropic and non-psychotropic. Successful deprescribing of BZPs occurred in more IP than OP (46.7% vs 35.7%). BZP dosage reductions also occurred in more IP than OP (26.7% versus 7.1%). We will discuss other medications tapered or added to produce treatment response. Overall treatment response was achieved in 9 IP (60%) versus in 12 OP (85.7%). 10 IP (66.7%) and 12 OP (85.7%) met DSM-5 ADHD criteria. 4 IP and 1 OP met bipolar disorder criteria (26.7% versus 7.1%), 1 IP had major depression with psychosis and 1 IP schizoaffective, bipolar type. Antiseizure medications were used in 4 IP and 5 OP (28.6% vs 33.3%). No subject suffered withdrawal symptoms or seizures, using taper principle of reductions of no more than 10% per week for BZPs. BZP withdrawal was not attempted in the 2 OP receiving them as antiseizure medications.

Conclusions: Successful deprescribing of BZPs in IP and OP can be safely achieved but must be extremely slow. The groups were small and the reader is cautioned. BZP deprescribing and reduction was achieved more often in IP than OP. Clarification of ADHD, bipolar and other diagnoses, and tailoring medications to psychiatric diagnoses are useful strategies in individuals with ASD/ID, aggression and self-injury.

429.005 *(Poster)* Effect of Bacopa Monnieri on VPA Induced Neurotoxicity: An Approach Towards Preclinical Screening for Autism

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Background: Autism is a complex neurodevelopmental disorder of early onset, characterized by impaired sociability, cognitive function and stereotypies. There has been no pharmacological intervention approved for the overall treatment of autism. The currently available therapies are mainly focused on disease management and symptomatic rescue. The search for herbal remedies that may conceivably act as therapeutic agents for autism has always been an active area of research.

Objectives: The present study was designed to investigate the protective role of *bacopa monnieri*, an Indian medicinal herb, towards autism like phenotypes in cell-based study as well as zebrafish model of VPA toxicity.

Methods: *Bacopa monnieri* was screened against VPA induced toxicity in neurosphere (in vitro) and zebrafish larvae model for autism (in vivo). The neurospheres were obtained from embryonic day 15 cortical neuronal cells and were co-treated for 7 days with VPA (1mM) along with *bacopa monnieri* (0.1, 1 and 10µg/ml) . The neurospheres were investigated for cell proliferation and differentiation. Zebrafish larvae were exposed to VPA (75 µM) from 4 hours post fertilization to 5 days post fertilization followed by treatment with *bacopa monnieri* (3, 10 and 30µg/ml) from 5-7 days post fertilization. After 7 days post fertilization battery of behaviour test (for anxiety, attention deficit and stereotypic behaviour) were performed followed by gene expression studies

Results: Chronic (7 days) VPA treatment in neurospheres leads to a decrease in proliferation of neurospheres followed by disrupted differentiation pattern. In the neurosphere model, co-treatment of *bacopa monnieri* with VPA, rescues VPA induced neurotoxicity as evidenced by an increase in proliferation followed by differentiation and neurite outgrowth. In zebrafish larvae model, post treatment with Bacopa monnieri was able to abrogate VPA induced behavioural despairs in a dose dependent manner observed with open field test, inattentive behaviour test and circling behaviour test. The herbal drug also rescues the effect of VPA on gene expression level of autism related genes.

Conclusions: In conclusion *bacopa monnieri* shows neuroprotective activity against VPA induced toxicity when tested in vitro and in vivo. However, further exploration may be needed to validate the use of *bacopa monnieri* as a therapeutic approach for autism.

429.006 *(Poster)* Evaluation of (±) Catechin Hydrate in Experimental Paradigm of Autism Spectrum Disorders (ASD): Exploring Possible Role of Nitric Oxide Pathway

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Background: Autism spectrum disorders (ASD) is a pervasive neurodevelopmental disorder manifested in children of age 1-3 years old. The pathogenesis of autism is complex due to its heterogeneous and polygenic nature. Autism pathogenesis involves interplay of genetic, epigenetic and environmental factors. Role of gut-brain axis is considered to be of high significance in development of ASD and its associated behavioural complications . Propanoic acid which is short chain fatty acid (SCFA's), an enteric gut product produced by species of Clostridia, Sutterella, and Ruminococcus in intestine is known to worsen the behavioural complications of ASD. PPA is reported to cause oxidative & nitrosative stress, mitochondrial dysfunction and neuroinflammation hence, leading to immune system dysfunction in brain. Excess nitric oxide affects neurodevelopmental process by causing demyelination, neuroinflammation and blood brain barrier disruption. Various clinical studies indicates that levels of NO, and cytokines involved in NO production, might be high in children suffering from autism.

Objectives: The present research work aims at deciphering the involvement of nitric oxide pathway and its modulation by (±) Catechin hydrate in experimental paradigm of Autism Spectrum Disorders (ASD).

Methods: : An intracerebroventricular infusion of 4µl of 1M PPA was given in anterior region of lateral ventricle to induce autism like phenotype in male rats. Oral administration of (±) Catechin hydrate (25, 50 and 100mg/kg) was initiated from 3rd day lasting till 28th day. L-NAME (50mg/kg) and L-Arginine (800mg/kg) were also given individually as well as in combination to explore the ability of (±) Catechin hydrate to act via nitric oxide pathway. Behaviour test for sociability, stereotypy, anxiety, depression, novelty, repetitive and perseverative behaviour was carried out between 14th and 28th day. On 29th day, animals were sacrificed and levels of mitochondrial complexes and oxidative stress parameters were evaluated. We also estimated the levels of neuroinflammatory and apoptotic markers such as TNF-α, IL-6, NF-κB, IFN-γ, HSP-70 and caspase-3. To evaluate the involvement of nitric oxide pathway, levels of iNOS and homocysteine were estimated.

Results: Treatment with (±) Catechin hydrate significantly restored behavioural, biochemical, neurological and molecular deficits. Hence, (±) catechin hydrate has potential to be used as neurotherapeutic agent in ASD targeting nitric oxide pathway mediated oxidative & nitrosative stress responsible for behavioral, biochemical and molecular alterations via modulating nitric oxide pathway.

Conclusions: The evaluation of levels of iNOS and homocysteine conclusively establishes the role of nitric oxide pathway in causing behavioural, biochemical & molecular deficits and the beneficial effect of (±) Catechin hydrate in restoring these alterations.

429.007 *(Poster)* Examining Real-World ADHD Diagnosis and Pharmacologic Treatments for Challenging Behaviors in Autism Spectrum Disorders and Intellectual Disabilities: A Retrospective Case Series.

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Background: Attention deficit hyperactivity disorder (ADHD) is frequently diagnosed in youth with autism spectrum disorders (ASD) and intellectual disability (ID), and often persists into adulthood (Hellings et al. 2017). ADHD may contribute to hyperactivity, impulsive aggression and self-injury, and mood swings related to poor affect regulation. The latter may be misinterpreted as part of bipolar disorder rather than ADHD. Treatment-resistance may relate to missed ADHD as a diagnosis to clarify and target for treatment.

Objectives: To examine a real-world clinic sample of patients with ASD/ID diagnosed with DSM-5-based ADHD for treatment responses and outcomes.

Methods: Following IRB approval, we extracted data from clinic charts of consecutive patients with ASD and/or ID who met DSM-5 ADHD diagnostic criteria, excluding verbal criteria if they were minimally verbal. Data extracted includes race, gender, age, ASD/ID level, presence of aggression and self-injury, and treatment duration and resistance. DSM-5 diagnoses, ADHD medications taken prior to and at the first visit, and medications tapered were also extracted. Final diagnoses and medications were extracted. Treatment outcomes were measured at clinic visits using the Clinical Global Impressions (CGI) scale (Guy, 1976), with treatment response of final CGI-Improvement subscale Much Improved (2) or Very Much Improved (1).

Results: We reviewed 60 charts, of 45 males and 15 females; mean age 34 years (9-69). Two were children, 5 adolescents, and 53 adults. All but 5 met DSM-5 ASD criteria. Treatment duration averaged 14.7 months (2-34.3). Fifty three patients (88.3%) were treatment-resistant (>3 previous failed psychotropic drug trials). Twenty four (40%) were minimally verbal (< 20 words of expressive language). Fifty (83.3%) had an ADHD history confirmed by relative report or previous childhood ADHD medication trials. Only 14 (23.3%) presented on ADHD medications. Baseline aggression presented in 53 (88.3%). Self-injury including self-biting, picking, scratching, slapping and head-banging presented in 47 (78.3%). Thirty-five (58.3%) had prior seizures. Response rated on CGI-I of 1 or 2 was achieved in 48 (80%); 8 (13.3%) were Minimally Improved (3). Thirty-two (66.6%) of those Much improved and Very Much Improved received ADHD medications (mostly with antipsychotics and antiseizure medications) at the final treatment point. These were amitriptyline (AMI) in 21, AMI and dextroamphetamine (DEX) combination in 5, atomoxetine (ATX) in 3, dexmethylphenidate in 1, methylphenidate in 1, and methylphenidate-ER in 1. Three of the 8 who were Minimally Improved received ADHD medications: 1 AMI, 1 ATX, 1 AMI and DEX. Three were diagnosed with bipolar disorder and 2 with rule-out bipolar disorder.

Conclusions: ADHD awareness, diagnosis and treatment may ameliorate treatment-resistance in a significant number of individuals with developmental disabilities, including in adults and minimally verbal individuals. While the tricyclic antidepressant /ADHD medication amitriptyline appeared effective for irritability and impulsive aggression in ASD/ID, randomized controlled trials are still needed. A trial of ADHD medications starting in low dose may be worthwhile, as well as clarifying early childhood history of ADHD. More studies are needed to confirm these findings.

429.008 *(Poster)* Grey Matter Volume Predicts Changes in Social Behavior Due to Single-Dose Propranolol in Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is characterized by persistent deficits in social communication, in addition to restricted or repetitive behaviors. Currently, there is no FDA-approved pharmacological treatment for these core symptoms of ASD. Previous research has indicated that when given propranolol, a beta-adrenergic antagonist, some patients with ASD show an increase in social behavior in a single-dose psychopharmacological challenge, as measured by the General Social Outcome Measure (GSOM). However, some individuals with ASD do not respond to propranolol. This highlights the need to develop biomarkers to determine whether propranolol will be an efficacious treatment for individuals with social communication deficits in ASD.

Objectives: In the current study, volumes of individual brain regions, measured with magnetic resonance imaging (MRI), were compared to changes in GSOM scores after propranolol administration. These relationships were analyzed to determine neuroanatomical predictors of increased social behavior when individuals with ASD are given propranolol.

Methods: 13 participants (12 male, 1 female), between the ages of 18 and 31 years old, underwent structural MRI prior to drug administration. GSOM scores were assessed separately in sessions in which participants were given either placebo or propranolol, in a double-blinded crossover manner. Freesurfer was used to determine volumes of cortical and subcortical regions from the structural MRI data. Volumes of cortical and subcortical regions were compared to the difference in GSOM scores when participants were given propranolol and placebo using R. Total intracranial volume was used as a covariate in these analyses to control for potential effects of head size.

Results: Left precentral and precuneus cortex showed significant positive relationships, after false discovery rate correction for multiple comparisons, between grey matter volume and changes in GSOM after administration of propranolol when controlling for intracranial volume. Left thalamus, pallidum, and nucleus accumbens showed significant negative relationships between volume and changes in GSOM after administration of propranolol when controlling for intracranial volume. There were no significant relationships between cortical or subcortical volumes and changes in GSOM scores in the right hemisphere, however there was a significant positive relationship between changes in GSOM score and volume of the optic chiasm.

Conclusions: Based on results from cortical regions, it is possible that higher grey matter volume in left precentral and precuneus regions, relative to total intracranial volume, is a predictor for the efficacy of propranolol in treating social communication deficits in ASD. Inversely, results from subcortical regions indicate a possibility that lower volumes in left pallidum, thalamus, and nucleus accumbens, relative to total intracranial volume, predict an increase in the efficacy of propranolol to treat social communication deficits in ASD. Larger sample sizes are needed to further validate these biomarkers, in addition to determination of their utility for predicting response to serial doses. This exploratory study has generated several potential neuroimaging biomarkers to predict changes in social behavior of patients with ASD after administration of propranolol, which will need to be confirmed and validated as predictors of treatment efficacy in follow-up studies.

429.009 *(Poster)* Preliminary Report on Results from an Open- Label Extension Trial of the Effects of Propranolol on Core Symptoms and Anxiety in Autism Spectrum Disorder

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Background: Propranolol is widely utilized for performance anxiety and public speaking anxiety. We previously reported single-dose psychopharmacological challenge studies revealing a significant beneficial effect of propranolol on a structured social interaction task in ASD. This led to the initiation of a clinical trial on the effects of serial doses of propranolol in ASD.

Objectives: Autism spectrum disorder (ASD) is characterized by impairments in social communication and restricted and repetitive behaviors, with a high incidence of co-occurring anxiety. We are conducting a double-blinded, placebo-controlled trial of the beta-adrenergic antagonist propranolol in ASD. Herein, we report preliminary results of the patients completing the open-label extension phase for the primary outcome measure of social communication and, secondarily, anxiety. Effects of the drug on restricted interests were also explored.

Methods: ASD patients (age 7-24) are being enrolled, titrated up to 100mg propranolol daily in divided doses over 12-weeks (body weight adjusted in children), monitoring social interaction, and secondarily anxiety and overall ASD severity. Fifteen participants have completed a 12-week open label extension. Separate Clinician Global Clinical Impression -Severity (CGI-S) scales are reported for both social interaction and anxiety as well as overall ASD severity. Clinician Global Clinical Impressions of Improvement (CGI-I) were also assessed at 12-weeks.

Results: CGI-S for social interaction at baseline was 3.81 (±0.83 sdev) (scores range from from 1-7, where 1=normal and 7=most severe), decreasing to 3.53 (±0.74 sdev) at week-12 (p=0.019). Additionally, CGI-I at 12-weeks was 2.87 (±0.99 sdev) for social interaction (where 4=no change, 1=maximal improvement, 7=maximal decline). CGI-S for anxiety at baseline was 3.81 (±1.17 sdev), decreasing to 3.4 (±1.3 sdev) at week 12 (p=0.014). CGI-I at 12-weeks was 2.8 (±1.2 sdev) for anxiety. CGI-S for overall ASD severity was 3.62 at baseline (±0.50 sdev), decreasing to 3.47 (±0.52 sdev) at week 12 (p=0.082), and CGI-I at 12-weeks was 2.87 (±0.91 sdev) for overall ASD severity. CGI-S for restrictive interests at baseline was 3.8 (±1.11 sdev), decreasing to 3.53 (±0.99 sdev) at week 12 (p=0.04).

Conclusions: A preliminary analysis of the first participants to complete open-label extension portion of the trial begins to suggest promising results for social interaction, as well as the secondary outcome of anxiety, and restrictive interests. As well, there was an initial trend toward significance for reductions in overall ASD severity. Conclusions should not yet be drawn from these findings given this small and unblinded initial open label sample.

429.010 *(Poster)* Receipt of Behavior Therapy Among Preschool Children Who Have and Have Not Taken Psychotropic Medications for Symptoms Associated with Autism

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Background: Survey and administrative data suggest that between 11% and 35% of preschool children with autism spectrum disorder (ASD) are prescribed psychotropic medications to treat co-occurring symptoms, such as aggression, hyperactivity, irritability and self-injurious behaviors. The American Academy of Pediatrics (AAP) recommends that psychotropic medication only be prescribed to children with ASD when they demonstrate suboptimal response to behavior therapy. However, it is unknown how often children with ASD who are prescribed psychotropic medications ever receive behavior therapy.

Objectives: Our objectives were to: (1) Describe the number and type of psychotropic medications used by preschool children with ASD enrolled in a case-control study and (2) Explore whether children with ASD who took psychotropic medications ever received behavior therapy.

Methods: Participants were children 2.5-5 years of age enrolled in the Study to Explore Early Development Phase-2 (SEED2) during years 2012-2016. SEED2 is a multisite, community-based study of preschool children designed to investigate the development and risk factors of ASD. Children were screened for ASD risk upon study enrollment. Those with a positive ASD screen or previous ASD diagnosis received a comprehensive evaluation including the Autism Diagnostic Observation Schedule (ADOS) and Autism Diagnostic Interview – Revised (ADI-R). Results of the ADOS and ADI-R determined ASD status.

Mothers were asked to complete a services and treatments questionnaire (STQ) designed for SEED. Mothers were asked to report whether their child ever used the following classes of medications to treat symptoms of ASD: antidepressant or antianxiety, atypical antipsychotic, seizure medication (also used to stabilize mood), stimulant (to treat inattention and hyperactivity), non-stimulant (to treat inattention and hyperactivity), and other (open response). Co-authors with a background in pediatrics and psychology reviewed open response fields for medications that could be included in other categories. Mothers also reported whether their child had ever received behavior therapy.

Results: The analytic sample included 772 children classified as ASD with a complete STQ. Four hundred ninety-six (64.2%) children never received behavior therapy and 62 (8.0%) were reported to use at least one psychotropic medication. Of these 62 children, 20 (32.3%) were reported to use medications in more than one class and 37 (59.7%) never received behavior therapy. Of the medication classes reported, the most common were non-stimulant (N=23; 37.1%), seizure medication (N=24; 38.7%), and stimulant (N=23; 37.1%). Antidepressant/antianxiety and atypical antipsychotic medications were uncommonly reported (N=4; 6.5% for both classes).

Conclusions: Psychotropic medication use among preschool children with ASD was lower in our sample than reported previously in survey and administrative datasets for similar aged children, although these studies used different methods than ours. Use of non-stimulant, seizure, and stimulant medications were most commonly reported whereas use of antidepressant, antianxiety, and atypical antipsychotic medications were less frequently reported. A majority of the children in our sample were reported to have never received behavior therapy, and this was true even for children receiving psychotropic medications. Our findings are inconsistent with AAP recommendations of behavior therapy as a first-line treatment for emotional and behavioral problems in children with developmental disorders.

429.011 *(Poster)* Spectral Brain Dynamics of Pregnenolone Treatment in Adults with Autism Spectrum Disorder

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Background: Pregnenolone (PREG) is the biologically-active precursor of all endogenous steroid hormones that has been implicated the treatment of various neuropsychiatric disorders. In adults with autism spectrum disorder (ASD), therapeutic intervention with PREG may modulate neuronal excitability and be beneficial for improving core ASD features such as, maladaptive sensory reactivity and social information processing. In an open-label trial of PREG, we found that PREG was well tolerated and reduced the levels of irritability in adults with ASD. To explore the impact of PREG on brain dynamics, we examined changes in resting-state brain activity following PREG treatment using electroencephalography (EEG), which provides a high-temporal resolution of brain dynamics. Given that PREG is a robust negative allosteric modulator of several receptors critically involved in brain development (i.e., type 1 cannabinoid receptors, Ɣ-aminobutyric acid A receptors, and glutamate receptors) changes in brain dynamics following PREG may clarify the mechanisms underlying hyperexcitability in ASD.

Objectives: To investigate the changes in band power before and after 12-week trial of oral PREG in autistic adults.

Methods: Scalp-level resting-state EEG was recorded as participants were adults with ASD (N = 14) before and after PREG treatment in an open-label trial. Resting-state EEG, recorded in the absence of overt task performance, can be used to characterize oscillatory activity and reflects the excitation/inhibition (E/I) balance of neural interactions (Cornew, Roberts, Blaskey, & Edgar, 2012). PREG treatment was initiated at 50mg twice daily in weeks 1 and 2, then increased by 50mg twice daily every 2 weeks to a final dose of 250mg twice daily which was maintained from weeks 9 to 12. EEG was analyzed for changes in absolute power spectra. EEG data was filtered, segmented into 2-s epochs, before applying ICA to remove eye-blink and noise artifacts. Time/frequency analysis was performed using the standard frequency band ranges: Delta: 1- 4Hz; Theta: 4 - 8Hz, Alpha: 8 - 12Hz; Beta: 12 - 25Hz; Gamma: 25 - 50Hz; and High Gamma: 50 - 80Hz (Delorme and Makeig, 2004). Changes in theta, alpha, and gamma bands are of the greatest relevance to study the impact of PREG on hyperexcitability, sensory processing, and social information processing. Additionally, these bands are associated with deficits in cortical inhibition in ASD.

Results: Five participant with baseline and post-PREG data were examined in this preliminary analysis. At baseline, adults with ASD demonstrated *high gamma* (in low and high bands) power. This result parallels several previous studies that demonstrate increased gamma power in ASD compared to typically developing individuals. After PREG, *increased* power was observed for all bands (i.e., delta, theta, alpha, and beta), **except gamma** which *decreased* in power. Changes also appear to be spatially-specific with increased activity localized to posterior regions following treatment.

Conclusions: Although data collection and analysis are ongoing, preliminary data analysis showed changes in spectral power in low-and high-frequency bands following PREG treatment in adults with ASD. This suggests PREG may modulate hyperexcitability and the E/I balance by altering coupling between high and low frequency bands in adults with ASD.

429.012 *(Poster)* The Role of Nitric Oxide in Autism Spectrum Disorder: Towards Novel Strategies for Treatment

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Background: Mutation in the *SHANK3* human gene leads to different neuropsychiatric diseases including Autism Spectrum Disorder (ASD). *SHANK3* is one of the most promising ASD candidate genes, but still significant gaps exist regarding the molecular mechanism that lead to the pathology. Recently, we showed that *Shank3* human-mutation based in a mouse model of ASD (InsG3680 model) led to a dramatic increase of nitric oxide (NO) formation and alterations in nitrergic signaling. NO is a multifunctional signaling molecule and a neurotransmitter that plays an important role in physiological and pathophysiological processes including neuronal signaling. Pioneering works showed that NO can engender nitrosative stress in the nervous system, contributing to neurodegenerative diseases. In the case of ASD, there is no evidence for a link between NO and ASD.

Objectives: Our ultimate goal is to determine and gain a deep mechanistic understanding of the molecular role of NO and derive novel strategies for treatment in ASD.

Methods: S-nitrosylated proteins in two ASD-related brain regions, cortex and striatum of young and adult InsG3680(+/+) mice (a human mutation-based *Shank3* mouse model), were identified by an innovative mass spectrometric method, SNOTRAP. To gain a systems-level insight into SNO-proteins' functionalities, and to test whether enriched processes are related to ASD, we conducted systems biology analysis. To test for functional and physical interactions among S-nitrosylated proteins in the InsG3680(+/+) mice, we used STRING to analyze protein-protein interactions. We used WB and IHC to dissect signaling pathways and discover novel drug targets.

Results: Our preliminary results showed, for the first time, that *Shank3* mutation led to significant increase of NO formation, and affects key synaptic proteins through protein S-nitrosylation, the NO-mediated posttranslational modification of cysteine thiols (SNO). Furthermore, we discovered *de novo* SNO modification on the phosphatase calcineurin (CN), which led to alterations in synaptic vesicle cycle and in CREB signaling. Finally, we found that NO amplifies mTOR and CREB signaling in mutant suggesting these pathways as a therapeutic targets.

Conclusions: This work provides novel mechanistic insights into the contribution of NO in ASD and pinpointed on pathological proteins, signaling pathways, and neurobiological processes, thereby enabling future translational studies for novel therapeutic targets.

429.013 *(Poster)* Use of Benzodiazepines in People with Autism Spectrum Disorder in the United States

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Background: Benzodiazepine drugs have diverse therapeutic uses including hypnotic, anxiolytic, anticonvulsant, myorelaxant and amnesic in anesthesia, and confer a therapeutic value in a wide range of conditions. For this reason, they are a commonly prescribed class of psychotropic drugs. Psychiatric comorbidities and the use of psychotropic medications are common among patients with autism spectrum disorder (ASD) [1]. Reports of use in ASD vary and range from approximately 7% in pediatric populations in Germany [2] to 20-25% in children, adolescents and adults in the US [3,4], and for various different comorbidities among people with ASD including anxiety and epilepsy [5], sleep disturbances [6], catatonia [7] and seizures in chromosome 15q duplication syndrome [8], with inconsistent efficacy reports. However, scarce literature exists on the overall pattern of use of benzodiazepines in ASD.

Objectives: To investigate prescription patterns of benzodiazepines for people with ASD in the US and understand the differences of use by children, adolescents and adults.

Methods: We evaluated benzodiazepine claims in the Truven Marketscan database of health insurance data (both commercial and Medicaid) in the US. Medication usage was investigated throughout the calendar year 2014 among a cohort of people with ASD (≥3 years old, with at least two claims for an ASD diagnosis [of which at least one was recorded during 2014]). The prevalence and length of prescriptions, psychiatric comorbidity, class type and active principle used were described.

Results: Among the cohort of 93,639 people with ASD in the US, 10,872 (11.6%) had a benzodiazepine prescription in 2014. In terms of indication for use, the anxiolytic, sedative, hypnotic class were used more than the anticonvulsants (76.1% vs 36.6%) with diazepam, clonazepam and lorazepam being the most frequently prescribed active substances. Overall, the frequency of benzodiazepine use among adults (24.5%, ≥18 years old) was higher than among adolescents (12.3%, 13-17 years old) and children (5.4%, 3-12 years old), and more frequent for females (15.5%) than males (10.7%). From the length of the prescription, 45.6% were supplied benzodiazepines for acute use (≤30 days) while chronic use was less frequent with 33.6% and 9.9% supplied for more than 6 months and 1 year respectively.

Conclusions: Our analysis shows benzodiazepine use among people with ASD in the US is lower than previous reports and more frequently prescribed for acute/short-term use. This report sheds new light on the recent patterns of benzodiazepine prescriptions in ASD.

429.014 *(Poster)* Who Takes Medical Marijuana and Why? an Online Prospective Observational Study of Medical Marijuana Use in Autistic Children

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Background: Autism Spectrum Disorder (ASD) is one of 23 qualifying conditions for Medical Marijuana treatment in the state of Pennsylvania. While some research demonstrates that autistic children are taking Medical Marijuana to reduce challenging behaviors (e.g., verbal and physical aggression, self-injury, tantrums, meltdowns), these may not be the only behaviors, or even the primary behavior that providers and families intend to target with Medical Marijuana. There is also little information on the dose and caregiver perception of efficacy across symptom types and possible differences related to the autistic child's gender.

Objectives: To establish a research registry that quantifies the reasons autistic children are taking Medical Marijuana and cannabidiol (CBD) consumption, the target symptoms, the treatment dose, and perceived efficacy.

Methods: We conducted an online prospective observation study (NCT03699527) to establish a registry of children ages 3 to 19 years. Inclusion criteria included having an ASD diagnosis and receiving Medical Marijuana or CBD. Diagnosis was established with a community diagnosis of ASD and a score $\geq$ 12 on the Social Communication Questionnaire. Recruitment occurred in local clinics, social media, parent groups, and word of mouth. All procedures were conducted over the telephone, and follow-ups occurred quarterly. Caregivers completed questionnaires of the autistic child's demographics, concomitant medication, Medical Marijuana information, treatment indication, and detailed clinical information related to indication (e.g., Aberrant Behavior Checklist, 2nd Edition (ABC-2) if indication was challenging behaviors or stereotypies).

Results: The study is ongoing, but we currently have 123 participants enrolled. ~70% of the sample had a caregiver rate their intellectual functioning below their age bin (age bins were <12 months, 1-3 years, 4-5 years, 6-8 years, 9-11 years, 12-14 years, and 15-18 years), and were rated by caregivers as requiring substantial or very substantial support. ~77% had a caregiver rating on social functioning below their age bin. ABC-2 ratings (Social Engagement and Stereotypies) for those taking Medical Marijuana showed similar ratings as reported in the broader literature, whereas Behavior Rating Inventory of Executive Function – Shift scale showed an elevated rating in those taking Medical Marijuana. Caregiver ratings on Anxiety, Mood, and Irritability were elevated in those taking Medical Marijuana compared to the ASD population, whereas externalizing symptoms (ADHD, ODD) were slightly reduced in the Medical Marijuana registrants compared to an ASD+ADHD population. Those taking Medical Marijuana for sleep problems were shown to have ratings in the range of neurotypicals. Parent ratings of efficacy suggest some domains are associated with higher efficacy ratings (e.g., sleep disturbances) than others (e.g., anxiety).

Conclusions: This observational study provides insight into the general landscape of Medical Marijuana use in the pediatric autism population. While sleep problems are reported to have high efficacy and ratings are in the neurotypical range, the efficacy ratings and caregiver report of symptoms are not as convergent in other domains. Given that there is no baseline to directly establish a relationship between drug and symptom change, future research is needed to evaluate Medical Marijuana' potential therapeutic benefit in autistic children.

Medical and Psychiatric Comorbidity

PANEL SESSION — **MEDICAL AND PSYCHIATRIC COMORBIDITY**

216 - Current Trends in Suicide Prevention for Autistic Individuals

Panel Chair: Brenna Maddox*, University of Pennsylvania, Philadelphia, PA*

Discussant: Sarah Cassidy*, School of Psychology, University of Nottingham, Nottingham, United Kingdom*

The last five years have brought substantial progress in understanding the heightened risk of suicide in autistic people. Most of the published work to date has focused on risk factors, assessment, and screening. While this work has addressed many important questions, there is a dearth of research on what happens after an autistic person is determined to be at risk for suicide – how do we intervene appropriately and prevent suicide? The current panel focuses on this nascent area of suicide and autism research. Mirabel Pelton will discuss how suicide theory can inform suicide prevention efforts for autistic individuals. Lisa Morgan, co-chair of the Autism and Suicide committee of the American Association of Suicidology, will share about the development and dissemination of a crisis supports toolkit for people on the spectrum. Anne Huntjens will present on an ongoing trial of dialectical-behavioral therapy for reducing suicidal thoughts and behaviors in autistic adults. Brenna Maddox will share key stakeholder insights about modifying the Safety Planning Intervention for autistic adolescents and adults. Finally, Sarah Cassidy will lead a discussion about the clinical implications of these novel findings and future research directions for reducing suicide risk in autistic people of all ages.

216.001 *(Panel)* Suicide Prevention in Autistic Adults: What Can We Learn from the Interpersonal Theory of Suicide?

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Background: Autistic people are more likely to die by suicide than the general population, but, to date, an absence of theoretically driven research provides a weak evidence base for intervention. The Interpersonal Theory of Suicide (ITS; Joiner 2005) posits that social isolation ('thwarted belonging'), worthlessness ('perceived burdensomeness') and suicidal capability (reduced fear of death resulting from trauma) enable suicidal thoughts to be actioned. Existing research associates these concepts with mental health difficulties, social exclusion and poor quality of life in autistic adults suggesting the ITS may be useful to understand suicide in this group.

Objectives: First, to explore whether autistic people report higher levels of ITS variables. Second, to explore whether the ITS explains the pathways to suicidal thoughts and behaviours in autistic adults. Third, to examine whether the strength of association of any pathway is moderated by autism diagnosis. Fourth, to examine questionnaire measurement differences between autistic and non-autistic people.

Methods: 695 autistic and non-autistic people (mean age 41.7, 58% female) were extracted from an online cross-sectional survey dataset of self-report questionnaires measuring belonging and burdensomeness (Interpersonal Needs Questionnaire-10), suicidal capability (Acquired Capability for Suicide Scale – Fearlessness about Death), traumatic life events (Vulnerabilities Experience Quotient), lifetime suicidality (Suicidal Behaviours Questionnaire revised, item 1) and autistic traits (Autism Quotient – Short Form).

Results: The autistic group reported significantly more lifetime suicidal thoughts and behaviours, stronger feelings of burdensomeness and thwarted belonging, and more frequent traumatic life events than the non-autistic group. Thwarted belonging, perceived burden, suicidal capability and traumatic life events were significantly associated with suicidal thoughts and behaviours in both groups. Path analyses (Fig. 1) reported in both autistic and non-autistic groups: (i) an indirect effect of autistic traits on lifetime suicidality through perceived burden; (ii) an indirect effect of autistic traits on lifetime suicidality through thwarted belonging; iii) a direct effect of traumatic life events on lifetime suicidality. The association of each of thwarted belonging, perceived burden and traumatic life events with suicidality was significantly attenuated by autism diagnosis. Measurement invariance analysis (Table 1) showed that all items of the burdensomeness and two items of the thwarted belonging subscales were non-invariant between autistic and non-autistic groups.

Conclusions: Results suggest that addressing feelings of thwarted belonging, burdensomeness and exposure to traumatic life events could prevent suicide in autistic adults. This could include addressing themes such as (i) double empathy problem (expectation that autistic people will communicate using non-autistic norms) to reduce the need for autistic people to engage in social camouflaging and promote mutually genuine relationships; (ii) effectively meeting autistic peoples' support needs and promoting autonomy to reduce burdensomeness; and (iii) better safeguarding autistic people to reduce exposure to trauma. Results suggest that autistic people interpreted the questionnaire items asking about perceived burdensomeness and thwarted belonging differently to non-autistic people. This suggests that conceptualizing how autistic people experience belonging and burdensomeness could contribute to new and unique suicide prevention opportunities. Overall, our results suggest that addressing the social marginalization of autistic people could reduce suicide rates.

216.002 *(Panel)* Crisis Supports for the Autism Community – a Toolkit

L. Morgan[1] *and T. W. Benevides*[2]*, (1)American Association of Suicidology, Washington, DC, (2)Occupational Therapy, Augusta University, Augusta, GA*

Background: Suicide prevention and crisis response is an important part of a national strategy to reduce suicide (U.S. Department of Health and Human Services, 2012). Materials for crisis and first responders are an essential component of prevention. For autistic individuals, who may display different risk factors and ways of communicating need, there were no crisis response tools that first responders and others could use to address suicidal ideation in autistic individuals in late 2017.

Objectives: The purpose of this presentation is to share information about the development of resources that occurred through a multidisciplinary collaboration of people and organizations, led by an autistic suicide loss survivor.

Methods: A grassroots effort to discuss suicide in autism between several organizations led to the American Association of Suicidology (AAS) forming a committee to address suicide in autism in May 2018.The initial committee was formed from individuals and representatives from AAS, Nationwide Children's Hospital and the Tragedy Assistance Program for Survivors (TAPS). A literature review was conducted by the members of the committee. As a result, the committee identified a gap in available crisis response materials specific to autistic individuals. A toolkit for crisis response individuals was developed and modified for use in crisis centers nationwide. A webinar, a press-release, and an available toolkit on AAS's website were made available in October 2018. A total of 118 crisis response centers received the toolkit at that time.

Results: The AAS Committee has received positive feedback from crisis response teams who have used the toolkit. Several first person stories have reported that the toolkit resulted in use that positively facilitated the communication between crisis responders and autistic individuals experiencing suicidal ideation. There was additional dissemination of the toolkit to the 75 members of NASCOD (National Association of Crisis Organization Directors), 63 USA accredited agencies, the Center for Autism Research Excellence, and has also been distributed through word-of-mouth.

Conclusions: Autistically developed and vetted community toolkits are essential for effective suicide prevention with autistic individuals. The feedback received has demonstrated the need for crisis response materials that can be used in the community. Although use has been high and the response has been positive, an evaluation of the toolkit is a future step. Future evaluation with end-users is important for revision and more wide-spread adoption.

216.003 *(Panel)* The Effect of Dialectical Behavior Therapy in Autism Spectrum Patients with Suicidality and/or Self-Destructive Behavior: A Randomized Multi-Center Controlled Trial

A. Huntjens[1], *W. van den Bosch*[2], *B. Sizoo*[3], *A. Kerkhof*[1,4], *M. Huibers*[1,5] *and M. van der Gaag*[6], *(1)VU University, Amsterdam, Netherlands, (2)Scelta, Apeldoorn, Netherlands, (3)Dimence, Deventer, Netherlands, (4)CLINICAL PSYCHOLOGY, Amsterdam Public Mental Health Research Institute, Amsterdam, Netherlands, (5)Amsterdam Public Mental Health Research Institute, Amsterdam, Netherlands, (6)Parnassia Psychiatric Institute, The Hague, Netherlands*

Background: Many patients with autism spectrum disorder (ASD) are treated in long-term specialized care. In this population, suicidal behavior troubles patients, families, and specialists in the field because it is difficult to treat. At present, there is no documented effective therapy for suicidal behavior in ASD. Dialectical Behavior Therapy (DBT) is an efficacious treatment program for chronically suicidal and/or self-harm behavior in patients with Borderline Personality Disorder. This study will evaluate the efficacy of DBT in patients with ASD and suicidal/ self- destructive behavior in a randomized controlled multisite clinical trial.

Objectives: The primary outcome is the level of suicidal ideation and behavior. The secondary outcomes are anxiety and social performance, depression, core symptoms of ASD, quality of life, and cost-utility. Emotion regulation and therapeutic alliance will be investigated for mediation effects.

Methods: 128 patients with autism and suicidal and/or self-harming behavior will be recruited from specialized mental healthcare services and randomized into two conditions: 1) the DBT condition in which the participants have weekly individual cognitive behavioral therapy sessions and a 2.5 hour skills training group session twice per week, and 2) the treatment as usual condition which consists of weekly individual therapy sessions of 30-45 minutes with a psychotherapist or social worker. Assessments will take place at baseline, at post-treatment (6 months), and after a follow-up period of 12 months. The mediators will also be assessed at three months.

Results: Based on previous positive clinical experiences, we expect patients to benefit from the therapy. We expect that DBT would be effective in decreasing suicidal and self-destructive behavioral and to increase quality of life and increase social functioning. Results will be disseminated unreservedly, irrespective of the magnitude or direction of the effects.

Conclusions: This is an ongoing study. The results from this study will provide an evaluation of the effectiveness of DBT treatment in patients with ASD on suicidal and/or self-harming behavior. The study is conducted in routine mental health services and this enhances the generalizability of the study results to clinical practices.

216.004 *(Panel)* Modifying the Safety Planning Intervention for Autistic Adolescents and Adults

B. B. Maddox[1], *S. R. Crabbe*[1], *M. L. Airey*[2], *D. S. Mandell*[3] *and S. Jager-Hyman*[1], *(1)University of Pennsylvania, Philadelphia, PA, (2)Children's Hospital of Philadelphia, Philadelphia, PA, (3)Center for Mental Health, University of Pennsylvania, Philadelphia, PA*

Background: Suicide is a leading cause of premature death in autistic people. Autistic individuals are significantly more likely to think about and attempt suicide than the general population. No research has examined the effectiveness of suicide interventions for autistic individuals. The Safety Planning Intervention (SPI), an evidence-based suicide prevention intervention, may be an ideal intervention, with some modifications, for autistic individuals who experience suicidal thoughts or behaviors. SPI is a brief, individually-tailored, and easy-to-use approach designed to lower the short-term risk of suicide. Little is known about the utility of SPI for autistic individuals, nor has research examined adaptations necessary to best fit this population.

Objectives: The objective of this community-partnered study is to learn from autistic adolescents and adults, their family members, and community clinicians about their perceptions of using SPI with autistic clients.

Methods: One hundred and twenty-one clinicians (82.6% female, mean age = 37 years) completed an online survey about their clinical experience managing suicide risk in autistic clients. We also completed semi-structured interviews with 17 adolescents and adults on the spectrum (59% male, mean age = 28 years), 12 family members (83% female, mean age = 56 years), and 31 community clinicians (81% female, mean age = 43 years) with a range of experience working with autistic clients. All interviews were audio-recorded and professionally transcribed for analyses.

Results: Of the survey participants, only 24% reported feeling very confident in their abilities to intervene when an autistic client is at risk for suicide, and only 17.4% reported using SPI with autistic clients. Clinicians rated SPI as a more acceptable suicide prevention strategy for clients without autism than for autistic clients ($p < .001$). During the interviews, stakeholders discussed both advantages (e.g., a written, stepwise plan) and disadvantages (e.g., difficulties with generalizing the plan outside session) of using SPI with autistic clients. As one young woman on the spectrum said, “I found it helpful having it already written down, not having to think it up on my own.” Clinicians expressed concerns about an autistic client’s impulsivity interfering with the ability to implement the plan. Autistic individuals and their family members were enthusiastic about a suicide prevention strategy that can be initiated in an outpatient therapy setting, given their negative experiences with inpatient hospitalization for suicidal thoughts and behaviors. Suggested modifications to SPI included making the text more direct and concise, decreasing the emphasis on social supports and settings, increasing education and practice about internal coping strategies, increasing the involvement of family members, incorporating visual supports (e.g., photos for each step), and leveraging technology.

Conclusions: Although some aspects of SPI are a good fit for the learning style of many autistic people, other aspects pose challenges given the core traits of autism and other common co-occurring difficulties. Our three stakeholder groups expressed support for modifying SPI for autistic individuals and provided valuable recommendations to guide this process. Next steps include pilot testing and further refining the adapted SPI.

PANEL SESSION — MEDICAL AND PSYCHIATRIC COMORBIDITY
217 - Longitudinal Examinations of Mental Health Comorbidity in Young Children with ASD

Panel Chair: Connor Kerns, *University of British Columbia, Vancouver, BC, Canada*

Discussant: Peter Szatmari, *The Hospital for Sick Children, Toronto, ON, Canada*

Mental health comorbidities (MHC) affect the majority of individuals with ASD and are associated with poorer outcomes as well as more complex and costly care (Ahmedani & Hock, 2011; Croen et al., 2006). Nonetheless, most research has focused on school-age youth and is cross-sectional, providing only a snapshot of MHC in ASD rather than an understanding of their emergence and developmental trajectory. The proposed international panel will address these limitations by presenting data from 3 longitudinal studies regarding the emergence, stability and trajectories of varied forms or psychopathology in young children with ASD and their relationship to core ASD deficits, cognitive development and sex. It is unclear when and how to best assess MHC in young children with ASD or if MHC prevention/early intervention may be warranted. The selected studies consider this knowledge gap. Learning Goals: (1) Describe whether there is evidence for an increased rate anxiety and attention deficit hyperactivity disorder (ADHD) in preschoolers with ASD despite challenges in assessment; (2) Describe how internalizing psychopathology is related to trajectories of intellectual development and ASD symptoms in young children with ASD; (3) Describe gender differences in the developmental trajectory of co-occurring psychopathology in young children with ASD.

217.001 *(Panel)* Rates and Stability of ADHD and Anxiety Diagnoses in Preschoolers with Autism Spectrum Disorder and Comorbid Intellectual Disability

***A. L. Hogan**, C. J. Black and J. E. Roberts, Department of Psychology, University of South Carolina, Columbia, SC*

Background: Psychiatric comorbidities such as attention deficit/hyperactivity disorder (ADHD) and anxiety disorders are found at elevated rates in individuals with ASD. However, most of what is known about psychiatric comorbidities in ASD has been derived from older, higher-functioning samples. Thus, the rates and stability of psychiatric comorbidities in young children with ASD and intellectual disability (ID) remains poorly understood.

Objectives: Characterize the rates and stability of ADHD and anxiety diagnoses in preschool-aged children with ASD and ID relative to typically-developing (TD) peers.

Methods: The sample included 46 children with ASD (*M* age=3.89) and 32 TD controls (*M* age=4.00). Participants were assessed at 3, 4, and 5 years of age, for a total of 129 observations (ASD: *n*=64; TD: *n*=65). Psychiatric diagnoses included the following disorders: ADHD, social anxiety, separation anxiety, specific phobia, and generalized anxiety disorder (GAD). The Preschool Age Psychiatric Assessment (PAPA) was used to measure ADHD and anxiety symptoms. Clinical best estimate (CBE) diagnoses were assigned based on review of multiple sources of data including PAPA diagnostic cutoffs, cognitive/adaptive skills, and ASD symptoms at each assessment. CBE diagnoses were determined by a multi-disciplinary team including a licensed child psychologist and those who conducted the assessments. Rates of diagnoses using the PAPA cutoffs versus clinician judgment (i.e., CBE) were compared at each age. In the children with multiple assessments (ASD: *n*=15, TD: *n*=17), stability of the number of CBE anxiety diagnoses was also characterized.

Results: Using PAPA cutoffs in isolation, the ASD group had higher rates of ADHD at 3 years (ASD: 41.2%, TD: 0%; $X^2(1)=10.60$, $p=.001$) and at 5 years (ASD: 25%, TD: 0%, $X^2(1)=3.71$, $p=.054$). In contrast, there were no group differences at any age in the rates of anxiety diagnoses according to PAPA cutoffs. However, when clinician judgment was used to assign diagnoses, distinct differences emerged. Children with ASD still had higher rates of ADHD at 3 years (ASD: 17.6%, TD: 0%; $X^2(1)=4.02$, $p = .045$) and at 5 years (ASD: 25%, TD: 0%, $X^2(1)=3.71$, $p=.054$). Children with ASD were more likely than TD children to have at least one CBE anxiety diagnosis at 3 years (ASD: 61.1%, TD: 26.1%, $X^2(1)=5.10$, $p=.023$), but not at other ages. The ASD group showed higher rates of specific phobia at 3 years (ASD: 50.0%, TD: 13.6%, $X^2(1)=3.71$, $p=.054$). Regarding anxiety diagnosis stability across age in the ASD group, 13.3% with no diagnosis remained undiagnosed (TD: 64.7%), 26. 7% maintained the same number of anxiety diagnoses (TD: 5.8%), 13.3% increased (TD: 5.8%), and 46.7% decreased (TD: 23.5%).

Conclusions: ADHD and anxiety diagnoses were diagnosed at elevated rates throughout the preschool period in children with ASD and ID. However, anxiety diagnoses in ASD appear to be less stable during this developmental period, perhaps due to the challenges of assessing and interpreting anxiety symptoms and internalizing behaviors in non- or minimally-verbal children with ASD. These results highlight the importance of examining psychiatric comorbidities longitudinally and weighing clinician judgment alongside diagnostic cutoff scores in young children with ASD and ID.

217.002 *(Panel)* Co-Occurring Trajectories of Anxiety and Insistence on Sameness Behavior in Autism Spectrum Disorder

D. A. Baribeau[1], *S. Vigod*[2], *E. Pullenayegum*[3], *C. M. Kerns*[4], *P. Mirenda*[4], *I. M. Smith*[5], *T. Vaillancourt*[6], *J. Volden*[7], *C. Waddell*[8], *L. Zwaigenbaum*[7], *T. Bennett*[9], *E. Duku*[10], *M. Elsabbagh*[11], *S. Georgiades*[10], *W. J. Ungar*[12], *A. Zaidman-Zait*[13] *and P. Szatmari*[3], *(1)University of Toronto, Toronto, ON, Canada, (2)Women's College Hospital, Toronto, ON, Canada, (3)The Hospital for Sick Children, Toronto, ON, Canada, (4)University of British Columbia, Vancouver, BC, Canada, (5)Dalhousie University / IWK Health Centre, Halifax, NS, CANADA, (6)University of Ottawa, Ottawa, ON, Canada, (7)University of Alberta, Edmonton, AB, Canada, (8)Simon Fraser University, Vancouver, BC, Canada, (9)Offord Centre for Child Studies, McMaster University, Hamilton, ON, CANADA, (10)McMaster University, Hamilton, ON, Canada, (11)McGill University, Montreal, QC, Canada, (12)University of Toronto / The Hospital for Sick Children, Toronto, ON, Canada, (13)Tel-Aviv University, Tel-Aviv, Israel*

Background: Children with autism spectrum disorder (ASD) have increased vulnerability to anxiety disorders. Emerging evidence suggests that there may be a relationship between the rigid, repetitive and routinized patterns of behavior that are core to the diagnosis of ASD, and the development of anxiety in this population. Insistence on sameness (IS) behaviors in particular (e.g., rigid adherence to rituals and routines, difficulties with transitions) have been shown to correlate with anxiety symptoms cross-sectionally. A recent study by members of our team showed that there is a longitudinal relationship as well - high restricted/repetitive behavior severity in preschool, especially IS behavior, was associated with future elevated anxiety symptoms at ages 8-11 years, even after adjusting for baseline anxiety and other confounders [1]. This analysis did not take into account potential heterogeneous longitudinal trajectories, however.

Objectives: The objective of the following study was to jointly examine heterogeneous developmental trajectories of IS and anxiety in ASD.

Methods: Data were collected through the Pathways in ASD study, a large (n = 421), longitudinal inception cohort study of children with ASD and their families that began in 2005. IS was measured using the Autism Diagnostic Interview-Revised at approximately ages 3, 6 and 11 years. Anxiety symptoms were quantified at 8 time-points between ages 3 and 11 years using the Child Behavior Checklist (CBCL) Anxiety Problems subscale. Multi-group trajectories were estimated for the continuous ADI-R IS subscale raw scores (at T1, T4, and T8) and the CBCL anxiety subscale T-scores (at T1 through T8) using group-based trajectory modelling. Clusters of participants following similar trajectories were identified using joint trajectory analysis.

Results: Three IS trajectories were identified: 1) 'low-stable' (41.7% of participants), 2) 'moderate-increasing' (52.0%), and 3) 'high-peaking' (i.e., increasing then stabilizing/decreasing behavior) (6.3%). Four anxiety trajectories were identified: 1) 'low-increasing' (51.0%), 2) 'moderate-decreasing' (16.2%), 3) 'moderate-increasing' (19.6%), and 4) 'high-stable' (13.1%). Anxiety trajectories 3 and 4 surpassed the threshold for concern (T-score >65) at one or more timepoints. Almost all children assigned to the 'high-peaking' IS trajectory were jointly assigned to anxiety trajectory 3 or 4. Anxiety and IS trajectories followed similar patterns of change for 26.2% of the sample, whereas for 18.1% opposing patterns of change were seen (e.g., decreasing anxiety and increasing IS).

Conclusions: This study revealed that the developmental trajectories of IS behavior and anxiety in ASD over childhood are associated, but the direction of the association may differ in distinct sub-groups. High IS in early development should prompt assessment/monitoring for anxiety. For some children, opposing IS and anxiety trajectories suggest heterotypic continuity, potentially reflecting a shared biologic vulnerability with evolving clinical manifestations. Overall, data suggest that there is an important opportunity for prevention of anxiety disorders in many children with ASD.

1. Baribeau, D.A., et al., *Repetitive Behavior Severity as an Early Indicator of Risk for Elevated Anxiety Symptoms in Autism Spectrum Disorder.* J Am Acad Child Adolesc Psychiatry, 2019 (in press).

217.003 *(Panel)* Cognitive Developmental Trajectories, Social Functioning, and Internalizing Psychopathology in Preadolescents with ASD

M. Solomon[1], *A. M. Iosif*[2], *B. Heath*[1], *A. J. Gordon*[3], *M. K. Krug*[4], *C. W. Nordahl*[1] *and D. G. Amaral*[1], *(1)Department of Psychiatry and Behavioral Sciences, The Medical Investigation of Neurodevelopmental Disorders (MIND) Institute, UC Davis School of Medicine, University of California Davis, Sacramento, CA, (2)Public Health Sciences, University of California Davis, Davis, CA, (3)Psychiatry & Behavioral Sciences, University of California, Davis, M.I.N.D. Institute, Sacramento, CA, (4)Department of Psychiatry & Behavioral Sciences, UC Davis MIND Institute, Sacramento, CA*

Background: In those with typical development (TD), the period between preadolescence (ages 9-13; referred to herein as "preadolescence") is a time of cognitive and social development that prepares individuals for the profound alternations in social functioning characteristic of adolescence. A failure to develop optimally during this period may set the stage for the onset of the internalizing psychopathology known to emerge in adolescence. This period has been understudied in ASD

Objectives: Recently, our group identified trajectories of intellectual development (IQ) between early (ages 2-4 years) and later childhood (ages 4-6 years) that were associated with unique behavioral profiles. Our goal is to extend this work into preadolescence, and to investigate whether group membership is associated with changes in social functioning and internalizing psychopathology across this period.

Methods: Participants include a relatively large sample of children with ASD taken from the Autism Phenome Project (APP) cohort who were assessed in both early and preadolescence (n=90 children ages 2-13 years). They were qualified into the cohort using gold standard measurements including ADOS-2 and ADI-R administered. For this investigation, we also used scores from the Differential Abilities Scale (DAS-II), Social Responsiveness Scale (SRS-2), the Vineland Adaptive Behavior Scale-2 (VABS-2), and the Child Behavior Checklist (CBCL; Anxious-Depressed Syndrome Scale). Group-based trajectory modeling conducted in MPlus was used to identify a small number of groups of children with similar IQ trajectories from early childhood to preadolescence. Once children were classified by trajectory, we examined performance on measures of social awareness, social motivation, social adaptive functioning, and anxious depressed syndrome scale scores using general linear models with correction for multiple comparisons.

Results: We found 3 distinct IQ trajectories with very similar criteria to the 2018 manuscript. We refer to these new groups that span ages 2 to 13 years as Persistently Low (**P-Low; 45%**), which had IQ scores < 75 at all timepoints;persistently average or better as Persistently High (**P-High; 27%**), which has IQ scores > 75 at all timepoints; and Positive Changers (**+CHG; 28%)**, which started with IQs < 75 in early childhood that then increased by at least 1 standard deviation by preadolescence. Scores on social awareness of the ASD **+CHG**and **P-High** IQ groupswas comparable and higher than those of **P-Low** during preadolescence, with the social awareness of only the **+CHG**group improving from early to preadolescence. Social motivation was comparable across the 3 ASD groups and declined between early and preadolescence.The**+CHG**group versus the **P-Low**and **P-High**groups showed the steepest growth in early to middle childhood/adolescence social functioning, which leveled off at the later period, while **P-Low**and **P-High**experienced declines. Anxious-depressed symptoms increased significantly between early and preadolescence in P-High.
Conclusions: Trajectory groups found at earlier ages persisted to ages 9-13. The **+CHG**group continued to show interesting strengths, while the **P-High**group appears to be most susceptible to internalizing psychopathology, while **P-Low**was least susceptible. All ASD groups declined in social motivation between early and preadolescence suggesting an area of concern.

217.004 *(Panel)* Sex Differences in a Subgroup of Children with Autism and Co-Occurring Symptoms of Psychopathology

C. W. Nordahl[1]*, A. M. Iosif*[2]*, B. Heath*[1]*, D. G. Amaral*[1]*, M. Solomon*[3] *and S. Ozonoff*[3]*, (1)Department of Psychiatry and Behavioral Sciences, The Medical Investigation of Neurodevelopmental Disorders (MIND) Institute, UC Davis School of Medicine, University of California Davis, Sacramento, CA, (2)Public Health Sciences, University of California Davis, Davis, CA, (3)Psychiatry and Behavioral Sciences, The Medical Investigation of Neurodevelopmental Disorders (MIND) Institute, UC Davis School of Medicine, University of California Davis, Sacramento, CA*

Background: Individuals with autism often have co-occurring psychiatric conditions, but little is known about the trajectory of development of symptoms of psychopathology during early childhood, whether there are sex differences in symptom presentation, and whether early childhood symptoms are predictive of later outcomes.
Objectives: We recently identified a subgroup of 3-year-old children with high levels of psychopathology. The goal of the current study is to evaluate symptoms of psychopathology in this subgroup later in childhood, around 5.5 years of age.
Methods: Participants include a large sample of children with ASD (91 females, 209 males) assessed between 2-3.5 years of age. ASD diagnosis was confirmed using ADOS-2 and ADI-R administered by clinical psychologists with expertise in ASD. Latent profile analysis (LPA) was used to identify ASD subgroups based on symptoms of psychopathology, adaptive functioning, cognitive development, and autism severity. Psychopathology was evaluated using t-scores from the Child Behavior Checklist (CBCL) DSM-oriented scales for affective problems, anxiety problems, attention deficit/hyperactivity problems, and oppositional defiant problems. Sex differences in the proportion of girls and boys in each subgroup were evaluated. A subset of children (45 females and 99 males) returned for longitudinal assessment two years after study entry, around 5.5 years of age. CBCL DSM-oriented scales were compared across subgroups and sex. Associations between baseline and longitudinal CBCL Internalizing and Externalizing scores were also examined across sex.
Results: At baseline assessment, three LPA subgroups were identified. One subgroup comprising 27% of the sample, was classified as having higher symptoms of psychopathology than the other two subgroups and moderate impairments on the other measures (*High Psychopathology, Moderate Impairments [HPMI]*). The other two subgroups had lower symptoms of psychopathology but were differentiated by high and low levels of impairment on other measures. Distribution of sex across subgroups was significantly different ($\chi^2 = 10.4$, $p = .006$). Almost twice as many girls were classified into the HPMI subgroup as boys (40% vs 22%). At longitudinal follow-up (mean age = 66.7 months), there was a sex by subgroup interaction for the Anxiety Problems t-score (p = .06). Females in the High Psychopathology subgroup had elevated anxiety scores relative to females in the other subgroups. In contrast, anxiety scores for males in the high psychopathology subgroup were no longer different from males in the other subgroups. There were no main or interaction effects on the other DSM-oriented scales. Internalizing and Externalizing scores were significantly correlated at baseline and follow up in females (r = .73, p = .003 internalizing, r = .761, p = .002 externalizing) but not in males (r = .16, p = .62 internalizing, r = .17, p = .58 externalizing).
Conclusions: Symptoms of psychopathology at age 3 were predictive of higher levels of anxiety at age 5 in females with ASD, but not males, and internalizing and externalizing scores were significantly correlated across time in females but not males. These results suggest that symptoms of psychopathology may be more stable in females with ASD across early childhood than in males.

POSTER SESSION — MEDICAL AND PSYCHIATRIC COMORBIDITY
430 - Medical and Psychiatric Comorbidity Posters

430.001 *(Poster)* A Comparison of the DSM Structure of Anxiety and Depression Symptoms across ASD and Non-ASD Youth

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Background: Youth with autism spectrum disorder (ASD) are at increased risk for experiencing co-occurring internalizing symptoms (e.g., Simonoff et al., 2008). Available evidence regarding internalizing symptom presentation in ASD is mixed; that is, some presentations of internalizing symptoms in ASD conform to standard DSM or traditional classification criteria (Lecavalier et al., 2011), while others reflect altered anxiety symptom presentation resulting from epiphenomena of ASD (e.g., Kerns et al., 2014; Wood & Gadow, 2010). Additionally, studies examining anxiety symptom presentation in ASD generally have not accounted for the putative overlap of depression symptoms, which may have influenced their obtained results. Crucially, understanding the appropriate conceptualization of anxiety and depression symptoms in ASD is needed to inform accurate assessment and subsequent treatment of internalizing disorders in ASD.
Objectives: The present study examines the extent to which DSM-defined symptoms of anxiety and depression present similarly in a sample of ASD and non-ASD youth.

Methods: Participants were ages 6-18, diagnosed with ASD in an outpatient clinic (N=280; M_{age} =10.7, SD_{age}=3.4) or referred to a psychiatry outpatient clinic with no ASD diagnosis (N=1195; M_{age} = 12.1, SD_{age}=3.4). Anxiety and depression symptoms were measured using the parent CASI-4R (Gadow & Sprafkin, 2008), a DSM-IV referenced rating scale.

Confirmatory factor analysis was used to examine measurement invariance of anxiety and depression symptom structure across the ASD and non-ASD groups (Figure 1). Anxiety subscale items (e.g., PTSD, somatization, specific phobia, panic, obsessive-compulsive disorder, generalized, social, separation anxiety) were fixed to load on an anxiety factor (Scahill et al., 2019), whereas depression and dysthymia items were fixed to load on a depression factor (Uljarević et al., 2017).

Results: Fit indices from measurement invariance analyses suggested relatively poor fit of the overall model of anxiety and depression symptoms (Table 1). However, fit improved at subsequent stages of invariance testing, indicating that anxiety and depression items are functioning similarly across groups in terms of factor loadings (e.g., metric invariance) and mean item endorsement levels (e.g., strong invariance).

Conclusions: Anxiety and depression items function similarly across the ASD and non-ASD groups, suggesting that parents are interpreting anxiety and depression items comparably across the ASD and non-ASD groups. This finding is consistent with recent work suggesting that internalizing symptoms (e.g., anxiety and depression on one internalizing factor) function similarly across ASD and non-ASD samples (Rodriguez-Seijas et al., 2019). Nonetheless, fit indices suggest that the overall anxiety and depression model demonstrated unsatisfactory fit across the two groups. It may be that accounting for the influence of ASD symptoms on internalizing symptoms would yield a better fit, which would have important nosological implications, such as adding ASD-specific manifestations of anxiety and depression to the DSM. Results underscore the importance of current efforts to validate adapted measures of internalizing symptoms for youth with ASD which consider ASD-influenced forms of anxiety (Kerns et al., 2017). Future studies are needed to validate such measures for depression in ASD, while continued efforts to identify evidence-based treatments for the unique forms of depression and anxiety in ASD are also warranted.

430.002 *(Poster)* A Lasso Analysis of Maternal, Obstetric, and Perinatal Predictors of Autism

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Background: While genetics is clearly implicated in the etiology of autism, other biological factors may also increase the likelihood of an autism diagnosis. Many of these pertain to obstetric history, prematurity, and other pregnancy complications. In addition, some studies show an association with maternal medical conditions, particularly those relating to sex-hormone imbalance. Importantly, many of these conditions co-occur, making it difficult to disentangle the relationships between individual predictors and increased likelihood of autism in the child. This is particularly difficult as most studies focus on a subset of symptoms or conditions, and do not examine them together.

Objectives: To investigate which individual symptoms or conditions are most predictive of an increased likelihood of a childhood autism diagnosis using LASSO (least absolute shrinkage and selection operator).

Methods: Women recruited online through the Cambridge autism research database (CARD) and through the Cambridge psychology website, reported medical and pregnancy history of their first-born (N=557, 34.5% of children diagnosed with autism) and second-born (N=374, 28.1% of children diagnosed with autism) children. Data collected included (1) medical conditions relating to sex-hormone imbalance, fertility, and autoimmune disorders; (2) obstetric factors relating to immune activation during pregnancy, infertility treatments, age at birth, and other obstetric complications; (3) perinatal factors relating to preterm birth and birth weight. The first-born and second-born data were analyzed separately using the LASSO procedure (including cross validation), which enables the selection of variables using regularization and normalization procedures. A total of 42 and 39 predictors were used in the first and second-child analyses, respectively (some variables were dropped due to extremely low frequency in our sample). In a follow up analysis ('siblings analysis'), obstetric course and perinatal factors were analyzed for mothers who have one child diagnosed with autism and another neurotypical child, from the same father (N mothers= 132, 61.7% males), thus allowing to control for many genetic and environmental aspects. Twenty-five predictors were analyzed using the CLOGIT-LASSO procedure, which allows a comparison between the siblings' dependent data.

Results: The main analysis revealed the maternal medical conditions, obstetric course factors and perinatal factors relating to an increased likelihood of autism in the child (20 and 11 predictors for the first and second child analyses, respectively). Factors included, parental age (both mother and father), anovulation, diabetes, child gestational age, and child sex (See all variables in Table 1). The sibling analysis revealed that high maternal BMI before pregnancy and maternal low weight gain during pregnancy differentiated the pregnancy course of children later diagnosed with autism from neurotypical children.

Conclusions: This is one of the few studies to analyze a large set of predictors, spanning maternal medical conditions, obstetric course, and perinatal factors. Analyzing these factors together, using machine learning methods, allows us to disentangle the specific factors contributing to increased likelihood of autism in the child. The follow up analysis enabled us to examine these factors within families, thus allowing to control for genetic and environmental effects. Findings show that conditions relating to sex-hormone imbalance and diabetes are important predictors of autism.

430.003 *(Poster)* A Preliminary Investigation of Fear in Those with and without ASD

***K. S. Ellison** and T. E. Davis, Department of Psychology, Louisiana State University, Baton Rouge, LA*

Background: A phobia develops when a healthy fear becomes more intense, interfering, and last longer for an individual over time (Craske, 1997). van Steensel and colleagues (2012) found that specific phobias were more common in children with Autism Spectrum Disorder (ASD) compared to other anxiety disorders. More qualitative research is needed to explore fears and phobias in children with ASD.

Objectives: This study investigated the amount of fears and types of fears reported by youth with ASD compared to youth diagnosed with Social Anxiety Disorder (SAD) and youth without a psychiatric diagnosis (NODX). Descriptives related to the types of specific phobia were explored.

Methods: Nine youths with ASD (7 males; *M=10.44* years-old), 9 with SAD (4 males; *M=10.67* years-old), and 9 with NODX (7 males; *M=12.78* years-old) were included as part of a larger IRB-approved study. Consent/assent was obtained. Diagnoses were confirmed by the *Childhood Autism Rating Scale, Second Edition (CARS-2)* or the *Autism Diagnostic Observation Schedule, Second Edition (ADOS-2)* and the *Anxiety Disorders Interview Schedule (ADIS- IV-C/P)*. Youths were matched on age and IQ. Full-Scale IQ was measured using the *WISC-V* (ASD *M*=95.66, *SD*=13.96; SAD *M*=103.44, *SD*=10.38; NODX *M*=102.56, *SD*=7.78). The *Fear Survey Schedule for Children – Revised (FSSC-R)* was completed by each youth in order to capture the individual's total amount of fear as well as specific fear domains (fear of failure and criticism, fear of the unknown, fear of injury and small animals, fear of danger and death, medical fears). Data collection is ongoing.

Results: A one-way ANOVA was performed examining the effect of diagnosis on the total fears score as well as the five fear category scores from the *FSSC-R*. The three groups differed significantly on total fear, $F(2, 24)=4.31$, $p=.03$: youth with NODX (*M*=19.78,*SD*=12.79) differed from both youths with ASD (*M*=35.11,*SD*=12.68) and SAD (*M*=39.11,*SD*=18.10). The three groups were also significantly different on fear of the unknown, $F(2, 24)=5.45$, $p=.01$, with NODX (*M*=19.88,*SD*=7.29) having significantly less fear of the unknown compared to youths with ASD (*M*=27.78,*SD*=5.89, $p=.04$) and SAD (*M*=28.89,*SD*=4.84, $p=.01$). Children with ASD and SAD did not significantly differ on fear of failure (ASD *M*=29.22, *SD*=6.74; SAD *M*=30.11, *SD*=8.13; $p=.80$), fear of injury and small animals (ASD *M*=34.00, *SD*=6.58; SAD *M*=35.67, *SD*=9.50, $p=.67$), fear of danger and death (ASD *M*=27.11, *SD*=7.30; SAD *M*=26.11, *SD*=6.82, $p=.77$), and medical fears (ASD *M*=9.56, *SD*=2.07; SAD *M*=10.55, *SD*=2.40, $p=.36$). Descriptive statistics yielded 6 of the 9 youth with SAD and 3 of the 9 youth with ASD were also diagnosed with a specific phobia. All 3 youth with ASD had a fear of wasps.

Conclusions: Contrary to previous research, children with ASD did differ in the amount of fear they endorsed compared to children with SAD, though both reported more fear than those with no diagnoses. Recruitment is ongoing to allow for additional comparisons and further exploration of group differences.

430.004 *(Poster)* ASD or Response to Childhood Trauma? How ACEs Type and Frequency Influence Symptom Presentation of Children with and without Autism Spectrum Disorder.

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Background: Children with Autism Spectrum Disorder (ASD) are twice as likely to experience four or more Adverse Childhood Experiences (ACEs) than their typically developing peers (10.2% vs 5.1%; Dixon Browne & Hamilton-Giachritsis, 2009). Families affected by ASD experience several risk factors that increase their likelihood of ACEs, including parent stress, financial strain, and lack of social support (Dabrowska & Pisula, 2010). In addition, social communication impairments can prevent children with ASD from reporting, limiting access to trauma-informed interventions (McEachern, 2012). Research has found that increased ACEs is associated with widespread mental health and physical health problems (Rigles, 2017). Specifically for children with ASD, increased ACEs are associated with delayed age of diagnosis and entrance into treatment services (Levy, 2010). To date, very few studies have examined posttraumatic response in individuals with ASD to inform differential diagnosis between ASD and trauma response.

Objectives: This study examined how children with ASD process and respond to ACEs similarly or differently than (a) ASD children without ACEs and 2) typically developing (TD) children with ACEs.

Methods: Participants included a nationwide sample (n=250) of parents of children ages 3-12. The study gathered data from a culturally and socioeconomically diverse sample to measure social, emotional, and behavioral symptoms associated with posttraumatic stress response in children. Three study populations were recruited: children with ASD who experienced ACEs, children with ASD who have not experienced ACEs, and TD children who experienced ACEs. Parents completed the Trauma Symptom Checklist for Young Children (TSCYC), the Social Responsiveness Scale (SRS-2), and self-injurious and compulsive behaviors subtests of the Repetitive Behavior Scale (RBS-R). One-way MANOVAs were conducted to assess for differences in symptom presentation between groups.

Results: Preliminary data suggest that ASD participants with ACEs have significant highly number of mental health diagnoses than the other two groups ($p<.001$). Thus far, findings suggest that as children with ASD accumulate three ACEs, their posttraumatic stress symptoms cross into in the clinical range, as opposed to TD children who seem to accumulate six ACEs before reaching the same level of clinical distress. In regard to autism-related symptoms, there were significant differences between groups ($p<.001$), with children with ASD and ACEs presenting as most symptomatic in all domains. Interestingly, 54% of parents of TD children with ACEs reported ASD-related symptoms in the clinical range (M=60.3, SD=10.4). Children with ASD and ACEs demonstrated significantly higher rates of self-injurious behaviors than their TD peers with ACEs ($p=.002$). Pending analyses will explore how number and type of ACEs impact symptom presentation.

Conclusions: This investigation is part of newly emerging research investigating the diagnostic similarities and differences between TD children with ACEs and their peers with ASD. It is hoped that these results will provide novel data about the influence of ACEs on symptom presentation of children with and without ASD and will provide clarity about differential diagnosis of ASD versus trauma response. By gaining information about the unique posttraumatic symptom presentation in children with ASD, we may strive to increase timely identification of victims and adopt *appropriate* interventions.

430.005 *(Poster)* Adaptive and Behavioral Functioning in Children with Co-Morbid Down Syndrome and Autism Spectrum Disorder

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Background: Down Syndrome (DS) is a genetic disorder associated with moderate to severe Intellectual Disability (ID). Approximately 16% of children with DS also have autism spectrum disorder (DS+ASD). Children with DS+ASD show more adaptive impairments than children with DS, but comparable adaptive function to children with ASD. Previous literature also indicates a general trend of children with DS+ASD showing elevated behavioral concern compared to those with DS, but reduced compared to those with ASD.

Objectives: This study aims to explore adaptive and behavioral functioning in children with intellectual disability/global developmental delay and co-morbid DS+ASD compared to children with co-morbid ASD (ASD+ID), and children with cognitive impairment alone (ID).

Methods: Children (n = 179) aged 1.5 to 18 years were evaluated at an interdisciplinary autism clinic and received diagnoses of DS+ASD (n = 22), ASD+ID (n = 112), or ID (n = 45). Since age differed across groups (ID group was older), one-way ANCOVAs were conducted comparing groups with respect to parent-reported adaptive functioning measured by the Adaptive Behavior Assessment System (ABAS) and behavioral functioning measured by the Child Behavior Checklist (CBCL). Bonferroni correction was used to control for multiple comparisons resulting in an adjusted alpha level of .004 (.05/14).

Results: Race/ethnicity and gender did not differ across groups (see Table 1). When controlling for age, all children demonstrated mildly to moderately impaired adaptive functioning on the ABAS (see Table 2). Children with DS+ASD showed the greatest impairment across almost all domains of adaptive functioning; however, differences in practical skills did not survive correction. Children diagnosed with ASD (DS+ASD and ASD+ID) showed greater social impairment than children with ID. On the CBCL, all groups had similar elevations on withdrawal and attention problems. Children with ID demonstrated greater externalizing problems, total problems, anxious/depressed symptoms, and aggression, which were lower and more similar in the ASD+ID and DS+ASD groups. These differences remained following correction. Children with DS+ASD had lower scores than children with ID across all other domains, although these findings did not survive correction. Children with DS+ASD showed significantly less oppositional/defiance than either those with ASD+ID or ID, even following correction.

Conclusions: All children showed adaptive impairment, withdrawal, and attention problems. In contrast to previous studies, lower overall adaptive function and conceptual skills were observed in children with more co-morbid diagnoses (DS+ASD<ASD+ID<ID). CBCL findings suggest similar behavioral profiles between DS+ASD and ASD groups, with the exception of decreased oppositional/defiance in children with DS+ASD relative to other groups. Children with ID showed greater behavioral difficulties on the CBCL across several scales. This finding may reflect differences in parent reporting or expectations across diagnostic groups. Children with DS are often diagnosed at or before birth which may contribute to increased parental adaption to behavioral symptoms, while challenges in children with idiopathic ID may be more attributable to emotional or behavioral factors. Future research is needed to examine profiles of cognitive functioning and ASD symptomatology in children with DS+ASD, ASD+ID, and ID to determine their impact upon adaptive and behavioral functioning.

430.006 *(Poster)* Age of Autism Diagnosis and Current Mental Health Concerns in Females. Are They Related?

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Background: Mental health concerns are over-represented in autistic adults. As many as 60% of all autistic individuals report at least one comorbid psychiatric diagnosis, with autistic females displaying higher levels of anxiety, depression and eating disorders. Females are also more likely to be late-identified and under-diagnosed as being autistic. It is currently unknown if historical delays in autism diagnosis worsen mental health outcomes at present.

Objectives: The purpose of this investigation was to understand if year of birth, and subsequent age of autism diagnosis influenced rates of current mental health symptomology.

Methods: We recruited 330 formally diagnosed autistic women online (M age = 33.69 years, SD = 9.97). The Autism Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin & Clubley 2001) was used to assess levels of autistic traits, with all participants scoring above 32. Current levels of disordered eating were assessed using the Eating Attitudes Test (EAT-26; Garner, Olmsted, Bohr & Garfinkel, 1982), and depression and anxiety symptoms were assessed using the Depression, Anxiety, Stress Scale (DASS-21; Lovibond & Lovibond, 1995). We investigated the interaction between year of birth, age of autism diagnosis, and current mental health symptom severity.

Results: Using a diagonal plot, we were able to give an approximation of the interaction between year of birth, age of autism diagnosis, and current mental health symptom severity.

We found that females who were diagnosed as autistic within particular age bands displayed the highest depression, anxiety and stress symptom burden at present (Fig. 1). These were autism diagnoses between the ages of 7 to 12 (DASS-21: M=62.33, SD=19.31), and 13 to 18 (DASS-21: M=61.26, SD=11.87) years respectively. Significant differences were found between those diagnosed with autism between the ages of three and seven years, and those diagnosed between 30 and 45 years ($F_{(12.76)}$=7.17, p=.008).

When considering current eating disorder symptomology, (Fig. 2) we again found that females displaying the highest level of eating disorder symptoms were those diagnosed with autism between the ages of 7 to 12 (EAT-26: M=19.83, SD=14.28), and 13 to 18 years (EAT-26: M=21.50, SD=16.84), though no significant differences were found between age bands.

Conclusions: It appears that delays in the identification and diagnosis of autism in females may reflect the strength of pathology. It is proposed that when females are diagnosed with autism under the age of seven, the ensuing early intervention therapies and support have a protective effect, that allow them to avoid poorer mental health outcomes in adulthood. This highlights the need for greater understanding of the female profile of autism, comorbid mental health conditions, and the development of female specific screening and assessment tools.

430.007 *(Poster)* Anxiety Problems Mediate Associations between Sleep and Gastrointestinal Problems in Hospitalized Children with Autism Spectrum Disorder (ASD)

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Background: Sleep and gastrointestinal (GI) problems are prevalent medical comorbidities in children with autism spectrum disorder (ASD). Sleep and GI problems are correlated with one another in both ASD and non-ASD children; however, mechanisms underlying this association are unclear. Anxiety is also highly prevalent in ASD and has been identified as a potential mediator of the sleep-GI association in non-ASD individuals. The role of anxiety in the sleep-GI association in ASD is unclear.

Objectives: To determine if anxiety symptoms statistically mediate associations between sleep problems and GI problems in a sample of psychiatrically hospitalized children with ASD.

Methods: Data from the Autism Inpatient Collection (AIC) were used for this analysis. The AIC is a multi-site study of children with ASD admitted to one of six inpatient units specialized for the psychiatric treatment of children with ASD. Caregivers provided information regarding medical comorbidities and completed the Child Behavior Checklist (CBCL). Autism diagnosis, autism severity, verbal ability, and intellectual functioning were assessed by research-reliable Autism Diagnostic Observation Schedule-2 and the Leiter International Performance Scale-3. Complete data were available in 276 patients. Logistic regressions were used to determine if caregiver-reported sleep problems predicted GI problems independent of age, sex, autism severity, verbal ability, intellectual functioning, and anxiety symptoms. Sobel tests were used to determine if anxiety symptoms statistically mediated associations between sleep and GI problems. A sensitivity analysis was used to examine if results held when the CBCL Anxiety Problem question about nightmares was removed from the total score. Exploratory logistic regressions examined items within the CBCL Anxiety Problem subscale to determine if specific indicators of anxiety were driving analyses.

Results: Prior to adjusting for anxiety symptoms, Logistic regression analyses revealed that children with ASD and a sleep problem were 78% more likely to experience a GI problem (OR=1.78, 95% CI: 1.05-3.01) after controlling for age, sex, autism severity, verbal ability, and intellectual functioning. This association was no longer significant when anxiety symptoms were entered into the model. Every point increase on the CBCL Anxiety Problem t-score was associated with a 4.7% increase in the likelihood that a participant would have a GI problem (OR=1.05, 95% CI: 1.02-1.07). Sobel tests suggested that anxiety symptoms are a statistically significant mediator of the association between sleep and GI problems (Sobel test statistic = 3.14, SE = 0.10, p = 0.002). Anxiety symptoms continued to mediate the association between sleep and GI problems after removing the “nightmare” item from the subscale. Three indicators of anxiety were found to drive the mediation results. These included being 1) nervous, high-strung, or tense; 2) too fearful or anxious; and 3) worrying.

Conclusions: Anxiety symptoms mediated associations between sleep problems and gastrointestinal problems independent of autism severity, intellectual functioning, and verbal ability. Though the current study is cross-sectional, these results suggest that sleep problems may contribute to heightened anxiety symptoms which may in turn contribute to or exacerbate GI disturbances. Sleep disturbance and anxiety may be important intervention targets in children with ASD and GI disturbances.

430.008 *(Poster)* Anxiety and ADHD in Young Children with ASD Are Associated with Distinct Patterns of Executive Function Deficits and Core ASD Symptoms

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Background: Two of the most prevalent co-occurring disorders in ASD are anxiety and ADHD, with 40-60% of children meeting criteria for one or both of these disorders (Simonoff, 2008). Executive function difficulties are proposed as a common pathway between ASD and ADHD and are also implicated in anxiety. However, little is known about how anxiety or ADHD symptoms differentially impact executive functioning or how these deficits may influence the presentation of core ASD symptoms in young children. Furthermore, the clinical implications of co-occurring anxiety/ADHD and associated executive functioning deficits remain a significant gap in the literature.

Objectives: We aimed to understand how the unique executive function difficulties associated with co-occurring anxiety and/or ADHD differentially impact the clinical presentation of ASD in young children.

Methods: Data were derived from two studies of young children with ASD: Study 1 included sixty-nine 3-6-year-old children; Study 2 included sixty-three 4-8 year old children. Both studies included children with a range of cognitive functioning. Anxiety and ADHD were assessed through parent interview using the Preschool Age Psychiatric Assessment (Study 1) and the Child Behavior Checklist (Study 2). Executive functions were assessed using the Behavior Rating Inventory of Executive Function – Preschool Version and core ASD symptoms were measured with the ADOS, Repetitive Behavior Scale-Revised, Sensory Experiences Questionnaire 3.0, and Social Responsiveness Scale. To explore the relationship between executive function difficulties and co-occurring ADHD or anxiety, we used an additive main effect general linear model. The relationship between anxiety or ADHD and core ASD symptoms was assessed via mediation models. All models included both anxiety and ADHD to account for the fact that some children experience both conditions and to explore the unique contribution of anxiety and ADHD on each outcome.

Results: In both samples, we found that greater difficulty with attentional shifting was uniquely associated with anxiety (Study 1: $F=22.6$, $p<.001$; Study 2: $F=24.3$, $p<.001$), whereas greater difficulty inhibiting behavioral responses was uniquely associated with ADHD (Study 1: $F=12.2$, $p<.001$; Study 2: $F=36.4$, $p<.001$). Additionally, the first model supported that attentional shifting mediates the relationship between anxiety and core ASD symptoms including: ritualistic behaviors (β(SE)=0.22(0.1), 95% CIs=0.05-0.5), sameness behaviors (β(SE)=0.35(0.12), 95% CIs=0.11-0.59), sensory over-responsivity (β(SE)=0.99(0.45), 95% CIs=0.11-1.9), and social motivation (β(SE)=0.20(0.11), 95% CIs=0.02-0.4). The second mediation model indicated that inhibitory control mediates the relationship between ADHD and self-injurious behaviors (β(SE)=0.37(0.17), 95% CIs=0.08-0.74).

Conclusions: Unique patterns of executive function difficulties are associated with anxiety and ADHD and mediate the relationship between these conditions and core ASD symptoms. These findings implicate executive functioning as an important cognitive process underlying psychiatric comorbidities and ASD. Future research should investigate the impact of early intervention for executive function deficits on psychiatric and neurodevelopmental outcomes in children with ASD.

430.009 *(Poster)* Assessment and Management of Attention Deficit Hyperactivity Disorder in Individuals with ASD

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Background: Both autism spectrum disorders (ASD) and attention-deficit hyperactivity disorder (ADHD) are severely impairing chronic conditions with high prevalence rates that manifest in early childhood, predominantly affect males, are known to be highly heritable, and characterized by distinctive clinical, cognitive, and neural correlates. Nearly half of the population with ASD suffers from symptoms of ADHD (hyperactivity, impulsivity, and inattention) that greatly adds to their morbidity and dysfunction. ADHD is the most common psychiatric condition diagnosed in children and adults with ASD (Joshi et al., 2010, 2012). In recent times there has been a surge in research aimed at promoting better understanding of the autism spectrum disorders (ASD) and related comorbidities. Management of this highly complex disorder is limited either by lack of recognition of autism in youth under psychiatric treatment or by the failure to recognize the presence of co-occuring psychiatric disorders in youth diagnosed with autism. This leads to under-recognition of reciprocal co-occurrence of ASD and psychopathology. The presence of ADHD further worsens the already compromised academic and social functioning in school children with autism. Considering that ADHD is known to respond to a variety of pharmacological and non-pharmacological interventions, identifying and treating ADHD in individuals with ASD can reduce morbidity and facilitate targeted behavioral efforts specific for ASD.

Objectives: This presentation will offer an up-to-date review of the emerging evidence on the prevalence, clinical characteristics, and management of Attention-Deficit/Hyperactivity Disorder (ADHD) in children and adolescents with autism spectrum disorder (ASD).

Methods: The literature on ASD was queried to identify published studies on: 1) the prevalence and the clinical presentation of ADHD in youth with ASD and 2) the psychopharmacological interventions for the treatment of ADHD in youth with ASD.

Results: The presentation will open with the information on the prevalence of ASD in non-referred and in psychiatrically referred populations. The first portion of the talk will underscore the burden of psychopathology associated with ASD followed by description of the clinical presentation and recognition of co-occurring ADHD. The second portion of the talk will discuss special considerations in the psychopharmacological management of individuals with ASD and provide a comprehensive overview of the available evidence on the psychopharmacology of ADHD in ASD. Presentation will emphasize best evidence practice pathways for practical, multimodal treatment of ADHD in the outpatient setting.

Conclusions: Emerging literature highlights high levels of psychopathology and dysfunction in individuals with ASD. Proper recognition of psychopathology in ASD offers the opportunity for appropriate medication intervention. An up-to-date knowledge of evidence-based pharmacotherapy for ADHD in individuals with ASD will help optimize therapeutic interventions and identify research directions.

430.010 *(Poster)* Assessment of Sleep Behaviors in Syndromic ASD

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Background: Sleep disturbances are highly prevalent in neurodevelopmental disabilities such as autism spectrum disorder (ASD) yet many measures of sleep behaviors are inappropriate due to the inability of the individual to describe sleep-wake patterns or the lack of tools assessing behaviors that affect sleep. Recently, a modified version of the Children's Sleep Habits Questionnaire (CSHQ) was published for use in ASD. No studies to date have investigated the feasibility of the CSHQ in syndromic ASD in which cognitive and language impairment may impede item applicability and comorbidities such as hypotonia and epilepsy may differentially impact sleep. Duplication of chromosome 15q11.2-q13.1 (dup15q syndrome) is one of the most common genetic variants associated with ASD, with evidence of atypical brain activity during sleep. Thus, dup15q syndrome may serve as a model for investigating behavioral sleep symptoms in syndromic ASD.

Objectives: To examine the feasibility of using the CSHQ in a population with syndromic ASD and to identify patterns of sleep behavior in dup15q syndrome.

Methods: As part of a comprehensive phenotyping study of dup15q syndrome, 42 caregivers of individuals with dup15q syndrome ages 4 to 42 completed the original version of the CSHQ. Caregivers were instructed to skip items or mark if questions were not applicable. Participants were split into "fully completed" and "partially completed" groups and independent sample t-tests determined whether groups differed by cognitive and language skills. Chi-square analyses determined whether the rate of fully completed versus partially completed questionnaires differed between the original and revised versions. Total and subscale scores were computed for both the original and revised version and compared to the normative samples reported in the literature. Given the high prevalence of epilepsy in individuals with dup15q syndrome, scores were also compared by epilepsy status.

Results: Overall, 56% of caregivers did not skip any questions. The "fully completed" group had significantly higher cognitive abilities than the "partially completed" group. Questions most frequently skipped relied on language skills (e.g., complains about sleep problems, reports body pains at night). The revised scoring did not yield more completed questionnaires, and medically-related sleep disturbances (eliminated from the original questionnaire) were endorsed as frequently as other items. The overall average score on the CSHQ was above the normative cut-off. Participants with epilepsy had lower scores (indicating fewer symptoms) on the Bedtime Resistance and Anxiety subscales of the original questionnaire compared to those without epilepsy.

Conclusions: Results suggest that while caregivers of individuals with syndromic ASD can feasibly use the CSHQ, some items remain inappropriate, in particular for individuals with more profound cognitive impairment. Results additionally support the need for a study with a larger sample size to investigate the psychometric properties of the CSHQ in a population with significant intellectual disability. Given that use of the revised CSHQ may have resulted in an oversight of medical sleep conditions, it is advised that providers use the original questionnaire to screen for potential medical sleep comorbidities in syndromic ASD. Results also highlight the importance of considering seizure activity, as epilepsy uniquely affected caregiver ratings.

430.011 *(Poster)* Attentional and Physiological Correlates of Emotional Problems in Autistic Adolescents: Focus on Negative Social Cues

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Background: Many autistic young people experience co-occurring emotional problems. The development of effective interventions requires greater knowledge of the causes of these problems. A key first step is to explore whether neurocognitive mechanisms reported from non-autistic populations function similarly in autistic populations. In typically developing populations, there is strong evidence to suggest emotional problems are in part driven by increased attention towards negative social cues (i.e. angry faces). There is also evidence to suggest emotional problems are associated with an increased physiological response (e.g., increased heart rate; HR) to negative social cues. Whether similar cognitive alternations are associated with emotional problems in autistic populations remains relatively unexplored.

Objectives: To test whether physiological response in response to, and attentional bias towards, negative social cues are associated with emotional problems in a well-characterised sample of autistic adolescents (QUEST sample; part of the wider IAmHealth study; n=56; 13-17 years; IQ range = 33-129). The subsample who completed the neurocognitive tasks were enriched for females (62% female).

Methods: Participants completed two computerised tasks; one measuring attentional bias through reaction times on a dot-probe task with angry and happy faces (n=56), and the other measuring HR response (average HR in the 6 second period after stimuli presentation) to happy, sad, angry and disgust faces (n=53). To account for variation in baseline HR, relative HR scores were calculated by subtracting response to happy faces from response to all other negative emotions. Emotional problems were assessed using the parent-rated Strengths and Difficulties Questionnaire (SDQ) subscale. Mixed models were used to test associations between co-occurring symptoms and differences in attentional bias and HR response to negative vs. positive social cues. Secondary analyses assessed the impact of IQ. Correlations between attentional bias and HR response were calculated.

Results: Attentional Bias: Positive values indicate bias towards (vigilance), negative values indicate bias away (avoidance) from the stimulus. A trend interaction term was found between emotion and SDQ emotional problems (β=-7.32, p=.06; see Figure 1); those with higher levels of emotional problems had a greater bias away from angry (but not happy) faces.

Physiological Response: A significant interaction term was found between emotion and SDQ emotional problems ($\chi^2(3) = 8.16$, $p<.05$); those with higher levels of emotional problems had a greater HR response to negative, as compared to positive (happy) emotions (Figure 2).

Both findings dropped to a trend when was IQ was included as a covariate (p=.07 for both interaction terms). No significant correlations were found between relative HR to angry faces and attentional bias. Relative HR to sad (r=-.32, p=.04) and disgusted (r=-.35, p=.02) faces was associated with attentional bias away from angry faces in the dot-probe task.

Conclusions: Results suggest emotional problems in autistic youth are associated with attentional avoidance of negative social cues and increased physiological response to negative relative to positive social cues. Studies testing the impact of interventions found to be effective in reducing emotional problems in typically developing population (such as attentional bias or biofeedback training) in autistic populations are required to assess directionality.

430.012 *(Poster)* Auditory Mismatch Negativity in Young Individuals Affected By High Functioning Autism Spectrum Disorder with and without Attenuated Psychosis Syndrome

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Background: Autism Spectrum Disorder (ASD) and Schizophrenia Spectrum Disorders (SSD) represent two different psychopathological conditions characterized by common epidemiological, genetic, cognitive, and neurophysiological factors. Among electrophysiological indices, the Mismatch Negativity (MMN), an event-related potential (ERP) reflecting preattentive processing, has been widely investigated as a promising candidate biomarker for predicting development of psychosis in individuals at clinical high risk and with attenuated psychosis syndrome (APS). Within ASD population, MMN has been used to identify auditory processing deficits showing conflicting results. However, despite evidences of a strong association between the two conditions, few studies have examinated the co-occurrence rate of ASD and SSD in pediatric populations by the use of a clinical and neurophysiological approach.

Objectives:To characterize the neurophysiological and clinical phenotype of ASD patients with Attenuated Psychosis Syndrome (ASD+APS) compared to ASD patients without APS (ASD-APS) and to Typically Developing individuals (TD).

Methods:30 high functioning ASD patients (Intellectual Quotient >70; age range 9-23 years; 9 female, 22 male) and 18 typically developing controls (TD), matched for age and gender, were enrolled. A standardized clinical assessment of autistic symptoms (Autism Diagnostic Observation Schedule – Second Edition ADOS-2) and of attenuated psychosis syndrome (APS) (Structured Interview for Prodromal Syndromes (SIPS) and Scale of Prodromal Syndromes-SOPS) was performed. In all participants, a 64-channel electroencephalogram (EEG) was recorded during the listening of a passive auditory paradigm (and the watching of a silent video) with 2000 frequent tones (frequency: 1000 Hz; duration: 50 ms) and two groups of deviant tones, 200 for a higher duration (100 ms) and 200 for a higher frequency (1500 Hz). MMN waveforms to frequency deviant tones (f-MMN) and duration deviant tones (d-MMN) were obtained for the Fz channel. MMN peak latency and peak amplitude were measured.

Results: 12 ASD patients met criteria for APS (ASD+APS) whereas 18 ASD patients did not (ASD-APS). ASD patients presented significant lower f-MMN and d-MMN peak amplitudes compared to TD. In ASD+APS group f-MMN and d-MMN peak amplitudes were lower respect to those of ASD patients without APS (ASD-APS). Higher ASD clinical severity, measured with ADOS-2, was related to lower d-MMN peak amplitude in ASD-APS group, but not in ASD+APS group. MMN peak latencies did not differ between groups.

Conclusions: Current findings confirm that young individuals with ASD are characterized by impairment of neurophysiological preattentive auditory processing as measured by MMN. Our results showed that the comorbid APS affects the amplitudes of MMN in ASD, revealing a more severe impairment in preattentive auditory processing. Interestingly, the presence of psychosis seems to moderate the relation between MMN impairment and ASD clinical severity.

430.013 *(Poster)* Autism Symptoms in Gender Diverse Cohort Correspond to Mental Health, Quality of Life, and Gender-Affirming Treatment Course

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Background: Increasing evidence suggests elevated co-occurrence of autism spectrum disorder (ASD) and gender dysphoria (GD), with individuals with ASD being 7.5 times more likely to express gender variance compared to those without ASD (Glidden et al, 2016; Strang et al, 2015; Paterski et al, 2014). As patients with ASD and GD seek gender-affirming medical treatment, it is essential that providers understand this population's clinical presentation and treatment barriers, such as intervention readiness and informed consent. Further understanding of self-reported gender identity markers and treatment trajectories for this population is also needed.

Objectives: To clinically characterize patients presenting for gender-affirming medical treatment with elevated autistic traits and to explore treatment trajectories for patients with and without elevated autistic traits.

Methods: Participants (n = 106, mean age = 14.93 years) included patients from a hospital-based gender clinic cohort enrolled in a longitudinal study of diagnostic, mental health, and psychosocial outcomes at baseline, 3, 6, and 12 months. Participants provided general information on medical treatment progress as well as self and caregiver report measures, including autistic traits (Autism Quotient (AQ)-10), depression (PHQ), quality of life (WHO-QOL), and resilience. Case review of specific treatment course for patients and coding of self-described identity markers (i.e., gender, sexuality) is ongoing. Analyses compared patients with and without elevated autistic traits on mental health, psychosocial factors, and treatment course.

Results: Clinical characterization of the cohort at baseline identified 20% (23/106) to have autistic features above the clinical cutoff on the AQ-10 ("high AQ"). High and low AQ groups did not differ in age. At baseline, high AQ patients presented with significantly higher rates of self-harm compared to low AQ patients, c^2 (1, N = 106) = 4.80, p = 0.028, and trended toward lower resilience, t(102)=1.93, p = 0.056. Results of Pearson correlation indicated a significant negative association between baseline AQ scores and baseline quality of life, r(51) = -0.37, p = 0.008, and resilience, r(100) = -0.23, p = 0.007. Additionally, there was a significant positive association between baseline AQ and baseline depression symptoms, r(94) = 0.20, p = 0.048. Preliminary findings suggest distinct trajectories for high and low AQ groups for prescription of cross-gender hormones (Figure 1). High AQ patients were less likely to be prescribed hormones over time compared to low AQ patients. Further analyses will be conducted to determine specific factors influencing differences in treatment course and to characterize self-described identity markers for high AQ versus low AQ patients.

Conclusions: Gender diverse patients with elevated autistic traits exhibited elevated psychopathology, diminished coping resources, and reduced quality of life. Furthermore, findings suggested different treatment trajectories for patients with and without elevated autistic traits. Further analysis of treatment trajectories and mental health outcomes between groups will provide critical insight into treatment course and barriers for patients with co-occurring GD and ASD symptomatology. These findings will inform gender-affirming treatment in a manner that is inclusive and personalized for patients on both gender and autism spectrums.

430.014 *(Poster)* Autonomic Startle Response and Anxiety in Preschool Children with Autism Spectrum Disorder and Fragile X Syndrome

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Background: Children with Autism Spectrum Disorder (ASD) are at an elevated risk for anxiety that emerges early in life with a profound negative impact on outcomes. Evidence suggests that 90.5% of preschoolers with ASD have at least one co-occurring anxiety disorder (Salazar et al., 2015). Fragile X syndrome (FXS) is a single-gene disorder that is the leading known cause of ASD. Children with FXS are also at an elevated risk for anxiety (Sinclair, et al, 2017). Early detection of anxiety is difficult, however, given a lack of anxiety measures validated for young or cognitively impaired children. Thus, implementation of multiple methods, including biomarkers, is ideal. Reflexive startle responses and autonomic regulation index stress and anxiety in neurotypical children (Chen et al., 2014) and require minimal compliance and effort from participants. A clearer understanding of how autonomic regulation to a startle probe is related to anxiety symptoms in ASD and FXS can provide insight into the mechanistic underpinnings of anxiety in neurodevelopmental disorders.

Objectives: The purpose of this study is to (1) compare autonomic responses to an auditory startle probe, and (2) assess the association between startle responses and anxiety symptoms across low-functioning preschoolers with ASD contrasted to FXS.

Methods: Participants included 30 children with ASD and 31 children with FXS between the ages of 3-6 years old. All children had an intellectual disability. Heart activity was measured during an auditory startle paradigm comprised of a silent movie and a brief white noise blast. For analyses, the task was assessed for 1) acute startle IBI response (5 seconds pre-startle to 2 seconds post-startle), and 2) pre-startle RSA baseline (30 seconds pre-startle). Parent-reported general anxiety on the Anxiety, Depression, and Mood Scale (ADAMS; Esbensen et al 2003) was used to assess anxiety. This study is part of an ongoing longitudinal project; thus, more participants will be added for the final INSAR dataset.

Results: The ASD group had more symptoms of general anxiety ($t(47) = 3.07$, $p < .01$). No significant group differences were seen for acute startle response or pre-startle RSA baseline. There was no relationship of acute startle IBI response to anxiety symptoms. However, elevated pre-startle RSA was marginally associated with reduced anxiety symptoms across groups ($b = -0.11$, $p = 0.05$, $R^{2=}0.09$).

Conclusions: These preliminary findings are the first to assess the relationship between autonomic regulation and anxiety in preschool children with ASD and FXS. Of particular importance, we examined these relationships in a low-functioning ASD sample. Although the ASD group showed higher parent-reported anxiety, no group differences in autonomic regulation to the startle probe were evident. Acute autonomic reactivity to the startle was not related to anxiety symptoms in either group. However, elevated baseline RSA prior to the startle was associated with reduced anxiety symptoms in both groups albeit to a modest degree. These results suggest that baseline RSA could be a sensitive early marker of anxiety in young cognitively impaired preschoolers with ASD or FXS.

430.015 *(Poster)* Biobehavioral Measurement of Autism Spectrum Disorder and Social Anxiety in Children with Neurodevelopmental Disorders

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Background: Autism spectrum disorder (ASD) and fragile X syndrome (FXS) are characterized by deficits in social communication and elevated social anxiety (SA). The phenotypic overlap between nsASD (ASD not associated with a syndrome), FXS, and SA complicates our ability to identify symptoms of SA in children with FXS and nsASD. However, biobehavioral markers such as temperament and physiological arousal (e.g., heart activity) are promising tools for distinguishing phenotypic profiles in children with neurodevelopmental disorders. Temperamental negative affect (NA) has been shown to predict anxiety (Brooker et al., 2013) and ASD (Clifford et al., 2013) early in development. Further, although heart rate has not conclusively distinguished children with ASD from their typically developing (TD) peers, children with FXS reliably present with elevated heart rate (Klusek et al., 2015). Heart rate has also been shown to distinguish anxious responses from other cognitive processes in children with ASD (Chiu, Anagnostou, Brian, Chau, & Kushki, 2016). However, no studies have integrated the measurement of NA and heart rate to predict ASD and SA symptoms in children with nsASD and FXS and most research has not included children with ASD who are low functioning.

Objectives: To investigate 1) group differences in NA and heart rate in preschoolers with nsASD, FXS without ASD, FXS with comorbid ASD (FXS+ASD), and TD controls and 2) whether baseline heart rate and NA predict SA symptoms within groups.

Methods: Participants included 33 preschoolers with nsASD (n_{males}=29; M_{age}=42.9 months), 14 with FXS only (n_{males}=6; M_{age}=45.4 months), 13 with FXS+ASD (n_{males}=11; M_{age}=45.1 months), and 23 TD (n_{males}=16; M_{age}=45.6 months). All participants in the clinical groups had an intellectual impairment. Heart rate was collected using an Actiwave ECG monitor during a 5-minute baseline video. ASD symptoms were measured using the Autism Diagnostic Observation Schedule (ADOS-2) Calibrated Severity Scale (CSS). Anxiety was measured with the Spence Children's Anxiety Scale (SCAS-P) Social Anxiety T-score.

Results: ANOVA results indicated no group differences in NA or heart rate (all *p*s > .05). Omnibus regression results indicated that NA and heart rate predicted SA in FXS ($F(3,13)=4.43$, $p=.032$, $R^2=.57$) and FXS+ASD ($F(3,9)=9.0$, $p=.012$, $R^2=.82$). Follow-up analyses indicating these effects were primarily driven by NA. No other regression analyses were significant.

Conclusions: The present study indicates that integrating both behavioral and physiological variables in a biobehavioral model holds promise for disentangling the inter-related features of ASD and SA in young children with nsASD and FXS. This is particularly important when examining these features in very young children who have limited communication skills and when features are subtle. We found that NA and baseline heart activity were not associated with SA in either nsASD or TD controls. In contrast, NA was associated with SA in the FXSonly group and both NA and heart activity were associated with SA in the FXS+ASD group. This suggests that elevated NA and atypical arousal may be unique signals for SA in FXS which is important both for early identification and targeting treatment.

430.016 *(Poster)* Characteristics Associated with Sleep Duration in Children with Autism Spectrum Disorder

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Background: Sleep difficulties in children with Autism Spectrum Disorder (ASD) have been well established. Previous studies have associated sleep problems in children with ASD with sleep habits, cognitive functioning, ASD intervention, and comorbid diagnoses. Many medications have adverse side effects, and therapy to address sleep problems may be costly in terms of time and money spent. Practicing good sleep habits, such as bedtime consistency, regular exercise, and reduced screen time, may improve sleep quality. Understanding the association between sleep problems and sleep habits, cognitive functioning, ASD intervention, other therapies, and comorbid diagnoses in a large sample may inform intervention development for sleep problems in children with ASD.

Objectives: To determine the impact of the following characteristics on sleep duration in children with ASD: parent-reported bedtime consistency, exercise (ages 6-17 years), screen time, ASD severity, medication, behavioral treatment for ASD, attention deficit disorder with/without hyperactivity, intellectual disability, anxiety problems, depression, and needing or receiving physical, occupational, or speech/language therapy.

Methods: This study analyzed cross-sectional data combined from the 2016 and 2017 National Survey of Children's Health. The sample included 209 children ages 0-5 years and 1,474 children age 6-17 years with a current parent-reported autism diagnosis. Multiple linear regression was performed in each age group with sleep duration as the dependent variable. Each model adjusted for baseline covariates and included all of the target characteristics listed above. All analyses incorporated strata and weighting to produce nationally representative estimates.

Results: In the age 0-5 years model, compared to children with mild ASD, children with moderate ASD slept 0.8 hour less on an average day in the past week (p=0.013), and children with severe ASD slept 2.1 hours less (p<0.001); children who have ever had depression reported slept 2.5 hours more than children without depression (p=0.009); and compared to children who rarely or never go to bed at the same time on weeknights, those who sometimes do slept 1.7 more hours (p=0.012), those who usually do slept 1.6 more hours (p=0.001), and those who always do slept 2.4 more hours (p<0.001). In the age 6-17 years model, compared to children with mild ASD, children with moderate ASD slept 0.2 hour less on an average day in the past week (p=0.032); and compared to children who rarely or never go to bed at the same time on weeknights, those who sometimes do slept 1.2 more hours (p=0.001), those who usually do slept 1.5 more hours (p<0.001), and those who always do slept 2.1 more hours (p<0.001).

Conclusions: ASD severity is associated with shorter sleep duration, and bedtime consistency is associated with longer sleep duration. Addressing sleep problems through good sleep habits, such as bedtime consistency, may promote healthy sleep in children with ASD and help avoid medications, the adverse effects associated with them, and the need for more intensive intervention. Further research on other sleep habits, such as bedroom environment, may provide additional confirmation of the importance of good sleep practices and inform sleep treatment targets in children with ASD.

430.017 *(Poster)* Characterizing Autism Subgroups and Related Profiles of Mental Health in Transgender Youth

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Background: A series of studies have identified a significant over-occurrence of ASD and autism spectrum traits among transgender youth. Clinical reports of the ASD and gender diversity co-occurrence have described a subset of transgender youth who clearly meet ASD criteria, a subgroup with notable subclinical ASD traits, and another subset with no significant ASD traits (i.e., allistic). Of particular importance is probing possible mental health differences between these groups given the extreme mental health risks experienced by transgender youth.

Objectives: Employing gold standard ASD diagnostic procedures, we aimed to assess transgender adolescents for autism symptoms and diagnosis, and investigate profiles of mental health between resulting autistic and allistic subgroups.

Methods: Transgender youth, age 13-21, who were diagnosed with ASD, suspected of having ASD, or presumed allistic were invited to participate. Sixty-six transgender youth (28 trans-feminine, 38 trans-masculine) were enrolled and completed autism and mental health assessments. ASD was assessed with the ADOS-2 and the ADI-R. Autistic traits were assessed with the self-report Broader Autism Phenotype Questionnaire (BAP-Q) and the Social Responsiveness Scale 2 (SRS-2; parent-report). Mental health was assessed with the Youth Self-Report (YSR; ASEBA), employing a composite suicidality score validated by Van Meter and colleagues (2018).

Results: Three diagnostic groups emerged based on gold-standard autism assessments: ASD (*n*=27), subclinical ASD (i.e., youth with clear autistic features and impairment but subclinical in terms of ASD diagnostics; *n*=17), and allistic (*n*=22). Self-reported BAP-Q differed between the groups ($F = 5.32$, $p < .01$), with autistic and subclinical autistic youth reporting significantly greater broader autism phenotype (BAP) characteristics than allistic youth ($t = 2.85$, $p < .01$; $t = 2.89$, $p < .01$). The autistic and subclinical autistic groups did not differ in self-reported BAP characteristics. Parent-report of autism-related social symptoms (SRS-2) differed by ANOVA Omnibus test ($F = 23.15$, $p > .01$), with significantly greater autism symptoms reported for the two autism subgroups as compared with the allistic group ($t = 7.2$, $p < .01$; $t = 4.17$, $p < .01$). The two autistic groups did not differ in SRS-2 scores. Regarding mental health, there were differences in youth reported internalizing symptoms (YSR; $F = 4.09$, $p = .02$), with greater internalizing reported in the ASD diagnosed group as compared to allistics ($p = .03$). Suicidality also differed between groups ($F = 3.54$, $p = .04$), with greater suicidality reported in both autistic groups as compared to allistics (p's = .03). Of note, 38% of autistic and 38% of subclinical autistic transgender youth reported suicide attempts as opposed to 9% of allistic transgender youth.

Conclusions: As has been described in the clinical literature, autistic and subclinical autistic youth were each identified as distinct neurodiversity subgroups among transgender youth based on gold-standard autism diagnostics. Self-report of BAP characteristics and parent-report of social autism symptoms aligned well with the diagnostic groupings. Of concern, the presence of autism at the diagnostic or subclinical level in transgender youth was related to significantly increased suicidality, and autistic transgender youth showed particularly high levels of internalizing symptoms.

430.018 *(Poster)* Characterizing Bedtime Routines in Children with ASD

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Background: Sleep hygiene involves environmental factors, behaviors, and rituals surrounding bedtime that promote healthy sleep across development. Bedtime routines (BR's) are one aspect of sleep hygiene that prepare children for sleep by reducing sources of stimulation and implementing a predictable series of relaxing activities prior to lights out/bedtime (Mindell et al., 2018). Poor sleep hygiene (e.g., electronic device use) exacerbates sleep problems for children with autism spectrum disorder (ASD; Mazurek et al., 2015). However, there is limited knowledge of ASD-specific BR's and their role in promoting sleep for children with ASD. BR's may be uniquely valuable for families raising children with ASD given elevated sleep problems that often stem from regulatory difficulties.

Objectives: To characterize bedtime routines and their associations with sleep outcomes in ASD.

Methods: Parents of children with ASD (*n*=23) and TD (*n*=12) ages 8 to 18 (M_{age}=12.26) completed the Yale Developmental Sleep Questionnaire (YDSQ) and were asked about the timing of their child's BR. Parents' written accounts of their child's BR were qualitatively coded for content themes, deriving seven BR components (Figure 1). Fisher's Exact Tests and regressions were used to determine differences in BR practices and their influence on sleep for children with ASD and TD.

Results: 92% (*n*=32) of the sample reported following a nightly BR. BR's for children with ASD were characterized by higher levels of parental interaction and communication-based activities (e.g., reading to their child; $p < .09$). Children with ASD and TD did not differ on other BR components (Figure 1).

BR's started at 8:41PM, on average (ASD=8:31; TD=9:00) and varied by roughly 70 minutes on weekdays (ASD=72.61; TD=67.5) and 31 minutes from weekdays to weekends (ASD=27.61; TD=37.50). Earlier start times for BR's were associated with longer nighttime sleep (b=-.56, $p < .01$, R^2=.31). In contrast, increased electronic device use (including the sum of device use at bedtime, while falling asleep, and during awakenings) was associated with less nighttime sleep (b=-.57, $p < .01$, R^2=.32) and longer sleep onset latency for children with ASD (b=.66, $p < .01$, R^2=.44) but not TD. Children most commonly used electronics at the end of the BR and while in bed.

Conclusions: Bedtime routines for children with ASD include higher levels of parental involvement when compared to TD peers. This difference likely reflects ongoing parental support for children with ASD that diminishes earlier in development among parents of TD children. Establishing earlier, consistent BR's and eliminating electronic devices at bedtime/throughout the night are important first steps toward promoting healthy sleep patterns in children with both typical and atypical development.

Data collection is ongoing, and final analyses will include a larger TD sample. Future studies should utilize objective measures of child sleep (e.g., actigraphy) and ecological momentary assessments to capture the nuanced and temporal effects of BR consistency, adherence, and content on sleep outcomes and family functioning. Parent focus groups or qualitative surveys focused on BR's may facilitate better understanding of the unique challenges facing children with ASD at bedtime and thus inform targeted, family-focused sleep interventions.

430.019 *(Poster)* Child Predictors of Maternal Anxiety and Depression Symptoms: Cross-Syndrome Comparison of Autism Spectrum Disorder and Fragile X Syndrome

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Background: Parents of children with autism spectrum disorder (ASD) demonstrate significantly higher rates of depression and anxiety than parents of typically developing children (Bitsika & Sharpley, 2004). Psychiatric risk in this group is thought to relate to both genetic liability and environmental stress exposure associated with parenting a child with a disability (Yirmiya & Shaked, 2005). Targeted intervention is limited by poor understanding of how psychiatric vulnerability may be moderated by specific child features, such as the severity of the communication impairment, ASD symptoms, and problem behaviors. Moreover, it is unclear whether the profile of psychiatric risk among parents of children with ASD is specific to this group or shared across parents of children with neurodevelopmental disabilities more generally, as evidence suggests that anxiety and depression are also elevated in parents of children with other types of heritable neurodevelopment conditions (Yirmiya & Shaked, 2005).

Objectives: Cross-syndrome comparison across ASD and FXS affords an opportunity determine the specificity of the psychiatric profile observed among parents of children with ASD. The present study conducted a cross-syndrome comparison of mothers of children with ASD and mothers of children with fragile X syndrome (FXS), a single-gene disorder that shows significant phenotypic overlap with ASD.

Methods: Participants included 33 mothers of children with nonsyndromic ASD and 33 mothers of children with FXS. The mean age of the children was 15 years (SD=5). Clinical diagnoses of ASD were confirmed via the ADOS-2 (Lord et al., 2012). Mothers completed the Beck Anxiety Inventory (BAI; Beck, 1993) and Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996). Child symptoms were indexed with the Social Communication Questionnaire–Lifetime (Rutter, Lord, & Bailey, 2003), Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) and Children's Communication Checklist-2 (CCC-2; Bishop, 2006).

Results: The parent groups did not differ in the severity of depression or anxiety symptoms (ps >.344). A significant group-by-ASD symptom interaction was observed in the model predicting maternal depression symptoms (p =.004, η^2_p= .12), where elevated child ASD symptoms were associated with increased depression in mothers of children with FXS but not mothers of children with ASD. Increased child communication deficits were also associated with maternal depression in both groups (p=.011, η^2_p= .13), although a trend-level group interaction term of a medium effect size was detected that suggested that this relationship was more pronounced in the FXS group (p=.011, η^2_p= .07). None of the child factors emerged as significant predictors of maternal anxiety symptoms (ps>.295).

Conclusions: Mothers of children with ASD and mothers of children with FXS exhibited similar levels of depression and anxiety symptoms, although syndrome-specific patterns emerged in the relationships between maternal psychiatric symptoms and child features. Child ASD severity was associated with maternal depression only in the FXS parent group, with a similar pattern observed for the severity of child communication deficits. These findings suggest the presence of syndrome-specific contributors to psychiatric risk among mothers of children with ASD and FXS, underscoring the need to develop interventions targeted towards the needs of specific etiological groups.

430.020 *(Poster)* Clinicians' Perceptions of Re-Experiencing and Avoidance in Post-Traumatic Stress Disorder in Adults with Autism and Intellectual Disability

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Background: Individuals with co-occurring autism spectrum disorder (ASD) and intellectual disability (ID) seem to be at increased risk for experiencing traumatic events, and for developing post-traumatic stress disorder (PTSD) following such events. However, identification of PTSD in this population is challenging and suspected trauma or abuse may be difficult to substantiate. A recent review indicates that symptoms of re-experiencing and avoidance are particularly challenging to recognize in this population if trauma is not known to caregivers. The remaining symptoms' lack of specificity may contribute to possible PTSD being misinterpreted and attributed, instead, to ASD, ID or other co-occurring conditions. Previously, it has been suggested that the challenges in identifying re-experiencing and avoidance may be due to these symptoms' intra-psychic nature and patients' limited verbal skills. Current knowledge on identification of PTSD in ASD and ID is sparse, involving a risk that PTSD may be overlooked, or that ongoing abuse is not being detected and stopped.

Objectives: The aim of the study was to provide further knowledge on how avoidance and re-experiencing present in this population, by exploring how clinicians had experienced and perceived them as being expressed.

Methods: Interpretative phenomenological analysis (IPA) was used in an explorative, qualitative study. Eighteen clinicians with 4-29 years of conducting mental health assessments in ASD and ID were recruited for individual interviews. These were audio recorded and transcribed verbatim. Analyses were carried out in line with the recommendations for IPA.

Results: Avoidance was described by informants to be expressed in a wide range of ways. These included specific avoidance of stimuli associated with a traumatic event, as well as some individuals presenting more unspecific or global avoidance. However, specific avoidance in some cases had been challenging to differentiate from challenging behavior and apparent obstinacy. Some individuals also were described to show a conspicuous lack of planned avoidance, apparently failing to protect themselves in any observable way from being exposed to distressing reminders of trauma. Re-experiencing was described to involve co-occurring, abrupt changes to arousal and responsivity, with interpretation of behavior frequently being necessary for identification even in cases where patients had been able to verbally disclose information about re-experiencing symptoms. Examples of re-experiencing also included behavioral or verbal re-enactments that seemed uncontrolled and highly distressing, and sudden, unexpected episodes of aggression or self-injurious behavior.

Conclusions: Expressions of re-experiencing and avoidance in PTSD in individuals with ASD and ID seem to be influenced by characteristics associated with ASD and/or ID. Their intra-psychic nature and limited verbal skills do not seem to be a sufficient explanation of the challenges in recognizing these symptoms in this population, and there is a need to take account of this during clinical assessments. The results further suggest that development of these symptoms may follow different trajectories in this population, and that re-experiencing may be experienced by these individuals in particularly impactful ways.

430.021 *(Poster)* Co-Occurring Mental Health Concerns Among Youth with Autism Spectrum Disorder, Their Relationship with Social Functioning, and Moderating Effect on Social Skills Intervention

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Background: Autism spectrum disorder (ASD) frequently co-occurs with mental health difficulties, including anxiety disorders, depressive disorders, and attention-deficit/hyperactivity disorder (ADHD; Salazar et al., 2015). However, limited research has been conducted examining how these comorbid conditions affect the social functioning of individuals with ASD or the outcomes of social skill intervention.

Objectives: This study had three main aims: 1) examine the co-occurrence of ASD with anxiety, depression, and ADHD amongst a diverse sample of school-aged children and adolescents; 2) determine if co-occurring mental health disorders are associated with differences in level of social functioning; and 3) examine how co-occurring mental health disorders moderate response to social skills intervention.

Methods: Participants (n = 176) included children and adolescents with ASD aged 6-18 years (M= 10.05, SD= 3.10) with IQ ranging 50-139 (M= 92.69, SD= 16.59) and diverse race/ethnicity (44.9% Caucasian, 22.2% Asian, 14.2% Hispanic, 7.4% African American) at four participating sites. Participants were randomized to one of two social skills interventions (SKILLS, didactic-based, or ENGAGE, activity-based) delivered in the school setting for 8 weeks (16 sessions). Measures of observed peer engagement, mental health symptoms via the *Behavior Assessment System for Children- 2nd Edition, Parent Rating Scale* (BASC-2 PRS), social skills and behavior problems via the *Social Skills Improvement System- Teacher* (SSIS-T) were analyzed.

Results: Baseline ratings of mental health symptoms indicated that 10.2% of the sample had elevated symptoms of anxiety, 15.3% had elevated symptoms of depression, and 34.7% had elevated symptoms of ADHD (9.1% inattentive type, 14.2% hyperactive type, and 11.4% combined type). 14.8% had more than one co-occurring mental health concern. Co-occurring inattention was found to be a significant predictor of lower social skills at baseline, b = -5.481, p = .044, model F(2, 143)= 6.566 p= .002, R^2= .084. Co-occurring depression (b= 10.830, p < .001, model F[2, 146]= 6.978, p= .001, R^2= .087) and hyperactivity (b= 9.459, p < .001, model F[2, 146]= 7.726, p= .001, R^2= .096 were significant predictors of increased problem behavior at baseline. A generalized estimating equations approach controlling for site, intervention group, age, IQ, and ASD symptom severity revealed that co-occurring mental health conditions did not have a significant moderating effect on response to social skills intervention.

Conclusions: School-aged children and adolescents with ASD have high rates of co-occurring mental health conditions, with ADHD being the most common. ADHD symptoms have a differential relationship with social functioning: inattentive symptoms were found to be related to more impaired social skills while hyperactive symptoms were found to be related to increased problem behaviors. The presence of co-occurring disorders did not appear to impact how participants responded to social skills intervention, suggesting that social skills treatment is efficacious for youth with ASD and comorbid mental health concerns. Further research is needed to examine how co-occurring mental health conditions impact response to intervention and if ASD-specific interventions result in improvement in mental health symptoms.

430.022 *(Poster)* Comorbidity and Health Services' Usage in Children with Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is a group of complex neurodevelopmental conditions that share common fundamental impairments in social communication and restricted repetitive behaviors. However, most people with ASD suffer from additional comorbidities that add to the medical burden associated with the disorder. We studied the comorbidity burden and health services' utilization of children with ASD to highlight potential etiologies and to better understand the medical needs of these children.

Objectives: To identify medical conditions that are associated with ASD among children with the disorder and to assess the burden of healthcare usage systems in these children.

Methods: We conducted a nested case-control study of ASD cases and typically developing controls that were matched to cases by age, sex, and ethnicity in a 1:5 case-control ratio. Both cases and controls were sampled from all children born between 2009 and 2016 in a single tertiary medical center. Medical diagnoses were obtained from the hospital's electronic database and were classified according to pathophysiological etiology and anatomical/systemic classification of disease. In addition, various aspects of healthcare services' utilization were assessed for each child. Standard univariate statistics were used to compare rates of medical comorbidities and patterns of healthcare usage between cases and controls. Further, multivariate conditional logistic regression models were used to assess the independent effect of ASD on the burden of the healthcare system.

Results: The research sample included 2,744 children (459 ASD cases and 2,285 controls) with a mean age of 5.5 ± 1.9 years and a Male-to-Female ratio of 4:1. ASD children had higher rates of comorbidities according to both pathophysiological and anatomical/systemic classifications ($p<0.001$). The most marked significant differences were observed for: hearing impairments (OR=4.728; 95%CI=2.207–10.127) and other auricular conditions (OR=5.040; 95%CI=1.759–14.438); neurological (OR=8.198; 95%CI=5.690–11.813), and ophthalmological (OR = 3.381; 95%CI=1.617–7.068) conditions; and ADD/ADHD (OR=3.246; 95%CI=1.811–5.818). In addition, children with ASD tended to be referred to the emergency department and to be admitted to the hospital more frequently than children without ASD, regardless of their comorbidity burden and illness severity (aOR=1.61; 95%CI =1.17–2.22 and aOR=1.68; 95%CI=1.23–2.29 for >1 referrals and admissions per year, respectively).

Conclusions: The higher comorbid burden and health care service utilization observed for children with ASD in this study highlight the greater health-related needs of these children. Increasing the awareness of healthcare professionals of these needs, and developing tools to manage difficulties associated with them, will improve the quality of healthcare provided to these children, and reduce the attendant medical, emotional, and financial burdens.

430.023 *(Poster)* Correlates of Sleep Problems in Autism Spectrum Disorder: A Meta-Analysis

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Background: Sleep problems are among the most primary and debilitating concerns reported by individuals with ASD and their caregivers (Gotham et al., 2015). These sleep problems/concerns arise in early development (Humphreys et al., 2014; Verhoeff et al., 2018), are present throughout the life course (Ballester et al., 2019; Baker & Richdale, 2015), and are known to exacerbate daytime behavior problems and core ASD symptomology (Mazurek & Sohl, 2016; Veatch et al., 2017). However, despite a proliferation of studies documenting adverse correlates of poor sleep in ASD, little is known about the strength and consistency of these effects across samples.

Objectives: The purpose of this study was to understand the daytime correlates of poor sleep in ASD across the lifespan. Specifically, we aimed to quantify the strength of evidence for relationships between sleep and adverse outcomes likely to impact quality of life for individuals with ASD and their families. We also explored individual and familial characteristics that may contribute to greater sleep problem risk.

Methods: Preliminary findings for the current meta-analysis are based on aggregated effects from empirical studies reporting a statistical association between sleep problems and adverse daytime correlates in individuals with ASD. From a comprehensive literature search, 35 studies met inclusion criteria. Effect sizes were calculated in Comprehensive Meta-analysis software (Borenstein et al., 2013) using a random effects model, aggregating similar outcome variables across studies.

Results: Analyses are ongoing. Preliminary findings are from 25 separate effects, extracted from 9 independent samples (combined $N = 5457$). Sleep problems were associated with multiple domains of ASD symptomology (social difficulties, $r = .331$, $k = 1$, $p < .001$; sensory sensitivities, $r = .313$, $k = 2$, $p < .001$; and severity of ASD traits, $r = .288$, $k = 4$, $p = .001$). Sleep problems were also significantly associated with co-occurring psychiatric and behavior problems, such as anxiety ($r = .426$, $k = 3$, $p = .002$), somatic complaints ($r = .366$, $k = 2$, $p < .001$), ADHD symptoms ($r = .331$, $k = 3$, $p < .001$), and aggression ($r = .201$, $k = 5$, $p = .001$). Finally, lower parental education ($r = -.190$, $k = 2$, $p < .001$) was related to higher levels of reported sleep problems, but child age was not ($r = -.165$, $k = 3$, $p = .329$).

Conclusions: Sleep problems are consistently associated with a variety of daytime behaviors in ASD, though directionality cannot be ascertained from the majority of existing research. Ongoing analyses will draw from a larger, broader developmental sample, attempting to disentangle whether sleep problems precede adverse outcomes in ASD and to elucidate potential predictors of poor sleep in this population. Additionally, we are examining whether measurement methods, including objective (e.g., actigraphy) vs. subjective (e.g., questionnaires) sleep measures and sleep problem subtypes (e.g., short sleep duration, increased sleep onset latency) moderate the associations reported here. Our findings support treatment research indicating that sleep-focused interventions may also yield improvements in cognitive, behavioral, and physical functioning in ASD.

430.024 *(Poster)* Current Evidence and Research Directions for Minimally-Verbal Patients with Autism Spectrum Disorder: A Review of Technological and Behavioral Interventions.

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Background: Approximately one quarter of all patients with Autism Spectrum Disorder are minimally verbal (MVASD). This subset of patients with ASD are vulnerable, understudied and underserved despite being at high risk for challenging behaviors, co-morbid psychiatric conditions, and suboptimal long-term outcomes. In recent decades, a rising number of studies have examined MVASD, taking into account the specialized research approaches necessary and especially focusing on early interventions and the development of language. As a result, some exciting research efforts, including a number that utilize technology, have emerged which could have a profound clinical impact and improve quality of life for MVASD patients and their families.

Objectives: For both researchers and clinicians to become familiar with cutting-edge research approaches in the field of MVASD in order to guide future studies and clinical treatment.

Methods: The presenter reviewed the literature for research studies in MVASD patients with the goal of synthesizing the data for the audience according to two categories: 1) Technology-based approaches to improve outcomes in the population and 2) Non-technological interventions, including behavioral and social approaches.

Results: The presentation will begin with an in-depth discussion on language development and potential intervention strategies using speech generation devices (SGD) and augmentative and alternate communication (AAC) devices. Next, the presenter will review how these devices are being integrated with behavioral techniques to promote language and improve clinical outcomes. The presenter will then discuss the use of wearable technology and its use to limit the impact of aggression and improve safety in patients with MVASD. The presenter will next provide a review of the latest evidence and research directions for non-pharmacologic interventions, including behavioral and social interventions, highlighting outcomes data and describing in detail how these approaches aim to promote language development, improve social/communication skills, and reduce challenging behaviors in patients with MVASD.

Conclusions: Understanding the current state of research in the area of MVASD is extremely important for both researchers and clinicians. In this way, they can continue to innovate new interventions and serve the needs of minimally verbal patients with ASD and their families, a vulnerable and underserved group of people.

430.025 *(Poster)* Dental Health of Children with Autism: Controlling Anxiety Using Dental Care Training Via ICT

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Background: Offering dental health to children with autism is challenging because it provides various visual/aural stimulations rarely experienced in any other setting. Their different perception of the surrounding world and difficulty accepting unknown social contexts can generate anxiety and fear, which if not adequately addressed, might trigger problem behaviors. This often forces dentists to use potentially dangerous chemical sedation in order to perform dental work on the child.

Objectives: Since digital tools are natural motivators for children, our study aims to expand previous research investigating the full potential of ICT to deliver the awareness and predictability of all dental clinic environment components (settings, tools, noise, procedures).

Methods: A multidisciplinary team applied co-design to selecting and creating digital resources and tools organized in a web application called 'MyDentist' (https://mydentist.iit.cnr.it). A clinical protocol was defined and tested with a group of 59 patients (45 males and 14 females) with ASD (*ma: 9,9 years; range: 4-25 years*) to implement desensitization and anxiety control in a real dental care setting using the kit of digital resources as assistive technology. Periodic visits (45 min) were scheduled for each child over a 3-month period in the same clinical room to ease familiarization. During dental care, structured training was delivered: 1) familiarization with medical procedures (control visits, dental hygiene, tooth decay treatment, dental sealant), and 2) educational activities (in the clinic) and homework using personalized digital resources.

Results: Caregiver questionnaire analyzed using Chi square test confirm the positive role of supportive technology in anxiety control: (1) most children showed a positive response, modeling their behavior and becoming increasingly collaborative (2) caregivers strongly committed to the protocol were satisfied with their active involvement; (3) children who respected the weekly schedule successfully completed the dental protocol in the scheduled time, and their caregivers felt the child-parent relationship was reinforced.

Conclusions: This study confirms the importance of ICT tools for reducing anxiety during dental care sessions as well as for active parent involvement in the care of their children. Involving children in content creation during the clinical meeting helps them accept the dental care protocols. A few guidelines for creating accessible digital tools for anxiety reduction can be shared to benefit designers. In addition, having clear referral pathways to specialist dental services to avoid any delay and distress for families would provide a framework for a 'best practice' protocol for autism families attending primary care dental services

430.026 *(Poster)* Differences in Physical Fitness Measures between Children with and without ASD: A Study of Habits and Body Metrics

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Background: Recent research has suggested that children with ASD may be at greater risk for obesity (Curtin et al., 2010). According to the CDC, childhood obesity is associated with myriad of physical health risks (e.g. high blood pressure, type 2 diabetes, or fatty liver disease), mental health risks such as anxiety and depression, and long term health risks including adult obesity and its associated serious health consequences (CDC, 2016). A better understanding of the lifestyle or habits associated with this risk may direct interventions aimed at reducing the high prevalence of obesity in children with autism.

Objectives: To examine how structured or unstructured free-time habits, body mass index, may differ between children with and without ASD.

Methods: Data were obtained from questionnaires given to parents of children with ASD (N=117; Age M=11.0 years; 75.6% Male) and without ASD (non-ASD; N=217; Age M=10.5 years; 58.2% Male) seen at three metropolitan health clinics (general pediatric clinic, ADHD clinic and autism clinic). Children without ASD collectively encompassed a heterogeneous set of mental health conditions, including ADHD, anxiety, conduct disorder, and depression, but without ASD. Pairwise t-tests were used to compare ASD and non-ASD groups on outcome variables. Spearman's rho was used to examine relationships among variables in the ASD group.

Results: Children with ASD showed less structured weekly physical activity (e.g. sports teams) than non-ASD children ($t(138.3)=-2.94$, $p=.004$), less time spent engaged in homework or other at-home study-related activities ($t(190.8)=-8.08$, $p<.0001$), and higher BMI (ASD M=20.8; non-ASD M=18.9; $t(149.2)=2.45$, $p=.015$). Groups did not differ by time spent in physical education in schools ($p=.893$) or media use including television and video games ($p=.125$). Structured weekly physical activity in children with ASD was not significantly correlated with either time spent engaged in homework ($r=-.03$, $p=.774$) or media use ($r=-.211$, $p=.058$), but correlated with lower BMI ($r=-.25$, $p=.021$).

Conclusions: This work suggests that the children represented in this survey with ASD are getting less structured physical activity outside of school compared to their non-ASD peers. Relationships between structured physical activity and BMI suggest that this may be a factor contributing to the higher prevalence of obesity in ASD. This reduced structured physical activity does not seem to be strongly associated with either increased time spent doing homework or higher media use, suggesting: (1) other classes of free-time or structured activities may be impacting time spent in physical activities outside of school; (2) intrinsic motivational factors associated with ASD may be reducing physical activity during unregulated time; or (3) accessibility to structured physical activity may have barriers which may need to be overcome to provide more favorable health outcomes for children with ASD. Further analyses, still ongoing, of already-collected questionnaire data, will examine these factors.

430.027 *(Poster)* Early Sleep Regularity in the Context of Elevated Autism Risk

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Background: Up to 80% of children with an autism spectrum disorder (ASD) have comorbid sleep problems that include short sleep duration, multiple night wakings, early morning rise times, and high night-to-night sleep variability (Anders et al., 2011; Richdale & Schreck, 2009). Sleep problems are associated with both frequency and severity of daytime challenging behaviors in children with ASD (Abel et al., 2018; Cohen et al., 2017) but their role in the early developmental progression of ASD is understudied.

Objectives: This study aims to (1) assess how sleep-wake patterns in typically developing children and those with developmental concerns (including ASD) differ using a validated metric, the Sleep Regularity Index (Phillips et al., 2017) and (2) examine if differences in sleep regularity in early development precede an ASD diagnosis.

Methods: As part of a prospective longitudinal infant sibling study, infant/toddlers participated in a sleep protocol at the ages of 6-, 9-, 12-, 15-, 18-, 24-, and/or 30-month. Actigraphy data from 81 infants were scored using the Sleep Regularity Index, the percentage probability of an individual being awake or asleep at any two points 24 hours apart. Group means of the Sleep Regularity Index were created for each age. Children completed an outcome visit between 30 and 36 months and were assigned to one of three groups: ASD (n=6), typically developing (TYP) (n=46), or other developmental concerns (DC) group (n=29). Children in the DC group demonstrated developmental concerns (e.g., language delay, broader autism phenotype) but did not meet the criteria for an ASD.

Results: The mean and range of children's Sleep Regularity Index were reported for Aim 1. Children in all three groups appear to have similarly wide ranges of sleep-wake patterns (Table 1; Figure 1). Multinomial logistic regression with multiple imputation was performed to examine if sleep regularity at specific ages preceded ASD or DC outcomes at 30- or 36-months (Aim 2). Sleep regularity significantly distinguished children in the DC group from TYP peers at 18-months and 30-months, though the effects were small (Table 1). Specifically, a unit increase in sleep regularity was associated with a decrease in the log odds of being in the DC group compared to TYP group at 18- and 30-months.

Conclusions: Using a validated metric, the Sleep Regularity Index, findings demonstrate that children's sleep-wake patterns become increasingly regular across early development, regardless of developmental outcomes. Given the small sample for children with ASD outcomes in the study, this study cannot test if children with ASD are significantly different from DC and TYP peers. However, they appear descriptively comparable. Children in the DC group were more likely to have high night-to-night variability in sleep patterns (i.e., a lower Sleep Regularity Index score). Future research with larger samples of children with ASD is needed to directly address the early role of sleep in ASD development.

430.028 *(Poster)* Effect of Comorbid ADHD and Anxiety on Autism Symptoms in a Large Clinic-Referred Sample of Youth with ASD

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Background: Many children with autism spectrum disorder (ASD) experience comorbid conditions, which can cause additional impairment and reductions in quality of life (Mayes et al., 2014; Simonoff et al., 2008). In childhood, the most common comorbid psychological diagnoses include attention-deficit/hyperactivity disorder (ADHD) and anxiety disorders (Van Steensel et al., 2013). However, few studies have investigated the effects additional conditions have on ASD presentation. Understanding how comorbidities influence core autism symptoms could help better tailor interventions.

Objectives: 1. Compare autism symptoms in verbally-fluent youth with ASD with and without comorbid diagnoses of ADHD, anxiety, or ADHD and anxiety in a large clinic-referred sample. 2. Examine congruence of examiner-reported ADHD and anxiety symptoms (as rated on the ADOS) with diagnostic comorbidities.

Methods: Participants included 255 individuals aged 3-15 who were evaluated for ASD and received an ASD diagnosis in a university-based autism diagnostic clinic. Children were grouped by whether they received additional diagnostic comorbidities of ADHD (N=24) and any anxiety disorder (N=29), both ADHD and anxiety (N=20), or neither disorder (N=182). Children with other mental health diagnoses were excluded from this analysis. Children who were verbally fluent, defined as receiving modules 3 of the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2), were selected for this study to create a sample that was homogenous in terms of language abilities. Autism symptoms in both the social affect (SA) and restricted/repetitive behavior (RRB) domains were measured using ADOS-2 domain calibrated severity scores (ADOS-CSS; Gotham, Pickles, & Lord, 2009; Hus, Gotham, & Lord, 2012). Factorial ANOVA models were used to evaluate the main effects of having ADHD and anxiety, as well as the interaction of the two, while controlling for verbal and nonverbal IQ and age. We then used a chi-square test to determine whether examiner-rated anxiety and overactivity on the ADOS-2 (e.g., E-codes) were related to comorbid anxiety or ADHD.

Results: In a full factorial model, there was a main effect of anxiety on both the SA and RRB domains, such that anxiety diagnoses were associated with lower ADOS scores, SA p=.005, RRB p=.04. There was no main effect of ADHD or interaction between the two for either domain. When examining congruence between ADOS-2 E-codes and comorbid diagnoses, those with elevated anxiety on the ADOS-2 were more likely to be diagnosed with an anxiety disorder, p<.001, though there was no significant association between overactivity on the ADOS-2 and ADHD comorbidity, p>.05.

Conclusions: This was the first study to compare autism symptoms by diagnostic comorbidity in a large clinic-referred sample of youth with ASD. Overall, having a comorbid anxiety disorder was associated with lower social communication symptoms on the ADOS. This suggests a protective effect of anxiety, in that symptoms of anxiety may reduce the appearance of autism symptoms. Children with ASD and anxiety may be more aware of how others perceive them, and thus regulate their behavior. Future work is needed to better characterize differences in other domains by comorbidity group and determine whether anxiety may influence the efficacy of treatment for social skills.

430.029 *(Poster)* Effects of rTMS on Behavioral Measures and Autonomic Nervous System Activity in Children with Autism

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Background: Many children with autism spectrum disorder (ASD) exhibit symptoms associated with autonomic nervous system (ANS) dysfunction indicative of low psychophysiological flexibility. It is suggested that ASD symptoms are associated with generalized abnormalities in the central nervous system (CNS) networks involved in the top-down regulation of the ANS.

Objectives: Repetitive transcranial magnetic stimulation (rTMS) has been proposed as a possible therapy to target ANS regulation deficits in ASD. The aim of this study was to investigate the effects of 18 sessions of low frequency (0.5 Hz) rTMS over DLPFC on autonomic function measures, and behavioral symptoms (based on parental behavioral reports such as Aberrant Behavior Checklist, repetitive Behavior Scale, and Social Responsiveness Scale) in children with ASD.

Methods: We used neuromodulation based on rTMS over the dorsolateral prefrontal cortex (DLPFC) to reduce sympathetic arousal and increase parasympathetic activity in children with ASD. In a study on 27 children with ASD (21 boys and 6 girls, mean age 12.52 ± 2.85 years) 0.5 Hz rTMS was administered bilaterally over the DLPFC with concurrent recording of electrocardiogram, electromyogram, pneumogram and electrodermal activity.

Results: The results of the study replicated findings of our prior studies reporting improvements in aberrant, stereotyped, and repetitive behaviors. In addition, we found improvements in social awareness, social cognition, and social motivation ratings of the SRS-2 questionnaire Statistical analysis of time and frequency domain heart rate variability (HRV) indices and skin conductance level (SCL) revealed a strong linear regression of most HRV and SCL measures. Several parental behavioral rating scores improved post-TMS and showed a correlation with autonomic outcomes, in particular parasympathetic indices of HRV negatively correlated with repetitive and stereotyped behaviors, while sympathetic arousal indices showed positive correlation with the same behaviors. Our post-TMS HRV and SCL outcomes point to a decrease of sympathetic arousal and to an increase of parasympathetic activity resulting in a trend of normalization of the autonomic balance.

Conclusions: The current theory-guided pilot study was based on a hypothesis proposing that rTMS over the DLPFC improves cortical excitation/inhibition ratio in autism, and enhances prefrontal functioning including normative prefrontal inhibitory influences on the limbic system and subcortical centers controlling level of autonomic arousal. We propose that the application of rTMS can be considered as a novel, customizable neurotherapeutic tool targeting autonomic balance that may positively affect the social and behavior deficits, as well as the hyperactivity and anxiety problems experienced by children with autism

430.030 *(Poster)* Emotional, Conduct and ADHD Symptoms in Autistic Young People and Their Parents' Mental Health: A Longitudinal, Multi-Informant Study

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Background: Autistic young people are likely to develop additional emotional and behavioural problems (EBP). Likewise, their parents are at heightened risk for experiencing mental health problems (MHP). According to family process theories, parent and child wellbeing are likely to influence each other reciprocally. Previous research investigating longitudinal associations has found mixed evidence for bidirectional relationships between EBP in autistic youth and their parents' MHP. However, this research largely relies on parent report of both constructs, potentially distorting observed associations due to shared method variance.

Objectives: In families of autistic children, we aimed to explore longitudinal associations between parent MHP and child emotional problems, conduct problems and hyperactivity rated by both parents and teachers, across three timepoints during childhood and adolescence.

Methods: Participants were a subsample of the QUEST cohort (n=101), a well-characterised, population-derived sample of autistic children and their parents. Data were collected at child age 4-9 years (T1), 11-15 years (T2) and 13-17 years (T3). Parents reported on their own MHP at each timepoint using the Kessler 10-item psychological distress screen. They also reported on their child's EBP at each time using validated questionnaires, such as the Developmental Behavior Checklist and the Strengths and Difficulties Questionnaire. Teachers also reported on child EBP at T1 and T2 using similar measures. Covariates were child IQ (assessed directly at T1 and T2) and ASD symptom severity (parent-report at T1 and researcher-assessed at T2). We explored longitudinal associations separately for emotional, conduct and ADHD symptoms using cross-lagged path analysis, whereby paths in a saturated model were successively dropped to achieve the most parsimonious model whose fit was not significantly worsened. Standardised path coefficients (SPCs) were examined for these models.

Results: Final models (see Figure 1) showed substantial trait stability across childhood and adolescence, except for teacher reports of child EBP. Whilst accounting for associations with child IQ and ASD symptoms and concurrent associations among all traits at each timepoint, distinct profiles of predictive associations were apparent between parent MHP and child emotional, conduct and ADHD symptoms.

Earlier child emotional problems predicted later parent MHP, but not vice versa. Specifically, T1 teacher-report emotional problems predicted T2 parent MHP (SPC .26) and T2 parent-report emotional problems predicted T3 parent MHP (SPC .28). For conduct problems, bidirectional associations were apparent. T1 parent MHP predicted T2 child conduct problems reported by both parents (SPC=.23) and teachers (SPC=.41), and T2 teacher-report conduct problems in turn predicted T3 parent MHP (SPC .30). No cross-trait predictive effects were found between child hyperactivity symptoms at T1 and parent MHP at T2; however, T1 parent-report ADHD symptoms did predict parent MHP at T3 (SPC .24).

Conclusions: The longitudinal associations between parent MHP and teacher-report emotional and conduct problems corroborate and extend previous findings in studies using parent-report only. Since these findings cannot be explained by shared method variance, they increase confidence that family-based mental health interventions may benefit the wellbeing of both autistic youth and their parents.

430.031 *(Poster)* Epilepsy in Adulthood: Prevalence, Incidence, and Associated Antiepileptic Drug Use in Medicaid Beneficiaries with Autism Spectrum Disorder

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Background: Epilepsy is associated with reduced quality of life and is a strong predictor of premature mortality in autistic people. Although epilepsy commonly presents with autism in children, the extent to which it occurs in and impacts autistic adults is less understood.

Objectives: To determine prevalence, incidence, and antiepileptic drug use associated with epilepsy in a unique population of autistic adults aged 21+ in Wisconsin Medicaid. We further assessed differences between people with (N=2,738) and without (N=4,775) intellectual disability (ID) and compared both groups to adults with ID alone (N=18,429).

Methods: We identified the presence of epilepsy (here referring to all seizure disorders) using the Chronic Conditions Data Warehouse category for epilepsy using ICD-9/ICD-10 codes. Epilepsy was determined by having two unique claims for epilepsy. We used log binomial regression to calculate 11-year period prevalence (2008-2018) and two-year prevalence (2017-2018). We tested differences in prevalence by age category (<30, 30-39, 40-49, 50-59, 60+) using a Type-III F test. We used log-Poisson regression to model incidence by age category. We ran log-binomial regression to calculate prevalence ratios and log-Poisson regression to calculate incidence rate ratios. Finally, we assessed concordance between epilepsy claims and antiepileptic medication prescription claims. A Cochrane Mantel-Hanzel (CMH) test examined whether the relationship between epilepsy claims and epilepsy medication differed by case group.

Results: We found that 34.6% of autistic adults with ID and 11.1% of autistic adults without ID had epilepsy, compared to 27.0% of adults with ID alone. New incidence of epilepsy was 35.5 incident cases per 1000 person years (95% CI: 32.6, 38.5) in autistic adults with ID, 13.4 incident cases per 1000 person years (95% CI:12.0, 15.0) in autistic adults without ID, and 24.4 incident cases per 1000 person years (95% CI: 23.5, 25.3) in adults with ID alone, with differences across age strata (Table 1). Female sex was significantly associated with epilepsy in autistic adults (with and without ID; Prevalence Ratio (RR): 1.21, 1.20 respectively). For autistic adults with ID, prevalence of epilepsy was 2.65 (95% CI: 2.3, 3.0) times that of autistic adults without ID. Incidence of epilepsy in female autistic adults was 1.22 (95% CI: 1.0, 1.5) times that of male autistic adults in 2008 to 2018 and 1.20 (95% CI: 0.9, 1.5) in 2017-2018. ID was significantly associated with increased incidence of epilepsy. Comparing epilepsy claims to anti-epileptic medication claims, we found that 80.3% of beneficiaries with ASD without ID who had received anti-epileptic medications did not have a claim for epilepsy (Table 2). Case groups significantly differed in their associations between medication use and diagnostic claims (CMH: $p<0.0001$).

Conclusions: Our findings on prevalence and incidence of epilepsy in autistic adults highlight the importance of treating prevalent epilepsy and preventing and screening for incident epilepsy as autistic adults age. Intellectual disability and sex may be pivotal areas to target treatments and identify subgroup-specific etiology in future research.

430.032 *(Poster)* Exploring Genetic and Environmental Influences on Anxiety and Depressive Disorders in Twins with Autism

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Background: Individuals with autism spectrum disorder (ASD) have an increased likelihood of comorbid psychiatric disorders (42-79%) compared to typically developing (TD) individuals (8.3-27%). In individuals with ASD, these disorders are also associated with worsened social and behavioral outcomes, which can cause considerable stress for the individuals and their families and impact treatment response. Despite serious implications, very little is known about the mechanisms involved in the etiology and presentation of comorbid psychiatric disorders in general or anxiety and depressive disorders in particular regarding ASD.

Objectives: The primary objective was to explore whether variation in internalization symptomatology (anxiety and depression), as measured by the Child Behavior Checklist (CBCL), is associated with genetic or environmental factors in twins with ASD compared to TD control twins.

Methods: Data from monozygotic (MZ) and dizygotic (DZ) twin pairs between the ages of 6 to 15 years, in which both twins were concordant for an ASD diagnosis or both were TD controls, were used for this investigation. T-scores from multiple CBCL subscales were examined and will be discussed but we highlight findings from the anxious depressed (anxious) and withdrawn depressed (withdrawn) subscales, which were compared between the groups to examine the presence of anxiety- and depression-related behaviors in children and adolescents with ASD. Intra-class correlations were also generated and the ACE model of broad sense heritability (a^2=additive genetics) and environmental (c^2=shared familial environment, e^2=unique environment) influences was examined to provide estimates for the proportion of variation associated with each factor. For both groups, the anxious and withdrawn subscales were best fit with simplified AE models.

Results: Data were available from 140 twins [35 concordant ASD pairs (MZ=19, DZ=16); and 35 concordant TD pairs (MZ=21, TD=14)]. As predicted, twins with ASD exhibited elevated anxious (M_{diff}=7.91, 95%CI [4.95, 10.86]) and withdrawn behaviors (M_{diff}=9.10, 95%CI [6.64, 11.57]) compared to TD twins. Based on ICC comparisons and ACE modeling, anxious behaviors appeared to be primarily associated with genetic factors in twins with ASD (a^2=0.67, 95%CI [0.19,1.14]) but potentially more environmental contributions in TD twins (a^2=0.26, 95%CI [-0.18,0.71]). Furthermore, genetic contributions may have exerted a larger impact on withdrawn behaviors in twins with ASD (a^2=0.59, 95%CI [0.25,0.93]) compared to TD twins (a^2=0.41, 95%CI [0.03,0.79]), albeit to a lesser extent compared to anxious behaviors.

Conclusions: Our findings support previous twin studies that reported a strong genetic influence on anxiety and depressive disorders in individuals with an ASD diagnosis or autistic-like symptoms. This study contributes novel findings by including a TD twin control sample to compare the influence of genetic and environmental factors with children and adolescents with ASD. Results from this comparison suggest that genetics may influence the presence of anxiety and depressive disorder symptomatology to an even greater extent in twins with ASD than the general population. Future research is needed to examine the specific genetic factors and associated neurobiology that contribute to these relationships in order to develop more specialized therapeutic initiatives for comorbid psychiatric disorders in general and anxiety and depression in particular in individuals with ASD.

430.033 *(Poster)* Exploring the Role of Physiotherapists in the Care of Children with Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) are less likely to participate in physical activity than their age related peers, and it has been suggested that physiotherapists (PT) could potentially facilitate their participation. Currently, no research has examined PTs' potential role in enhancing physical activity (PA) participation.

Objectives: The purpose of this qualitative study was to examine PTs experiences and perspectives of working

Methods: A descriptive qualitative study that used face-to-face interviews was conducted. Ten paediatric physiotherapists in Canada were interviewed. Interviews were analyzed using a thematic analysis.

Results: Three themes were identified: the role of PT, perceived lack of expertise, confidence and training, and structural and systemic barriers. The accounts highlight the social and institutional complexity and constraints in PTs potential promotion of PA for children with ASD. Participants supported a primarily consultative role whereby PTs could educate and partner with parents, teachers, and community service providers to enhance gross motor development and individualize PA needs.

Conclusions: Our study suggests PTs identify a potential role focused on consultation, providing education, gross motor assessment/treatment, and early intervention. Participants highlighted the lack of training and confidence many PTs experience in working with this group and noted that the structure of the health system in this region refers children to specific professionals/programs, limiting access to PTs. Despite these potential barriers, we highlight the role of physiotherapy in promotion of PAP and discuss how PTs might be involved in the care of children with ASD.

430.034 *(Poster)* Factors Contributing to Externalizing Symptoms in Autism Spectrum Disorder

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Background: Co-morbid psychiatric disorders are common in Autism Spectrum Disorder (ASD), with Attentional Deficit-Hyperactive Disorder (ADHD) and Oppositional Defiant Disorder (ODD) reported to be as high as 83% (ADHD) and 73% (ODD) in clinical settings (Joshi et al, 2010). Rates were lower in a population-derived cohort (28% for ADHD and 28% for ODD), though still substantially higher than in the general population (Simonoff et al. 2008). A variety of factors are thought to contribute to externalizing behaviors as symptoms of Disruptive Behavior Disorders (DBD) in general (Gremillion & Martel 2014), and more specifically to ASD (Lindor et al. 2019, Rodas et al. 2017, Vogan et al. 2018), including: IQ, ASD severity, language ability, and executive functioning (EF).

Objectives: The current study tests the independent contributions of specific processes to externalizing symptoms and diagnoses in a single large ASD sample.

Methods: Prior work established that individuals with ASD could move off the spectrum, a phenomenon termed a Loss of ASD Diagnosis, LAD (Fein et al., 2013). The current study presents a secondary analysis of psychiatric presentations in adolescents with LAD, with a current diagnosis of ASD, or with a history of typical development (TD); see Table 1. Participants completed assessments of IQ, structural and pragmatic language, parent-reported EF, and ASD symptomatology.

The Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS) parent interview provided a measure of symptoms of externalizing disorders (ODD, CD, and ADHD). Poisson multiple linear regression models assessed factors as predictors of current symptoms, controlling for age and FSIQ. The model testing predictors of externalizing symptoms was run as a summation across all externalizing symptoms, and then repeated individually for ADHD, ODD, and CD. Multicollinearity was assessed; all model predictors had a VIF<3 and Tolerance>0.4.

Results: The regression model for total externalizing symptoms was significant; pragmatic language, ASD severity, and age were each significant independent predictors (Table 2). Regression models for specific diagnoses were each significant. Structural and pragmatic language were significant predictors of the ADHD diagnosis; ASD symptomatology and age were predictors of ODD; and only pragmatic language was a predictor of CD.

Conclusions: Structural and pragmatic language abilities, age, and ASD symptomatology each accounted for significant variability in externalizing symptoms; across participants, lower language scores, younger age, and greater ASD severity was associated with more symptoms. Neither IQ and EF contributed significant variance to any of the models. ADHD was the most frequent comorbid diagnosis for children with ASD, and ADHD symptoms were strongly associated with *both* pragmatic and structural language skills. Given low base rates of ODD and CD in this sample, findings are necessarily tentative. These results point towards a constellation of factors that increase the likelihood of externalizing symptoms in individuals with ASD. Specifically, age, ASD symptomology and language abilities all played an important role in comorbid externalizing symptoms. Results suggest possible mechanisms underlying difficult-to-manage externalizing behaviors, and have implications for treatment interventions and long-term outcomes.

430.035 *(Poster)* Factors Contributing to Subjective Quality of Life and Anxiety and Depression Symptoms in Autistic Adults: A Qualitative Investigation.

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Background: Quality of life (QoL) is increasingly acknowledged as a gold standard for measuring progress and outcomes in autism (McConachie *et al.*, 2015). However, most previous studies used QoL measures developed for non-autistic individuals. It is therefore unclear which components of QoL are perceived as most important by autistic individuals, and which factors may impact them. For instance, we recently showed that frequently co-occurring anxiety and depression symptoms were a significant driver of reduced QoL for autistic people (Oakley *et al*., in prep). Consequently, understanding the determinants of elevated anxiety and depression symptoms in autism is an imperative research priority. Qualitative methods have potential for providing rich insights into these issues, however such methods have been significantly under-utilised in autism research to date.

Objectives: To take a qualitative approach to: 1) understand which aspects of QoL are most important to different autistic adults, and; 2) identify the factors that autistic individuals feel contribute to their co-occurring anxiety and depression symptoms.

Methods: 19 autistic adults (female *N*=10), aged 18-to-34 years, took part in a novel semi-structured interview about quality of life and mental health. The interview schedule was split according to several topics, each covering an aspect of well-being defined by the World Health Organisation (e.g. relationships, education/employment; WHOQoL Group, 1995). For each topic, participants were first asked to rate the importance of various statements related to that topic (e.g. "feeling supported by your friends?"). Next, the interviewer asked follow-up questions concerning the relationships between these everyday experiences, autism and mental health features. Qualitative data were thematically analysed using NVivo 12 Pro, following Braun and Clarke's six-step method (Braun and Clarke, 2006).

Results: The majority of autistic adults in our sample rated traditionally defined aspects of QoL as important, however we also noted individual variability between each participant (Figure 1a). Autistic adults in our sample stressed the impact of mental health symptoms, over core autism traits, in relation to difficulties across different aspects of everyday life. Within this context, we identified eight themes (encompassing several subthemes) that autistic adults expressed as contributing to their anxiety and depression symptoms (Figure 1b): 1. Exhaustion; 2. Loneliness; 3. Loss of Control; 4. Societal Factors; 5. Identity; 6. Stressful Life Events; 7. Negative Cognitions; and 8. Difficulties with Emotional Awareness.

Conclusions: Our study demonstrates the value of qualitative methods for providing rich insight into the lived experiences of autistic people. The eight themes that we report impacted QoL by increasing anxiety and depression for autistic adults in our sample. In particular, exhaustion from environmental 'overload' (and/ or its consequences) was frequently identified as a contributing factor for anxiety and depression. This suggests that supporting autistic adults in developing and implementing a range of coping strategies for managing different environmental demands may be beneficial. Furthermore, our findings have wider relevance for social policy and practice, highlighting that increasing autism awareness/ understanding and developing environmental adaptations to better support autistic people, may be key factors for improving mental health in this population.

430.036 *(Poster)* Familial and Socioeconomic Correlates of IQ in African-American Children with ASD

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Background: African-American children with autism spectrum disorder (ASD) exhibit approximately twice the rate of co-occurring intellectual disability (ID) than do non-Hispanic white children.

Objectives: The primary objective of this study is to identify correlates of cognitive disability in autism that would inform strategies to resolve racial disparities in this common comorbidity.

Methods: We enrolled 269 African-American children diagnosed with ASD into a multisite gene discovery study across two U.S. data collection sites. Cognitive assessments were conducted on first-degree relatives (biological parents and siblings) to examine familial correlates of low IQ in the sample. We collected socioeconomic demographic variables and the Vineland-II measure of adaptive functioning by parent-report interview. ASD severity was assessed using the Autism Diagnostic Observation Schedule (ADOS-2) and/or the Autism Diagnostic Interview Revised (ADI-R). We used hierarchical regression to estimate the proportion of variance in adaptive and cognitive function that was accounted for by: 1) income, gender, and estimated gestational age at birth; 2) retrospective reports of ASD severity; 3) age of ASD diagnosis.

Results: ASD probands and their first-degree relatives exhibited very broad distributions for IQ. In the context of such sample variation, we observed an *absence* of association between the IQ scores of ASD probands and those of their first-degree relatives; we obtained the same negative result in an analysis of variance which considered *categories* of cognitive impairment in the ASD-affected offspring (F=.263, df=2, 160, p<.769). No significant association was observed between proband IQ and (a) family income above versus below the median income of this group (t=-.148, df=211, p<.883); (b) maternal education with versus without a college degree (t=-1.851, df=231, p<.065); or (c) estimated gestational age at birth before versus after 37 weeks (t=-.093, df=239, p<.93). When restricting the sample to children diagnosed prior to 96 months (in keeping with the Center for Disease Control's surveillance program) and considering the complete set of predictors for IQ, only age in months at time of ASD diagnosis was statistically significant, with earlier diagnosis predicting lower IQ. The full model for IQ explained 7.5% of variance ($F = 2.1$, $p = .07$), and age at time of diagnosis uniquely explained 3.8% variance ($F = 5.2$, $p = .02$). IQ scores of the affected children, which reflected ID rates that were above national averages from epidemiologic surveillance data, were unrelated to family income or variation in the IQ scores of first-degree relatives.

Conclusions: Serious racial disparities in the prevalence of intellectual disability comorbidity in autism were reflected in this sample and not explainable on the basis of common familial and socioeconomic correlates of low IQ. These findings underscore the need to prioritize implementation of earlier diagnosis and intervention, across a range of ASD severity, to determine the potential benefit to African-American children who are disproportionately at risk for comorbid ID. Future research is necessary to explore the causes of the disproportionate burden of ID in African-American children with ASD.

430.037 *(Poster)* Feeding and Eating Issues in Children and Adolescents with Autism Spectrum Disorder

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Background: Feeding issues such as picky eating and avoidance of foods due to texture or other sensory characteristics are pervasive in persons with autism spectrum disorder (ASD). Recently, however, it has also been recognized that other feeding and eating issues (e.g., disordered eating, mealtime behaviours) are also common in persons with ASD.

Objectives: The purpose of the current systematic review was to provide a comprehensive overview of the nature and extent of feeding and eating issues in children and adolescents with ASD. Specifically, we sought to identify commonly investigated feeding and eating issues, and to summarize characteristics of children and adolescents with ASD and feeding or eating issues. Additionally, given the recent literature examining the presence of ASD symptoms in individuals with eating disorders, a secondary objective of the current review was to identify the proportion of studies measuring the presence of weight, shape, and/or body image concerns in persons with ASD.

Methods: Publication dates were not restricted for the purpose of this study to ensure all possible articles examining eating issues were included up until June, 2019. Across all databases, searches were restricted to articles written in English, conducted with human participants, and published in peer-reviewed journals. The review articles had to contain empirical research with a focus on feeding and/or eating issues (e.g., eating disorders, feeding disorders, eating behaviours, picky eating), not exclusively related issues (e.g., studies primarily focusing on nutrient deficiencies, genetic markers, and parental feeding practices were not included). Samples also had to focus on children or adolescents, aged 18 years or under.

Results: Thirty-four studies were included in the current review, with the majority of studies investigating feeding issues. Amongst these studies, food selectivity was the most commonly reported feeding issue, and sensory sensitivities appeared to be a strong contributor to selective eating. Only a handful of studies examined concern over weight, shape, and/or body image in children and adolescents with ASD, but authors from these studies suggested that disordered eating thoughts and behaviours may occur more frequently in those with ASD than their peers without ASD. Importantly, there were no common demographic characteristics (e.g., similar cognitive functioning, ASD symptom severity) identified to describe children and adolescents who experience feeding or eating issues.

Conclusions: Findings from the current review highlight that no clear differentiation exists between feeding and eating issues in children and adolescents with ASD; however, clinically, the differentiation is critical for accurate identification, assessment, and treatment planning. To accurately make this distinction, further research examining disordered eating in children and adolescents with ASD is critical.

430.038 *(Poster)* Functional Brain Abnormalities Associated with Comorbid Anxiety in Autism Spectrum Disorder

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Background: Anxiety disorders, including generalized anxiety disorder (GAD) and phobia, and the related obsessive-compulsive disorder (OCD) are among the most common comorbid conditions in ASD, and have been associated with more severe ASD symptoms. While challenges objectively evaluating anxiety among individuals with ASD has hindered progress in understanding and treating these issues, resting state functional magnetic resonance imaging (fMRI) is well-suited to quantify neurophysiological processes associated with anxiety in ASD. The amygdala is a structure associated with emotion, reward, and social processing, and is anatomically and functionally disrupted in both anxiety disorders and ASD; top-down control of the amygdala by anterior cingulate (ACC) and medial prefrontal cortex (mPFC) is a key locus of impairment in anxiety disorders in which amygdala-ventral prefrontal hypoconnectivity is associated with impaired emotion regulation, whereas amygdala-dorsal prefrontal hypoconnectivity is associated with impaired emotion monitoring/appraisal. Amygdala-basal ganglia networks also have been implicated in anxiety and in restricted and repetitive behaviors (RRBs) in ASD, but have not been measured systematically in individuals with ASD and comorbid anxiety.

Objectives: Our goal was to localize disruptions to amygdala functional connectivity in ASD with comorbid anxiety, and to relate brain connectivity to ASD clinical symptoms.

Methods: Resting state fMRI data were analyzed from 232 participants ages 5-18 in the Autism Brain Imaging Data Exchange, divided into three demographically matched groups: 1) ASD+Anxiety (N = 25) included individuals with a diagnosis of ASD plus GAD, phobia, or OCD and no other psychiatric disorders; 2) ASD-NoAnx (N = 68) included individuals with an ASD diagnosis but no comorbid psychiatric diagnoses, and 3) TD controls (N = 139) included individuals with no known psychiatric or developmental disorders. After preprocessing, timecourses were extracted from ROIs in left/right amygdala, medial prefrontal areas (dACC, dmPFC, rACC, sgACC, vmPFC), and left/right basal ganglia (caudate head, nucleus accumbens, putamen). Functional connectivity between left/right amygdala and each ROI was analyzed by entering normalized correlation coefficients into linear mixed effect regression models that incorporated group, hemisphere, age, ASD severity, and interactions with group.

Results: ASD+Anxiety individuals had decreased connectivity between amygdala and dorsal/rostral medial prefrontal areas (dACC, dmPFC, rACC) compared to ASD-NoAnx and TD groups. Further, higher social impairment was associated with decreased amygdala-dmPFC and amygdala-rACC connectivity, but only in the ASD+Anxiety group. RRBs were more severe in ASD+Anxiety, but were not associated with any connectivity measures. Amygdala-basal ganglia connectivity did not differ between any groups, and ASD-NoAnx did not differ from TD in any connectivity measures.

Conclusions: Results indicate that comorbid anxiety with ASD involves selective disruption to emotion monitoring/appraisal circuits, with relative sparing of the amygdala-vmPFC connection that is commonly disrupted in anxiety without ASD. The association between amygdala connectivity and social impairment only in the ASD+Anxiety group suggests that the underlying brain processes that contribute to ASD symptoms vary in relation to presence of comorbid anxiety which may require unique treatment approaches. These findings have broad implications for understanding the role of comorbid disorders on unraveling neurobiological heterogeneity in ASD.

430.039 *(Poster)* Functional Connectivity within the Anxiety Network Is Atypical in Middle-Aged Adults with Autism and Is Associated with Anxiety Symptom Severity

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Background: Behavioral evidence demonstrates that anxiety is more prevalent in individuals with Autism Spectrum Disorders (ASDs) than in typically developing controls (TC). Brain regions implicated in anxiety have been found to have atypical functional connectivity (FC) in children and adults with autism, suggesting atypical communication between these regions, which could affect anxiety symptoms. However, few functional MRI studies of ASDs have taken co-occurring anxiety into account. Even fewer studies have focused on middle-aged adults with ASDs.

Objectives: The current study contrasted FC between brain regions within the anxiety network in adults with and without autism, and tested if there were differences in relationships between FC within the anxiety network and anxiety symptom severity across diagnostic groups.

Methods: 22 adults with ASDs (16 male; M_{age} = 49.5 years, SD = 6.0) and 26 TC adults (22 male; M_{age} = 51.0 years, SD = 7.0), enrolled in an ongoing study of aging in autism, and completed the Beck Anxiety Inventory (BAI) and a resting state functional MRI scan. Groups were matched on age and in-scanner head motion. An anxiety network consisting of 12 regions of interest (bilateral amygdalae and posterior insulae; left anterior insula; left globus pallidus; right fusiform, parahippocampal, superior temporal, and inferior and middle frontal gyri; left ventromedial frontal gyrus) was defined based on a large meta-analysis in TC adults and two previous studies on anxiety in autism. ANCOVA was used to test for main effects of group, as well as group by anxiety interactions on FC within this anxiety network, controlling for head motion. Results were FDR corrected and are reported at $q<.1$ (corrected), and $p<.05$ (uncorrected).

Results: Adults with ASD (compared to TC adults) showed both higher anxiety scores and underconnectivity within the anxiety network, with prominent involvement of all three insular ROIs. Connectivity within the anxiety brain network showed distinct relationships with anxiety in the ASD group, but did not relate to autism symptom severity or full scale IQ. Specifically, we found positive correlations between BAI scores and FC involving the bilateral posterior insulae in the ASD (but not the TC) group.

Conclusions: Increased levels of anxiety in middle-aged adults with ASDs were associated with atypical FC, predominantly implicating bilateral posterior insulae. Results were not related to autism symptom severity, suggesting relative independence of anxiety-related effects. Correlations between insula FC and BAI scores in the ASD group showed an opposite pattern to what has been robustly found in research on anxiety disorders conducted in adults without ASDs. In this study, adults with ASDs showed a positive correlation between insula FC and anxiety, whereas previous meta-analyses in adults without ASDs found negative correlations between insula FC and anxiety. This suggests possible distinct neurobiological mechanisms underlying anxiety in adults with ASDs. Results may relate to the prominent role of the insula in the salience network, which is involved in allocation of neural resources based on stimulus salience. However, given complexity of functional differentiations within insular cortex, involvement of other circuits cannot be ruled out.

430.040 *(Poster)* Growth Status of Children with Autism Spectrum Disorder in Shanghai and Around Area

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Background: Caused by restricted interests, repetitive behaviors, and many other reasons, autism spectrum disorder(ASD) has been found to have high risk of unhealthy growth status.Evidence showed overweight are more severe problems than wasted for kids and youth with ASD. However, the study reported that children with ASD at southwestern part of China actually had lower mean BMI z-scores than typically developing children.

Objectives: To deep understand the growth status of children with ASD, our study was designed to increase the database for growth status of Chinese children with ASD, and make up the lack of data at east and central parts of China.

Methods: Participants included 516 children diagnosed as ASD at Children's hospital of Fudan University from 2016 to 2019, aging from1 to 8 years old. Gender, age, gestational weeks, parents' enducation were recorded when they met the clinical. Physical measurement was conducted by trained pediatricians. The values were converted to BMI z-score for age using the WHO Anthro. BMI z-score >+2SD was define as overweight, and <-2SD was indicatied as wasted. Trained clinicians scored ASD symptoms during the ADOS. The second part of ADOS scale presenting restricted and repetitive behavior was defined as ADOS RB score. The fine motor score of Gesell Developmental Observation or the performance score of Wechsler Intelligence Scale had been used as the development/intelligence quotient (DQ/IQ) less impacted by verbal ability. SPSS Statistics Version 26 were employed for binary logistic regression and t test.

Results: In the whole study population, the BMI score were around 15.99 (SD=1.73). 7.17% cases are overweight. 4.46% cases are wasted. The prevalence of overweight and wasted were increased to 11.96% among children ages 5 to 8 years old, respectively. Binary logistic regression was used to find that older children (5 to 8 years old group) had 2.079 (95%CI 0.988-4.376) times higher prevalence of overweight than younger(1-4 years old, P=0.054). In addition, the prevalence of wasted was remarkably difference between these two age groups (P=0.000). 5 to 8 years old group had 4.663 (95%CI 1.989-10.932) times higher prevalence of wasted than 1-4 years old group. For the ADOS RB score, BMI z-score <-2SD patients had higher score than others (P=0.042). Binary logistic regression also supported that the cases with ADOS RB score ≥4 had 3.606 (95%CI 1.091-11.919) times higher prevalence of wasted than cases with low score (<4) (P=0.035). Gestational weeks, sex, and fine motor DQ/IQ had no significant association with unhealthy weight among children with ASD.

Conclusions: The prevalence of overweight with ASD children mostly coming from central and eastern of China is not as high as American and northern of China's data. Children over 5 years old has higher risk of unhealthy growth status, not only overweight but also wasted, than children under 5. Our results indicate that more attention should be paid to the nutrition status of older children (5 to 8 years old) and children with high ADOS RB score. Early health prevention strategies may reverse the unhealthy growth outcome.

430.041 *(Poster)* Heart Activity across the First Six Years of Life in Children with ASD and Siblings of Children with ASD

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Background: Previous research has clearly established that children with autism spectrum disorder (ASD) exhibit atypical physiological regulation (e.g., heart activity) that is related to impaired social-communicative functioning. However, the developmental course of physiological regulation in ASD remains largely unknown, particularly for the first few years of life. Furthermore, no studies have examined physiological regulation in non-ASD siblings of children with ASD (i.e., ASIBs), who often display subtle ASD-like characteristics (i.e., the broad autism phenotype, BAP), which are thought to reflect underlying genetic vulnerability to ASD.

Objectives: To determine whether children with ASD (Study 1) and ASIBs with and without BAP features (Study 2) differ from typically developing peers on heart activity across the first six years of life.

Methods: Participants were drawn from larger prospective longitudinal studies. Study 1 included 44 children with ASD (M_{age}=40.29 months) and 30 chronological age-matched typically-developing (TD) children with confirmed TD outcomes and no family history of ASD (M_{age}=38.40 months). Study 2 included 23 typically-developing ASIBs (ASIB-Typ; M_{age}=27.32 months), 10 ASIBs with BAP features (ASIB-BAP; M_{age}=28.10 months), and 34 TD controls (M_{age}=29.36 months), all matched on chronological age. Participants completed multiple assessments between 6 and 72 months of age, resulting in 163 total observations for Study 1 (n_{ASD}=75; n_{TD}=88) and 250 observations for Study 2 ($n_{ASIB-Typ}$=82; $n_{ASIB-BAP}$=31; n_{TD}=137). Baseline heart activity was recorded via electrocardiogram (ECG) while the child watched a 3-minute video. Mean interbeat interval (IBI, the time that elapses between heart beats) and respiratory sinus arrhythmia (RSA, the beat-to-beat variability in IBI that fluctuates with breathing), were extracted using CardioBatch software. Multilevel models (MLM) were run separately for RSA and IBI, with group, age, and the group*age interaction (when indicated by model fit parameters) included.

Results: For Study 1 (ASD/TD), the main effects model, omitting the group*age interaction term, proved to be the best-fitting model. For RSA, significant effects $F(1,72)=4.61$, $b=-0.47$, $p=.035$, and age, $F(1,88)=124.07$, $b=0.05$, $p<.0001$, were observed, suggesting lower RSA across age in ASD. For IBI, the effects of group, $F(1,72)=4.43$, $b=-21.46$, $p=.039$, and age, $F(1,88)=227.15$, $b=3.31$, $p<.0001$, were significant, indicating shorter IBI (i.e., faster heart rate) across age in ASD. For Study 2 (ASIB-Typ/ASIB-BAP/TD), the interaction model proved to be the best-fitting model. For RSA, a significant group*age interaction was observed, $F(1,180)=3.27$, $p=.04$ ($b_{ASIB-TYP}$ = -0.01, p = .086; $b_{ASIB-BAP}$=0.01, p=.180), in that RSA increased less with age in the ASIB-Typ group relative to the TD group. For IBI, a significant group*age interaction was observed, $F(1,180)=4.17$, $p=.017$ ($b_{ASIB-TYP}$=-0.26, p=.59; $b_{ASIB-BAP}$=1.74, p=.011), indicating that, relative to the TD group, IBI increased more with age in the ASIB-BAP.

Conclusions: Overall, findings suggest physiological dysregulation may not be limited to ASD but may subtly affect non-ASD siblings as well. Specifically, children with ASD exhibited lower RSA and shorter IBI starting in infancy (i.e., prior to diagnosis) and throughout the first six years

430.042 *(Poster)* Homotypic and Heterotypic Continuity of Comorbid Disorders in Autism

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Background: High rates of co-morbidity between psychiatric disorders are common, but their developmental origins remain poorly understood. In *homotypic* continuity, the presence of a disorder predicts the later presence of the same disorder, whereas in *heterotypic* continuity, the presence of a disorder predicts the later presence of a different disorder. Evidence from typically developing samples indicates substantial homotypic continuity, but also heterotypic continuity, in psychiatric disorders. In particular, heterotypic continuity exists between early externalizing disorders (aggression and attention problems) and later anxiety/depression (Wichstrom et al., 2017). This has been interpreted within the "failure model", whereby early behavioral problems influence interpersonal relationships, which in turn lead to anxious/depressed symptoms (Burke, Hipwell, & Loeber, 2010). In autism, trajectories of internalizing and externalizing problems were reported as relatively stable and co-occurred throughout the pre-school years (Vaillancourt et al., 2016). Furthermore, psychiatric disorders tend to persist or increase throughout childhood (Chandler et al. 2015, Midouhas et al. 2013) and adolescence (Gotham et al., 2015). However, it is unknown whether specific psychiatric symptoms seen early in autism predict the later presence of the same or different psychiatric symptoms.

Objectives: To investigate the homotypic and heterotypic continuity of specific psychiatric symptoms in autism from preschool-age to middle childhood.

Methods: Participants came from a longitudinal study of autistic children, "Pathways to Better Outcomes". Psychiatric symptoms were assessed by parent report using the Child Behavior Checklist (CBCL) at age of diagnosis (M=24.23 months, SD=8.99) and from the CBCL Teacher Report Form at 8.5 years (M=105.02 months, SD=3.14) (n=164). Continuity in symptoms from the Anxious/depressed, Attention problems and Aggressive behaviour syndrome scales were examined, using raw scores. These symptom domains reflect common co-morbid disorders in autism (Simonoff et al., 2008). A linear regression model was estimated for each outcome with the three earlier syndrome scales as predictors. The models controlled for age at completion of Time 1 CBCL, site and ADOS severity.

Results: Attention subscale scores at 8.5 years were significantly predicted by Attention scores at age of diagnosis (p<.05), but not by the other two symptom domains. Similarly, Aggressive Behavior scores at 8.5 years were only significantly predicted by Aggressive Behavior at age of diagnosis (p < .05). In contrast, there was no evidence for homotypic continuity of anxious/depressed symptoms, as anxious/depressed scores were not significantly predicted by earlier scores on the same syndrome dimension, nor Attention problems at time of diagnosis (p=.06). Regression models including and excluding ADOS severity yielded similar results.

Conclusions: These results provide evidence for homotypic continuity in problems with attention and aggressive behaviour from early to middle childhood in a sample of autistic children. Results did not show homotypic nor heterotypic continuity in Anxiety/depression problems. Given the preliminary nature of those results, next steps will include testing whether other early symptoms or difficulties could successfully predict Anxiety/Depression problems, thus confirming heterotypic continuity for this type of psychiatric problems, or if difficulties not yet evident at time of diagnosis are predictive of Anxiety/depression in later childhood.

430.043 *(Poster)* Hormonal Imbalance Among Women with and without Autism

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Background: There is a robust sex bias in the diagnosis of autism– more frequent in males than in females with a ratio of 2-4:1. This sex bias suggests that the sex-hormone system could be implicated in the etiology of autism. Establishing such a relationship can give insight into the biological underpinnings of autism.

Objectives: To investigate the relative prevalence of hormonal conditions and symptoms, and altered puberty course in women with and without a diagnosis of autism, hypothesizing that these will be more common in the former. Additionally, we aimed to examine whether these effects are important across the spectrum.

Methods: N = 1,230 women participated in an online study, of those, n = 361 were autistic women. Participants reported whether or not they had an autism diagnosis, as well as completing a measure of autistic traits (the Autism Spectrum Quotient (AQ)). Furthermore, participants reported endocrine-related conditions and symptomology; onset and symptoms of puberty; reproductive health, medical diagnoses, and physical symptoms related to hormonal-imbalance; physical health as reflected in current weight and height. Twenty-eight conditions and symptoms were grouped into six factors using an exploratory factor analysis: hypertension and type II diabetes (including high blood pressure, high cholesterol and type II diabetes); fertility-diagnoses (including anovulation, Polycystic ovaries syndrome, premenstrual syndrome, ovarian cancer and uterine cancer); immunology-diagnoses (including autoimmune disorder, hyperthyroidism and hypothyroidism); diabetes-symptoms (including extreme thirst, frequent need to urinate, hair loss or thinning, and sudden, unexplained weight loss); excessive menstruation symptoms (including unusually painful periods and excessive menstrual bleeding); hyperandrogenism-symptomatology (including hirsutism and severe acne). Additionally, timing of puberty as compared to peers, menstrual length, menstrual consistency and age were also included in the analyses. Together, with age and BMI as control variables, eleven predictors were used.

Results: Binomial logistic regression was performed to investigate the relationship between the above variables and the likelihood of an autism diagnosis. Six variables were statistically significant: age (ß=.026, p<0.00); timing of puberty (ß=-.456, p<0.05); hypertension and type II diabetes (ß=.411, p<0.05); diabetes-symptoms (ß=-.270, p<0.01); and fertility-diagnoses (ß=-.244, p<0.05), irregular menstrual length (ß=-.314, p<0.05). Next, a hierarchical regression was performed to investigate the relationship between the predictors and AQ scores in the combined sample of autistic and neurotypical women. Six were statistically significant: age (ß=-.184, p<0.00); BMI (ß=.091, p<0.01); diabetes-symptoms (ß=.176, p<0.00); irregular timing of puberty symptoms (ß=.151, p<0.00); excessive menstruation symptoms (ß=.073, p<0.05); hyperandrogenism-symptoms (ß=.083, p<0.05); irregular menstrual length (ß=.077, p<0.05). A second hierarchical regression was performed with neurotypical women only. The similarity of these results to those that included autistic women suggests that the general findings were not driven by the autistic group solely, and similar patterns are observed across the spectrum.

Conclusions: Autistic women have a higher likelihood for conditions and symptoms linked to hormonal imbalance. Higher levels of autistic traits are linked to hormonal imbalance. These findings are important in informing medical care for autistic women, by emphasizing medical conditions that typically co-occur with autism.

430.044 *(Poster)* Identifying the Cognitive Correlates of Social Anxiety in Autistic and Neurotypical Young People.

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Background: Social anxiety is one of the most common and disabling mental health problems for autistic young people, which has a significant impact on school performance and opportunities to form important peer relationships. Despite the high prevalence rates seen in this population, very little is known about the cognitive factors underpinning the development of social anxiety in autistic adolescents. Further research focusing on understanding the profile of factors that contribute towards social anxiety in autistic adolescents and how this may differ from neurotypical adolescents is imperative for understanding aetiology and informing effective disorder-specific interventions.

Objectives: Our project aims to explore the cognitive factors that may contribute towards feelings of social anxiety in autistic and neurotypical young people. The cognitive factors that were explored include Theory of Mind, negative interpretation biases (i.e. a tendency to interpret ambiguous situations negatively), intolerance of uncertainty and social insight, often defined as an individual's awareness of their own social difficulties/differences. This project aims to answer two key research questions. Firstly, are the factors underpinning social anxiety the same in young people with and without a diagnosis of autism? Secondly, are there some factors related to social anxiety in autistic young people that are specific to these individuals?

Methods: We employed a mixed experimental design, with young people completing both cognitive tasks (e.g. IQ, Theory of Mind) and questionnaires (e.g. social anxiety, intolerance of uncertainty, social insight). Parent-reported questionnaires were also completed (e.g. autistic traits, intolerance of uncertainty). In total, 61 autistic (42 boys, $mean_{age}$ = 13.46) and 62 IQ-matched neurotypical (26 boys, $mean_{age}$ = 13.52) young people took part in our research project. Questionnaire data from 119 parents was also collected.

Results: Firstly, we observed no significant difference in social anxiety symptoms for autistic and neurotypical young people. Autistic and neurotypical adolescents with elevated social anxiety symptoms reported significantly increased intolerance of uncertainty and a negative interpretation bias for social information. Theory of Mind performance was not associated with social anxiety symptoms in either autistic or neurotypical young people. In autistic young people only, elevated social anxiety symptoms were associated with better social insight. Overall, the cognitive factors driving or maintaining social anxiety in autism appear to be very similar to those in neurotypical adolescents.

Conclusions: The present research will have important implications for understanding the factors that contribute towards the development of social anxiety in autistic and neurotypical young people. Furthermore, this research has important clinical implications for prevention, early identification and subsequently informing the development and adaptation of interventions to improve the efficacy of treatments designed to target social anxiety in autistic young people.

430.045 *(Poster)* Increasing Access to Mental Health Services for Individuals with Autism and Intellectual Disability: Bridging the Gap between Research and Clinical Practice

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Background:

The prevalence and burden of mental illness in individuals with autism and intellectual disability (ID) has been increasingly recognised. Identification and treatment of psychiatric disorders in these individuals is, however, challenging. Mental health services are variable in quality and often poorly integrated. Strategies to improve the quality of, and access to, specialised mental health services for autistic adults with ID are needed in countries like Norway, which have a small and scattered population and cover a large geographical area.

Objectives:

To explore the outcome, in terms of patient change, of a newly developed professional network and a standardised protocol for clinical assessment as an implementation strategy to improve services and outcome for autistic adults with ID in Norway.

Methods: Eight clinical centres, responsible for providing mental health services for autistic individuals with ID across all four health regions of Norway, participated in the development of a specialised professional network. The network emphasized professional competence and development, and the implementation of research- based strategies in clinical practice. Intervention was based on professional education, workshops and case discussions. To assess patient progress, a standardised assessment protocol was developed used and referred patients were assessed three times, at referral (T1), after one year (T2) and after two years (T3). Changes in psychiatric symptoms and behaviour problems over time were assessed with Psychopathology in Autism Checklist (PAC) and Aberrant Behavior Checklist (ABC).

Results: In the present study, 132 participants assessed at T1, T2, and T3 are included with age between 16 – 66 years (M = 28.6); 43 (32.6 %) are females and 89 (67.4 %) men, 87 (65.9 %) have mild / moderate level of ID and 45 (34.1 %) with severe / profound level of ID. All participants have been clinically diagnosed with ASD + ID.

Patients showed significant ($p \geq .001$) improvements from T1 to T2 on the psychosis, depression and anxiety subscales of PAC, but the improvement was not significant on the obsessive compulsive disorder (OCD) subscale. The improvements were maintained from T2 to T3. Patients showed significant ($p < 0.01$) improvements on the ABC total score and on all ABC subscales except inappropriate speech from T1 to T2, and the improvements were maintained from T2 to T3 – see figure 1 and 2.

Conclusions: The combination of a professional network and a standardised protocol for clinical assessment offers promise for improving professional competence and access to specialised mental health services for autistic individuals with ID and psychiatric disorders across a large geographical area.

430.046 *(Poster)* Interdisciplinary Intensive Treatment for Children with Severe Pediatric Feeding Disorders: Examining the Role of Autism Spectrum Disorders and Treatment Complexity

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Background: Pediatric feeding disorder (PFD) is defined by impaired oral intake that is not age appropriate and is associate with areas of dysfunctions including medical, nutritional, feeding skills, and psychosocial (Goday, 2019). Children with autism spectrum disorders (ASD) are at particular high risk for problematic feeding and associated challenges (Ledford & Gast, 2006; Maston & Fodstad, 2009; Marshall et al., 2015; Volkert & Vaz, 2010). The estimated prevalence of feeding problems in children with ASD has been reported to be as high as 90% (Kodak & Piazza, 2008). Clinical research reported positive outcomes associated with multidisciplinary intervention with emphasis on behavior treatment, particularly escape extinction (Sharp et al., 2017). Common behavior treatment procedures, such as escape extinction and positive reinforcement strategies, have been utilized alone or in combination and have shown effectiveness in decreasing challenging behaviors and increasing consumption (Freeman & Piazza, 1998; Hoch et al., 2001; Lerman & Iwata, 1996; Piazza et al., 2003; Reed et al., 2004). Although escape extinction procedures are effective in reducing food refusal, it has been associated with problematic side effects including extinction bursts (Lerman & Iwata, 1995). Ledford et al. (2018) has called for attention to appropriately adopt a "least to most restrictive" procedure when working with individuals with PFD in order to prevent possible aversive effects.

Objectives: The purpose of this study was to examine if ASD diagnosis status alone is a predictor of increased complexity of treatment components utilized per child within an interdisciplinary intensive outpatient program.

Methods: A total number of 43 children (M_{age} = 77 months) with PFD completed a two-week intensive program within the Pediatric Feeding Program at Seattle Children's Autism Center from 2012 to 2019. Among all children, 65% had a current diagnosis of ASD (N = 28, M_{age} = 82 months), 49% had anxiety disorder, not otherwise specified (N = 21, M_{age} = 77 months), and 30% had disruptive behavior disorder (N = 13, M_{age} = 92 months). The diagnostic status was coded into a binary category with effect coding. The total number of treatment components utilized were identified, grouped according to behavioral intervention, and summed per child.

Results: Pearson correlation coefficients (r) were first computed. Diagnosis status of ASD and anxiety were not correlated with increased multi-component treatments. However, a diagnosis of disruptive behavior was positively correlated with high level of multicomponent treatments utilized (r = 0.35, $p < 0.05$). Multiple linear regression with sequential predictor entry was used. ASD diagnosis ($R^2 < 0.01$, $F_{change}(1,41)$, $p > 0.05$) and anxiety diagnosis ($R^2_{change} = 0.01$, $F_{change}(1,40)$, $p > 0.05$) did not account for significant variation in total number of treatment components. Diagnosis status of behavior disorder, however, did account for 15% of the variance in the outcome, $R^2_{change} = 0.16$, $F_{change}(1,39)$, $p = 0.009$.

Conclusions: Individuals with PFD and ASD did not receive a higher number of treatment components, rather, the diagnosis of disruptive behavior disorder predicted the use of more complex treatment packages. Both groups achieved similar positive outcomes within the interdisciplinary feeding program.

430.047 *(Poster)* Investigating the Association between Heart Rate Variability and Autism Symptoms in a Sample of Low- and High-Risk Infants

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Background: An emerging body of literature suggests decreased heart rate variability (HRV) in autism spectrum disorder (ASD), and that these differences may emerge in infancy. Despite reports of group differences, it remains unclear how individual differences in HRV are associated with severity of early behavioural signs of ASD.

Objectives: To examine the association between HRV and ASD symptom severity in a sample of low- and high-risk infants.

Methods: Data were obtained from a sample of participants (n=32) from an ongoing longitudinal study of ASD. Participants were designated as high risk if they had an older sibling with ASD (n=20) or low risk if they did not (n=12). Behavioural signs of ASD included the total scores on the Autism Parent Screen for Infants (APSI), Autism Observation Scale for Infants (AOSI), and the Autism Diagnostic Observation Schedule (ADOS)-Toddler module. The APSI and AOSI were administered at 12 and 18 months, whereas the ADOS was only administered at 18 months. Physiological data consisted of 'baseline' HRV as well as HRV reactivity extracted from electrocardiography signals at 12 months using the Porges method (natural logarithm of the total power in the frequency band 0.24 to 1.04 Hz). For the baseline task, participants watched a 2-minute calming video clip. Reactivity was measured using a series of tasks designed to elicit negative emotions (masks, face wipe, and brushing). This was quantified as the magnitude of change from baseline relative to pre- and post-task baselines (summed). Linear regression was used to examine the association between HRV (baseline and reactivity) and the behavioural scores.

Results: There was no significant effect of group (high risk/low risk) on baseline HRV (p=0.1) or HRV reactivity (p=0.40). Linear regression revealed a significant association between HRV reactivity and APSI scores at 12 (beta=-4.04+1.6, p=0.02, adjusted R^2=0.19) and 18 (beta=-6.17+1.08, p=0.01, adjusted R^2=0.21) months, with lower HRV associated with higher scores on the APSI. No significant associations were found between HRV (baseline or reactivity) and the AOSI or ADOS scores, or baseline HRV and APSI scores.

Conclusions: Consistent with previous findings in samples of older children with ASD, our preliminary results suggest that decreased levels of HRV may be associated with increased ASD symptoms in a sample of infants at low and high familial risk of ASD. This may be related to biological differences in ASD (e.g., differences in the central autonomic network), or a by-product of other emotional and cognitive processes associated with HRV differences (e.g., emotion regulation, attention). Interestingly, the associations with HRV were only found with parent-reported ASD symptoms, and not observational measures. Future studies with larger sample sizes are needed to clarify these associations.

430.048 *(Poster)* Links between Poor Sleep and Behavior in Children with ASD and Children with ADHD

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Background: Sleep disturbances are highly prevalent in both children with autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (ADHD) presenting in an estimated 50-80% of children with ASD and 50% with ADHD. Sleep disruption in childhood has the potential for significant detrimental effects on cognition and broader aspects of behavior. Despite the prevalence of sleep disturbances in both ASD and ADHD, there have been no reported studies comparing patterns of sleep disturbance in cohorts of children with ASD to children with ADHD, nor comparing patterns of sleep dysfunction in children with ASD with and without comorbid ADHD.

Objectives: Compare sleep quality in children with ASD-only, ADHD-only, ASD+ADHD, with that of typically developing (TD) children and examine associations of sleep quality with quantitative measures of ASD- and ADHD-related traits.

Methods: Participants included 740 children (55 ASD-only, 245 ADHD-only, 133 ASD+ADHD, 307 TD) aged 8-12 years whose parent's completed the Children's Sleep Habits Questionnaire (CSHQ).

Multivariable linear models examined associations of CSHQ measures with 1) diagnosis and 2) measures of social-communicative function, using the Social Responsiveness Scale-2 (SRS-2), inattention and hyperactivity/impulsivity using the Conners scales, executive function using the Behavior Rating Inventory of Executive Functioning (BRIEF) and adaptive function using the Behavior Assessment System for Children, 3rd Edition (BASC-3). Models were adjusted for age, sex, race, ethnicity, family socioeconomic status, and use of stimulant medications.

Results: Compared with TD children, those with ASD-only, ADHD-only, and ASD+ADHD showed higher CSHQ total scores and were more likely to reach a clinical level of sleep problems (all ps<0.0001).

Poorer sleep (higher CSHQ total scores) was associated with: 1) SRS total score in all groups (ps<0.01) except ADHD-only, 2) Conners inattentive T score in all groups (ps<0.05) except ASD+ADHD, 3) Conners hyperactivity/impulsivity T score: TD (p=0.03) and ADHD-only (p<0.0001), 4) lower BASC adaptability T scores in all groups (ps<0.05) except ADHD-only, and 5) BRIEF executive function composite T score in all groups (ps<0.05).

CSHQ clinical scores were associated with 1) SRS total score: TD (p<0.0001), ASD-only (p=0.01), and ADHD-only (p=0.04), 2) Conners inattentive T score: ASD-only (p=0.01) and ADHD-only (p=0.01), 3) Conners hyperactivity/impulsivity T score: ASD-only (p<0.01) and ADHD-only (p=0.04), 4) lower BASC adaptability T scores: TD (p<0.0001), and 5) BRIEF executive function composite T score in all groups (p<0.05).

Sleep duration was largely unassociated with the behavioral outcome measures. Individuals with ADHD-only who had greater sleep duration had significantly lower (i.e. better) inattentive T scores (p=0.04) and lower (i.e. better) adaptability T scores (p=0.01).

Conclusions: This is the first large-scale study to examine the impact of sleep in children with ASD and children with ADHD. Consistent with prior reports, we observed poorer sleep quality in all groups compared to TD peers. Further, poorer sleep quality was associated with social communication deficits, inattention and hyperactivity/impulsivity, executive, and adaptive function in children with ASD and those with ADHD. We extend prior work by examining sleep quality in children with ASD with comborbid ADHD revealing distinct patterns of sleep dysfunction compared to children with ASD-only and ADHD-only.

430.049 *(Poster)* Medical Comorbidities in a Cohort of Patients with Autism Spectrum Disorder

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Background: subjects with ASD are often burdened by numerous medical comorbidities, sometimes hard to identify. Data on this type of comorbidities in ASD are often inconsistent. Of note, the vast majority of the studies on the topic has focused on children and adolescents with ASD. However, as ASD are life-long chronic conditions, it is plausible that an almost equal number of adults with ASD are present. Additionally, adults with ASD may display a different pattern of comorbidities compared to childhood: for instance, obesity as well as other metabolic conditions (i.e. diabetes, stroke, cardiovascular disease) tend to increase during the lifespan while childhood typical diseases (i.e. asthma, seizures) tend to decrease. Two recent reviews has observed that only a few studies have recruited also adults with ASD: of these studies, only one has actually investigated the presence of medical comorbidities in this patient group

Objectives: the identification of medical comorbidities in subjects with autism spectrum disorder (ASD) (especially if not verbal) is a challenge for clinicians but is essential for improving patient's quality of life. The aim of the present study is to evaluate the presence of medical comorbidities in a sample of adults with ASD.

Methods: this is a cross-sectional observational study. Medical history was recorded and each reported diagnosis (i.e. allergic reactions, metabolic disorders) was reinvestigated to obtain a clinical confirmation. Congenital diseases for which appropriate documentation and genetic testing was provided were not reinvestigated. Additionally, each patient underwent a complete neurological and physical evaluation. Each observed physical sign or symptom was subsequently investigated by specific instrumental testing or by referral to the appropriate medical specialist. Blood tests were prescribed if performed more than 6 months before evaluation.

Results: total sample size was 191. Presence of at least one medical comorbidity was observed in 114 subjects (59.7%). Number of comorbidities per subject varied from one to four. The more common comorbid conditions were epilepsy (n=29, 15.18%), allergic rhinitis (n=17, 8.9%) and irritable bowel syndrome (n=13, 6.8%).

Conclusions: people with ASD presented higher rate of medical comorbidities compared to general population rates. Family physicians caring for adults with ASD should be aware of the possible presence of comorbid conditions, which could go unnoticed given the communication impairment and problem behaviors inherent to ASD.

430.050 *(Poster)* Mental Health Symptoms of Children and Adolescents with Autism Spectrum Disorder

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Background: Mental health problems are more common among individuals who have Autism Spectrum Disorder (ASD) than the general population. They are believed to negatively impact long-term outcomes of those with ASD as well as worsen the core symptoms of autism. Like most mental health difficulties, it is believed that these issues emerge during childhood and adolescence and then persist through to adulthood with early identification and treatment offering the greatest opportunity for positive long-term outcomes. Understanding the prevalence of mental health problems among individuals with ASD is notoriously difficult due to symptom overlap, validity issues with existing mental health assessment tools in this population, and differing factors such as gender, age, and IQ showing inconsistent relationships with mental health problems.

Objectives: Our research aims to provide a better understanding of the prevalence of mental health concerns in children and young people with ASD as well as explore relationships between mental health symptoms and IQ, gender, and age.

Methods: The participants were 60 children, between the ages of 3- and 18-years who were diagnosed with ASD between April 2018 to August 2019 at the Autism Spectrum Assessment Clinic at a Community Paediatrics Department in Victoria, Australia. 33% of the sample were female. The mean Full Scale IQ was 87 (*SD* = 16.34). Parents and carers of these children completed the Child Behaviour Checklist (Achenbach & Rescorla, 2001) and the Spence Anxiety Scale (Spence, 1998).

Results: For the overall sample, mean T-scores on all CBCL empirically based scales (anxious/depressed, withdrawn/depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, and aggressive behavior) fell in the borderline clinical range. Spence subscale T-scores for separation anxiety, and panic/ agoraphobia for the overall sample also fell in the elevated range, and Spence T-scores for the remaining scales (social phobia, generalized anxiety, physical injury fears, and obsessive compulsive problems) all approached the elevated range. A description of scores based on age groups (under 6 years, 6-12 years, and over 12 years), gender, and IQ groups (FSIQ<85/ FSIQ>85) is also presented although no statistically significant differences were found among these groups.

Conclusions: Very high rates of clinically significant mental health symptoms were found among the entire sample. Results of the current study indicate children diagnosed with ASD are at risk of comorbid mental health symptomology, with particular concerns in areas of anxiety, depression, social problems, attention difficulties, challenging behaviours and panic disorder. With this knowledge, it is critical that children diagnosed with ASD are also supported to manage their mental health in addition to the challenges associated with ASD. This highlights a need for diagnostic tools, clinicians and services to support children, adolescents and adults to be cognizant and holistic in assessment and treatment approaches for individuals diagnosed with ASD.

430.051 *(Poster)* Mental Health and Relationships of LGBQ Youth on the Autism Spectrum

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Background: Studies suggest that between 10-24% of autistic people are transgender and/or lesbian, gay, bisexual, queer (LGBQ). Both autistic teens and LGBQ teens are at higher risk for social isolation, depression, and suicide compared to other teens. Thus, autistic LGBQ teens may be at high risk for mental health issues and require targeted supports. However, there is currently little data on mental health for this population. For LGBQ teens without disabilities, family relationships and bullying by peers are linked to risk for mental health issues; this possibility has never been investigated for LGBQ youth with autism.

Objectives:

1. Do autistic LGBQ teens experience poorer mental health, higher rates of depression and anxiety, and higher rates of SSRI use than other autistic youth?
2. Do LGBQ youth experience poorer family and peer relationships than other autistic youth?
3. When accounting for family and peer relationships and adjusting for other factors, do differences between LGBQ and other autistic youth persist?

Methods: Participants were 246 parents of youth aged 14-17 years with formal diagnoses of autism. They completed a web-based survey about their child's quality of life (parent proxy sample). Measures were drawn from the National Institutes of Health Patient-Reported Outcomes Measurement Information System (PROMIS). Based on parent report, the sample included parents of youth who were LGBQ (7.7%, *n*=19) or asexual (8.1%, *n*=20). Non-parametric statistics (Kruskal-Wallis), Chi-square, and linear regression were used to address objectives.

Results: 1. Compared to non-LGBQ autistic youth, parents reported that LGBQ youth had higher depressive symptoms (p=.002), anxiety (p=.008), and stress (p=.010) and lower life satisfaction t-scores (p=.033). LGBQ youth had higher rates of depression/mood disorder (32% vs. 7% heterosexual youth; p=.006) and anxiety disorder diagnoses (53% vs. 24%; p=.021), and were more likely to be prescribed anti-depressant medication (63.2% vs. 29.7%; p=.013) than other youth.

2. There were no significant differences in PROMIS peer (p=.274) or family relationships t-scores (p=.07) for LGBQ youth. However, average family relationships t-scores fell in the mild-moderate symptom range for LGBQ youth but were within normal limits for other youth.

3. Peer and family relationship t-scores were strong predictors of depressive symptoms (R^2=.220) and life satisfaction t-scores (R^2=.349); only family relationships predicted anxiety (R^2=.147), stress (R^2=.181), and global health t-scores (R^2=.153). LGBQ status continued to predict worse depressive symptoms (p=.038) after adjusting for family/peer relationships, sex (male/female), and grade level performance (below vs. at or above); grade level performance continued to predict lower global health.

Conclusions: LGBQ autistic youth may be at higher risk for mental health difficulties compared to other youth with autism. Family relationships are a potential target for intervention. LGBQ youth did not report poorer peer relationships than others, but peer relationships were in the severe range for all autistic youth and predicted worse depressive symptoms.

430.052 *(Poster)* Night Wakings and Cognitive Functioning in School-Age Children Diagnosed with Autism Spectrum Disorder

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Background: Sleep problems, which are highly prevalent in those with ASD, have been associated with deficits in several areas of cognitive functioning including learning, memory, and attention. Little is known about whether specific types of sleep problems (i.e. delayed sleep onset latency, night wakings) may differentially impact cognitive functioning in children with ASD. However, work in the general population suggests that frequent night waking is associated with compromised executive functioning. Similarly, in children with ASD, night wakings have a stronger association with daytime inattention than other aspects of sleep, including sleep latency and duration.

Objectives: To determine whether children with ASD with significant sleep problems including night wakings (SP-NW) have more problems with school functioning, attention, and working memory than those 1) with sleep problems without night wakings (SP-alone) and 2) those without sleep problems (NSP).

Methods: The sample (n=2134) included school-age children (ages 4-10) enrolled in the Autism Treatment Network Registry. This secondary analysis was limited to those with complete data for relevant measures, including the Children's Sleep Habits Questionnaire (CSHQ), the PedsQL School Functioning subscale, the Child Behavior Checklist (CBCL) Attention Problems Subscale and an IQ measure. The SP-NW (n=771) included those with CSHQ Total Scores above 40 and CSHQ Night Wakings scores above 4. The SP-alone group (n=679) consisted of those with CSHQ Total scores above 40 and CSHQ Night Wakings scores of 4 or lower. The NSP group (n=684) included those with CSHQ Total Scores of 40 or lower. Working memory scores were derived from several IQ tests (Stanford Binet-5, WISC-IV, WPPSI-III, WPPSI-IV, and WPPSI-V) for a subsample of the SP-NW (n=227), SP-alone (n=187) and NSP (n=224) groups. While significantly older (M= 7.25) than the larger sample (M= 6.67), the groups did not differ in IQ and other relevant ASD characteristics. ANOVA was used to determine if significant differences exist among the groups in any of the three main outcomes. For outcomes with significant differences, all groups were directly compared, and p-values were adjusted using a Bonferroni correction.

Results: Significant differences were found among the three sample groups for attention problems (F= 40.81; p<0.0001) and school functioning (F=46.42; p<0.0001), but not for working memory (F=0.18; p=0.8350). The SP-NW had significantly lower school functioning scores (M=55.92; SD=19.57) compared to SP-alone (M=58.50; SD=18.25; Adjusted p=0.0196) and NSP (M=65.21; SD=18.38; Adjusted p<0.0001). The SP-NW group also had higher attention problems M=68.62; SD=10.24) than the SP-alone (M=67.45; SD=10.38; Adjusted p=0.06242) and NSP (M=63.96; SD=9.75; Adjusted p<0.0001) groups. The difference in attention problems between the SP-alone and SP-NW was not significant.

Conclusions: School-age children with sleep problems show significant deficits in school functioning and attention. Night wakings appear to have a particularly strong association with neurocognitive difficulties but may not impact working memory in the ASD population. Parents and clinicians should monitor for night wakings, as they may contribute to impairments in attention and learning. More work should be done to understand the differences between sleep maintenance and sleep initiation issues and their respective relationships to cognitive functioning in this population.

430.053 *(Poster)* Prediction of the Perception of Family Relations in Youth with and without ASD

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Background: Broadband measures have been used to identify emotional/behavioral problems in children with Autism Spectrum Disorder (ASD*)*. Children with more emotional/behavioral problems tend to have more negative family interactions and may believe their family has a negative perception of them. However, limited studies have extended this research to examine if parent's perception of their child's emotional problems predict ASD youths' report of their family relations.

Objectives: This study examined the relationship between parent-reported emotional/behavior problems on the *CBCL/6-18* and child self-reported family relational problems on the *Conners-3-Self Report Form (Conners-3-SR)* among children with ASD, Social Anxiety Disorder (SAD), and those having no diagnoses (NODX). Additionally, the child's age and gender were explored as separate predictors.

Methods: Eight youth with ASD (5 males; *M=10.88* years-old), 7 with SAD (5 males; *M=12.00* years-old), and 6 with NODX (4 males; *M=13.33* years-old) were included as part of a larger IRB-approved study. Consent/assent was obtained. Diagnoses were confirmed by the *Childhood Autism Rating Scale, Second Edition (CARS-2) or the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2)* and the *Anxiety Disorders Interview Schedule (ADIS- IV-C/P)*. Full-Scale IQ was measured using the *WISC-V* (ASD *M*=93.63, *SD*=12.05; SAD *M*=104.57, *SD*=11.13; NODX *M*=105.00, *SD*=9.53). The *CBCL/6-18* was completed by the primary caretaker and for this study, the Internalizing Problems, Externalizing Problems, and Total Problems scales were utilized as primary predictors. The *Conners-3-SR* was completed by the participant (the Family Relations subscale was used to capture the youth's perception of their family's love towards him or her). Three separate hierarchal linear regressions were conducted for each of the diagnostic groups to determine if the addition of child's age and gender improved the prediction of youth's ratings of family relations over and e. Data collection is on-going.

Results: For the youth with ASD, the full model of the Internalizing Problems and Externalizing Problems scales, child's age and gender, to predict youth family relation ratings was statistically significant, R^2=.98, $F(4, 3)$=35.21, p<.001; adjusted R^2=.95. Model 1 yielded the Internalizing Problems scale as a unique predictor (b=-1.37, p=.02). When child's age and gender were added (Model 2), gender was significant (b=-.80, p=.01), the Externalizing Problems scale became a significant predictor (b=.92, p=.03) and the Internalizing Problems scale remained significant (b=-1.83, p<.001). For youth with SAD, the full model was not significant, R^2=.95, $F(4, 2)$=9.54, p=.10. The full model was not significant for NODX.

Conclusions: Caregiver ratings of both internalizing and externalizing problems in youth with ASD predicted the youth's own ratings of family relations. Higher ratings of internalizing problems were associated with lower family relational problems, whereas higher ratings of externalizing problems were associated with more family relational problems. Surprisingly, this finding was not replicated in youth with SAD. Future research should address the limitations of the current study specifically, the small sample size, in order to further explore how internalizing and externalizing problems both impact a child's perception of his or her family relations.

430.054 *(Poster)* Prevalence of Behavioral and Emotional Problems in Youth with ASD, Asthma, and Neither Condition

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Background: Prior reports suggest that emotional and behavioral problems are elevated in children with autism (ASD) when measured both as categorical psychiatric disorders and scores of dimensional measures of psychopathology. However, many studies relied on clinical samples subjected to referral biases, and often lacked control groups of non-autistic chronic health conditions that would permit an evaluation of the specificity of the findings.

Objectives: The objectives of this study were to examine the prevalence of individual behavioral and emotional problems (BP) in youth with ASD, and to compare these patterns to two independent control groups: youth with Asthma , and youth without either of these health conditions (GENPOP). In addition, we examined age sex and other correlates of individual BP.

Methods: We used baseline data from an ongoing longitudinal study (r-Kids) that is examining the economic impact on families of raising a child with ASD. Youth with ASD ages 3 to 17 years were randomly selected from three Kaiser Permanente regions (Northwest, Hawaii, Northern California) and health clinics in the OCHIN network in the US using the electronic health record. Youth with asthma and GENPOP were matched to the ASD group distribution on age and sex of the child. A total of 1,461 parents joined the study, (564 ASD, 468 Asthma 429 GENPOP). At baseline, 1,267 parents completed the Strengths and Difficulties Questionnaire (SDQ), a standardized behavioral screening measure comprising 25 items, 5 subscales, a total behavioral score, and an impact score assessing impairment associated with behavioral problems. The prevalence of individual behavioral problems was compared across groups using chi-square tests. Total and subscale scores were compared with ANOVAs, followed by post-hoc tests. Age and sex differences were further evaluated with chi-square and ANOVAs.

Results: The sample was 79.4% male, with a mean age of 9.2 years (SD=3.9). There were no statistically significant differences between groups for both age (p=.08) and sex (p=.23). Youth with ASD had significantly higher SDQ mean scores on overall difficulties than Asthma or GENPOP youth (ASD: 18.14 (6.5); Asthma: 9.39 (6.3); GENPOP: 8.63 (6.2); p<.001); the trend was similar for externalizing and internalizing subscales and overall impact (Figure). By contrast, youth with Asthma were similar to GENPOP youth, with all SDQ scale scores comparisons being non-significant. Within each age group, youth with ASD had higher mean scores on overall difficulties than Asthma and GENPOP youth. There were no significant sex differences across groups for the SDQ total score, externalizing and impact scores. However, a significant sex effect was found for the Internalizing score; girls in the Asthma and GENPOP groups scored higher than boys on the Internalizing subscores but not in the ASD group.

Conclusions: Youth with ASD have significantly more behavioral and emotional problems than youth with asthma and youth from the general population.. This study confirms and extends previous findings on a larger and more diverse sample. These findings indicate that youth with ASD should be actively managed by primary care providers.

430.055 *(Poster)* Profiles of Internalizing Symptomatology and Social Motivation in Youth with ASD

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Background: Anxiety and depression are highly prevalent in children, adolescents, and adults with ASD and contribute to poor outcomes and diminished quality of life (Howlin, Goode, Hutton, & Rutter, 2004). Social motivation may vary among individuals with ASD and is likely implicated in the development of anxious and depressive symptoms (Deckers, Roelofs, Muris, & Rinck, 2014). However, the extent to which variation in social motivation contributes to distinct patterns of comorbidity remains unclear.

Objectives: The purpose of the current study was to identify clinically meaningful subgroups of youth with ASD with varying levels of anxiety, depression, social motivation, and ASD symptomatology. We hypothesized that a substantial proportion of youth would present with clinically significant anxiety and depression, and that a group would be identified with high social motivation and associated comorbid symptoms.

Methods: The sample for the current study was drawn from the National Database for Autism Research (NDAR) and consisted of 195 youth with ASD. Youth ranged in age from 6 to 17 (M = 10.08, SD = .80) and were 74% male. All participants were administered Module 3 of the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2012). Comorbid depression was assessed using the Withdrawn/Depressed subscale of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001), anxiety was indexed by the Screen for Child Anxiety Related Disorders (SCARED; Birmaher et al., 1997), and social motivation was measured using the social motivation subscale of the Social Responsiveness Scale (SRS-2; Constantino & Gruber, 2012). To identify distinct classes of youth with varying levels of ASD symptoms, anxiety, depression, and social motivation, latent profile analysis was carried out using MPlus Version 8 (Muthén & Muthén, 2017). Profile solutions were evaluated using five model fit indices. Differences across the resulting groups in primary indicators, as well as association of group membership with demographic factors (i.e., age and sex), were also examined.

Results: A three-class solution provided acceptable model fit with clear distinctions among classes. The largest class (n = 106) was characterized by low comorbidity, with subclinical scores on depression and anxiety measures and with relatively stronger social motivation. A second class (n = 66) consisted of those with significant comorbid symptomatology, with clinical elevations in depression and anxiety and diminished social motivation. The smallest identified class (n = 23) presented with low comorbidity, but significantly greater ASD symptomatology. Class membership did not differ on the basis of age or sex.

Conclusions: The proportion of our sample presenting with significant comorbid symptoms was consistent with prior literature. The hypothesized socially motivated class with elevated anxiety and depression was not identified. Notably, there was a strong correlation between social motivation and depression, but not between ASD severity and social motivation. Diminished motivation for social discourse may therefore have resulted from mood and anxiety symptoms, rather than from ASD. Longitudinal work with valid measurement of key constructs is necessary to determine whether social motivation plays a causal role in the etiology of internalizing symptoms in ASD.

430.056 *(Poster)* Profiles of Sleep Problems Among Young Children with Autism Spectrum Disorder

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Background: Sleep problems are more common and severe among young children with autism spectrum disorder (ASD) compared to typically developing peers. Previous research on sleep problems in children with ASD has mainly been variable-centered, examining associations between severity of sleep problems and child and family outcomes. An alternative approach is to use person-centered analytic methods that can identify groups of individuals with distinct sleep problem profiles. Identification of such profiles could help parse heterogeneity and help tailor intervention efforts. The goal of this study was to identify sleep problems profiles and their clinical correlates, based on a five-factor model (reported elsewhere) of the Children's Sleep Habits Questionnaire (CSHQ) among preschool children with ASD.

Objectives: (1) To describe empirically- derived patterns (i.e., latent profiles) of sleep problems among young children with ASD; and (2) To examine relations between family cumulative risk and emotional-behavioral dysregulation symptoms and sleep profile membership.

Methods: The study included 318 three- to-five years old children (M= 49.45 months; SD = 5.77). Latent profile analysis was used to identify and describe profiles of sleep problems. Sleep problems were assessed using the aforementioned CSHQ five-factor model: (1) Bedtime Routine; (2) Sleep Onset & Duration; (3) Night Waking; (4) Morning Waking; and (5) Sleep Disordered Breathing. We assess whether profile membership was associated with dysregulation difficulties derived from the Child Behavior Checklist 1.5–5 (Althoff et al., 2012), and family cumulative risk index (CRI; based on socioeconomic status, maternal distress, family functioning, and other related factors) using the three-step method (Vermunt & Magidson, 2013) with Omnibus Wald chi-squared tests to examine each predictor.

Results: A five-profile model of children's sleep problems showed the best fit (see Figure). *Profile 1, Nighttime Sleep Problems* (28%), consisted of children with scores near the sample mean, except low scores on Morning Waking. Profile 2, *Severe Sleep Problems* (25%), consisted of children with high scores relative to the entire sample across all sleep problems. *Profile 3*, *Low Sleep Problems* (18%) included children with the lowest levels of all sleep problems. *Profile 4, Moderate Sleep Problems* (17%), consisted of children with sleep problem levels near the sample mean on all factors. Finally, *Profile 5*, *Morning Waking Problems* (12%), consisted of children with low scores on Bedtime Routine problems but pronounced Morning Waking problems. Results of the multivariate model indicated that dysregulation difficulties (Wald = 13.90; p = .001) and family CRI (Wald = 13.27; p =.001) emerged as significant predictors of profile membership. Higher CRI was associated with higher odds of membership in Profile 2 (*Severe Sleep Problems*), and lower scores for dysregulation difficulties were associated with higher odds of membership in Profile 3 (*Low Sleep Problems*).

Conclusions: Children with ASD experience distinct profiles of sleep problems that differ not only by overall severity, but also by relative severity with respect to types of sleep problems. Children's dysregulation and family risk should be considered as potential correlates of sleep problems in children with ASD relevant to assessment and intervention planning.

430.057 *(Poster)* Psychopharmacologic Therapy in 4-and-5-Year-Old Preschoolers with Diagnoses of ADHD and ASD

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Background: ADHD is present in 22–85% of children with ASD. Mixed results have been reported from studies examining stimulants in children with ASD and ADHD. Guanfacine, an alpha-2 agonist is a common off-label agent prescribed in preschool ADHD children. The current literature for the treatment of preschool age children with ADHD and ASD is limited.

Objectives: To determine the safety, tolerability, and efficacy of psychopharmacologic treatment in a sample of 4-and-5-year-old developmental-behavioral pediatrics (DBP) clinic patients with a diagnosis of ADHD and ASD.

Methods: All children younger than 6 years old with *DSM-5* criteria for ADHD and ASD diagnoses seen at the Rush University Medical Center DBP clinic from 2012 to 2018 were included in this study. The information on clinical response and adverse events to methylphenidate and guanfacine treatments administered to patients until they turned 6 was collected from electronic medical records. Methylphenidate and guanfacine were the first-line ADHD treatment options.

Results: Forty-eight patients with ASD and ADHD out of a 149-preschool-patient ADHD database were included in this study. Of the 48 patients with ASD, 26 received at least one drug to treat ADHD with a total of 31 drug trials (guanfacine=15, methylphenidate=16). 66% of patients receiving guanfacine and 45% of those receiving methylphenidate had a positive response: improved behavior noted in home and school environments. The positive response rate to guanfacine in patients with ASD and ADHD (66%) was similar to the general ADHD database response rate (65%). The positive response rate to methylphenidate in patients with ASD + ADHD (45%) was lower than the general ADHD database rate (63%). The rate of side effects as a cause to end treatment in ASD patients with a positive response was similar for the patients taking guanfacine (10%) and methylphenidate (14%) and was not different than the rate of ADHD patients without ASD. 33% of all the ADHD patients who received guanfacine reported lethargy and 10% reported irritability as the more common and significant side effects, which was similar to the 32% rate of lethargy and 7% irritability in patients with ASD and ADHD treated with guanfacine. From the general ADHD database, 18% of the patients who received methylphenidate were reported to present irritability, 14% decreased appetite, 7% headaches, and 4% emotional lability, whereas 50% of the patients with ASD + ADHD treated with methylphenidate were reported to present irritability, 0% decreased appetite, 6% headaches, and 13% emotional lability. No severe adverse events were reported in our database.

Conclusions: ADHD children younger than 6 years of age with concurrent ASD diagnosis had a similar rate of positive responses to guanfacine but a lower positive response rate to methylphenidate when compared to same-age children who present ADHD without ASD. The rate of side effects in all children with ADHD was not significantly different from children with ADHD and ASD who were treated with guanfacine. Irritability and emotional lability were more common side effects in children with ASD and ADHD when treated with methylphenidate and compared with all children with ADHD.

430.058 *(Poster)* Relationship between Prematurity, ASD Diagnosis, and Comorbidities in the SPARK Sample

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Background: SPARK is an online research study of individuals with a professional autism spectrum diagnosis and their families with measures of ASD symptoms and medical history. Associations have been made between autism and premature birth and other developmental co-morbidities (eg. Leavey, Zwaigenbaum, Heavner, and Burstyn, 2013), and SPARK offers the ability to confirm these trends with a very large sample.

Objectives: Our aims were to analyze the relationship between premature birth and ASD, assess frequencies of comorbid developmental diagnoses in individuals with ASD born prematurely, and assess differences in autism severity.

Methods: Participants included 35,972 individuals with ASD, ages 1-85 (M=11, SD= 8.9), and 54,317 individuals without a diagnosis of ASD (NASD), ages 1 month to 99 years (M = 32, SD= 16.21). Data for this study included a medical screener and standardized measures: Social Communication Questionnaire-Lifetime (SCQ), Developmental Coordination Questionnaire (DCDQ), and Repetitive Behavior Scale-Revised (RBS-R). Prematurity was defined as birth at less than 37 weeks gestation. Odds Ratios were calculated on frequencies of comorbidities. T-tests were done as a measure of specificity of autism symptoms in those born prematurely and full term.

Results: Within the ASD group, 77% were male at birth. In the NASD group, 36% were male at birth. In both ASD and NASD groups, the average age of gestation was 33 weeks for those born premature. ASD participants had 5.4 higher odds to be born prematurely than NASD participants (12% vs. 2.5%, 95% CI: 5.07, 5.74, $p<.01$).

Odds ratios were calculated within the ASD group to assess differences in frequencies of co-occurring diagnoses in preterm (PT) and full term birth (FT) groups. PT were only slightly more likely to have ADHD (43%) than FT (36%) (OR 1.3; 95% CI: 1.26, 1.43, $p<.01$). Similarly, likelihood of intellectual disability was only modestly associated with prematurity (31% vs. 20%, $OR = 1.19$, 95% CI = 1.11, 1.28, $p<.01$). Developmental Coordination Disorder, as determined by scores from the DCDQ, occurred in 30% PT vs. 17% FT, but this difference only increased odds to 1.15 (95% CI: 1.05, 1.26, $p<.01$).

T-tests were completed within the ASD group and found statistically significant differences in SCQ scores between PT ($M = 22.8$, $SD = 7.5$) and FT ($M = 21.7$, $SD = 7.6$) ($t(4958) = 8.13$, $p<.01$), as well as in RBS-R scores (PT M = 37.8, $SD = 21.9$; FT M = 34, $SD = 20.82$; $t(3592) = 8.6$, $p<.01$).

Conclusions: These findings from a very large sample of autistic individuals in SPARK support prior research illustrating a relationship between premature birth and developmental disabilities, including ASD. These results suggest a possible higher likelihood for those born prematurely to not only to be diagnosed with autism, but with other comorbid developmental disabilities. While statistically significant differences on social-communication markers and repetitive behaviors were found in premature and full term births, the means do not suggest a clinically meaningful difference in autism-specific symptoms. Limitations to the study include potential inaccuracies in self-reported history and adjustments were not made for potential confounds.

430.059 *(Poster)* Risk Correlates of Anxiety Symptoms in Three- to Five-Year-Old Children with and without Autism Spectrum Disorder

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Background: Individuals with ASD are at a significantly higher risk of developing co-occurring anxiety symptoms and diagnosable anxiety disorders compared to typically developing (TD) peers (Leyfer et al., 2006; Simenoff et al., 2008). However, because most studies focusing on anxiety in young children with ASD begin at age 5 or 6, less is known about the manifestation of anxiety in early childhood. Identifying variables associated with risk for anxiety earlier on may inform prevention and intervention efforts. A number of factors have been found to be associated with anxiety across ASD and TD populations, including behavioral inhibition, emotion dysregulation, and IQ (Bellini, 2006; Berkovits et al., 2017; Hallett et al., 2013). Among children with ASD, ASD symptoms (especially restricted and repetitive behaviors – RRBs) and communication skills have also been linked with anxiety (Kerns et al., 2014; Sukhodolsky et al., 2008).

Objectives: To examine child characteristics (i.e., behavioral inhibition, emotion regulation, IQ, communication, and ASD symptoms) associated with anxiety in children with ASD and in an age-matched TD comparison group.

Methods: Participants in our study included 61 children with ASD (M_{age}=4.46 years, 80.3% male, M_{IQ}=65.86, 72% comorbid ID), and 42 age-matched TD children (M_{age}=4.39 years, 42.9% male, M_{IQ}=105.86). Families in the ASD group were recruited as part of a larger clinical trial examining the efficacy of a stress-reduction intervention for parents of children with ASD. Measures included parent-report questionnaires (Spence Preschool Anxiety Scale, Behavioral Inhibition Questionnaire, Emotion Regulation Checklist Lability/Negative subscale, Repetitive Behavior Scale Revised (RBSR)) and clinician-administered assessments (Stanford-Binet 5, Vineland-3 Communication Domain). The RBSR and Vineland-3 were only administered to caregivers of children with ASD.

Results: We conducted linear regression analyses within each diagnostic group to determine which variables were unique predictors of anxiety symptoms on the SPAS. In the group with ASD, the following variables emerged as unique predictors of anxiety: RRB (β=.32, p<.01) and the Vineland-3 communication domain (β=.32, p<.01). IQ, emotion dysregulation, and behavioral inhibition were not unique predictors of anxiety in the group with ASD (ps>.05). In the group with TD, behavioral inhibition was the only unique predictor of anxiety (β=.54, p<.001).

Conclusions: This study sought to identify unique predictors of anxiety symptoms in a preschool-aged sample with and without ASD. It is noteworthy that the behavioral inhibition total score uniquely predicted anxiety in children with TD but not in children with ASD. Post-hoc analyses of behavioral inhibition in the group with ASD revealed that situational inhibition significantly predicted anxiety (p<.01), whereas the social inhibition subscale did not. Furthermore, results in the sample with ASD suggest that those with *fewer* deficits in communication and more repetitive behaviors are at a higher risk for anxiety symptoms, consistent with the existing literature (Davis III et al., 2011; Spiker et al., 2012). Gaining a better understanding of risk correlates of anxiety during early childhood can inform prevention and intervention for this at-risk population. Future analyses will examine correlates of DSM-5 anxiety disorders in our sample and will address the potential role of demographic and parenting factors.

430.060 *(Poster)* Shared ASD and ADHD Risk Alleles Can Contribute to Positive and Negative Polygenic Association Patterns with Educational Attainment

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Background: Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) are genetically complex neurodevelopmental disorders that often co-occur. Besides some shared genetic aetiology, both conditions display apparent differences in their genetic architectures, especially in their genetic overlap with educational attainment. While increased polygenic ADHD risk has been linked to lower cognitive abilities/educational attainment, increased polygenetic ASD risk has been associated with higher scores. These association patterns could either indicate independently acting genetic factors or complex pleiotropic, mediating or confounding mechanisms that result in different directions of polygenic effects across shared loci.

Objectives: Improve our understanding of shared genetic aetiologies between ASD, ADHD and educational attainment by investigating how educational attainment-related polygenic variation is encoded within ASD and ADHD genetic architectures.

Methods: Using a multivariable regression (MVR) framework and genome-wide association study (GWAS) summary statistics, we jointly modelled the association of ASD- and ADHD-related SNP estimates with educational-attainment-related SNP estimates, across selected variants. This translates a causal modelling approach into a multivariate polygenic context, without making causal inferences. Instead, we can dissect polygenic associations between each disorder and educational attainment into either ASD-specific or ADHD-specific associations, conditional on shared ASD/ADHD cross-disorder effects. We obtained (predominantly) European descent GWAS statistics from large consortia (Psychiatric Genomics Consortium, Lundbeck Foundation Initiative for Integrative Psychiatric Research, Social Science Genetic Association Consortium), including two clinical ASD samples (N=10,610 to 32,985), a clinical ADHD (N=37,076) and a years-of-schooling (N=766,345) sample. Variants were selected at different thresholds (P_{thr}<0.05 and P_{thr}<0.0015) from ASD or ADHD GWAS statistics. Corresponding SNP estimates were extracted from ASD, ADHD and years-of-schooling GWAS statistics. MVR effects are reported as changes in genetically predictable years-of-schooling per log-odds ADHD liability and log-odds ASD liability.

Results: Our findings show that polygenic links with educational attainment are shared between ASD and ADHD, involving overlapping loci. However, at these sites the same risk-increasing alleles, irrespective of whether they were selected to increase ASD or ADHD risk, gave rise to both positive and negative polygenic association patterns with educational attainment, solely depending on the assigned SNP estimate. For example, ASD risk-increasing alleles selected at P_{thr}<0.0015 (N_{SNPs}=1973), showed a 0.009 increase (SE=0.003) in years–of-schooling per log-odds ASD liability. Conditionally, the same alleles captured a 0.029 decrease (SE=0.004) in years-of-schooling per log-odds ADHD liability. Likewise, ADHD risk-increasing alleles (P_{thr}<0.0015, N_{SNPs}=2717) showed an inverse ADHD-specific association with educational attainment (β=-0.012(SE=0.003)), conditional on ASD-related positive cross-disorder effects (β=0.022(SE=0.003)). These findings were confirmed at the relaxed variant selection threshold (P_{thr}<0.05), and replicated when modelling ASD SNP effects from independent ASD GWAS statistics. MVR effect sizes increased when variants were restricted to markers associated with both ASD and ADHD.

Conclusions: Different combinations of the same risk-increasing alleles, including alleles that increase both ASD and ADHD risk, can reveal opposite association patterns with educational attainment. This suggests pleiotropic mechanisms, where individual alleles can contribute to multiple independent polygenic effects without involving distinct sets of loci. The observed inverse association patterns across shared loci may affect the detectable net genetic overlap between ASD and ADHD.

430.061 *(Poster)* Sleep Disruptions in Individuals with 16p11.2 Copy Number Variants

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Background: Sleep disruptions are significantly more common in individuals with autism, with difficulty falling asleep being the most frequently reported concern. Poor sleep is associated with reduced quality of life measures in affected individuals as well as family members. Interestingly, the disrupted sleep phenotype appears consistent across multiple genetic animal models of autism, including 16p11.2 copy number variations (CNVs). Mouse models of 16p11.2 microdeletion demonstrate decreased sleep efficiency, decreased total sleep time, and decreased REM sleep compared to wild-type litter-mates. Furthermore, this disrupted sleep phenotype appears to be present only in male mice. Despite the importance of sleep in early development, there are currently no published studies on sleep in humans with 16p11.2 CNVs.

Objectives: This is the first study to characterize sleep disruptions in individuals with 16p11.2 deletions and duplications.

Methods: As part of a pilot study, participants from the Simons Variation in Individuals Project (Simons VIP) were recruited at the 2019 16p11.2-CNV family conference in Denver, Colorado. All individuals completed the Pittsburgh Sleep Quality Index (PSQI) questionnaire. The PSQI is a 19-item self-report questionnaire, widely used for sleep assessment across clinical and research settings. It has good internal consistency, test-retest reliability, and diagnostic validity. Institutional Review Board (IRB) approval was received from Columbia University Medical Center, and informed consent was obtained from all participants prior to participation.

Results: Our pilot sample includes 11 individuals, 6 of whom are 16p11.2 duplications carriers (3 females, 3 males) and 5 with 16p11.2 deletions (3 males, 2 females). The duplication group reported a mean sleep latency of 14 minutes, whereas the deletion group reported a clinically significant mean of 55 minutes to fall asleep. This between group finding approached statistical significance, $F(1,9)=3.88$, $p=0.0804$. Consistent with prior mouse models, this finding appears specific to males, with mean sleep latency of 88 minutes (SD=33) for male deletion carriers compared to a mean latency of 5 minutes (SD=0) for female deletion carriers. Duplication with a larger sample size is necessary for adequate statistical power. Further analyses will also examine specific sleep-related concerns and total PSQI scores across groups.

Conclusions: This is the first study to examine sleep disruptions in humans with 16p11.2 copy number variants. Our initial findings support prior animal data and stress the importance of further work in this population. Interpretations are limited due to the small sample size but strongly suggest an effect of male gender on sleep in 16p11.2 microdeletions. It is important to better understand sleep-related genotype-phenotype correlations, given the prevalence of sleep disruptions in developmental disorders and their impact on quality of life. We hope to bolster our pilot findings with larger sample sizes and objective sleep measures going forward.

430.062 *(Poster)* Sleep Timing Contributes to Short Sleep Duration in Adolescents with TD but Not ASD

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Background: Sleep problems are common for children with autism spectrum disorder (ASD), though little is known about shifts in sleep patterns that may accompany puberty and adolescence (Goldman et al., 2017). Among typically developing (TD) adolescents, sleep is referred to as 'the perfect storm'—reflecting bioregulatory (e.g., circadian phase) and psychosocial (e.g., academic) pressures that delay bedtimes. Societal pressures, including school start times, also force adolescents to wake-up earlier (Carskadon, 2012). It is unclear whether adolescents with ASD follow a similar sleep timing pattern, ultimately leading to shorter sleep.

Objectives: To elucidate sleep patterns for adolescents with ASD vs. TD, as well as characterize developmental shifts in sleep timing from school-age to adolescence.

Methods: Participants included 45 children and adolescents with ASD (n = 29; M_{age}= 12.52; 62% male) and TD (n = 16; M_{age}= 12.40; 44% male). Parents completed the Yale Developmental Sleep Questionnaire (YDSQ), a tool designed to capture sleep behaviors/patterns in individuals with developmental disabilities. Mann-Whitney tests and regression analyses were used to explore sleep differences in ASD vs. TD. Children were separated into developmental stages using age-related cutoff's consistent with the *American Academy of Sleep Medicine's* (AASM) pediatric sleep guidelines: School-Age (6-12; n=23) and Adolescence (13-18; n=22).

Results: Sleep onset latency was significantly longer in ASD (*Mdn*=20) compared to TD (*Mdn*=10), U=60.50, p=.002, r=0.48. Developmental trends in sleep are described below and in Table 1.

School-Age: Nighttime sleep was not significantly different at school-age for ASD (*mdn*=555.0) vs. TD (*mdn*=590). All children slept at least 9 hours per night, which is developmentally appropriate according to the AASM.

Adolescence: In contrast, teens with TD (*mdn*=476.50) slept significantly less than those with ASD (*mdn*=537.50), U=10.00, p=.008, r=0.59. Differences were driven by later bedtimes (*mdn*=10:00pm) and earlier rise times (*mdn*=6:00am). TD adolescents who used electronics at bedtime slept for roughly one hour less than non-device using TD peers and all adolescents with ASD, b=-.60, $p < .05$, R^2=.51. Developmental shifts toward later bedtimes, earlier rise times, and less sleep were evident in TD but not ASD.

Conclusions: Preliminary findings are consistent with pubertal shifts in circadian phase associated with naturally later bedtimes, extra-curricular activities that delay homework/bedtime, and increased bedtime autonomy in TD. Short sleep duration arises from diminished sleep opportunity, occurring when adolescents go to bed later but continue to wake early for school. Variable weekday to weekend rise times reflect TD adolescents' biologically driven sleep patterns when un-restricted by school start times, as well as recovery from sleep debt accumulated on school-nights (Carskadon, 2004).

Longer sleep for adolescents with ASD could reflect various combinations of ASD-specific, contextual, and biological factors. Earlier bedtimes mirroring those at school-age could reflect ASD traits associated with more rigid bedtimes or higher parental control of sleep timing. Reduced participation in extra-curriculars, decreased social use of electronics, and biological differences could also explain these results. Data collection is ongoing and final analyses will include a larger sample of adolescents. Future research should utilize actigraphs to more accurately capture sleep patterns in adolescence.

430.063 *(Poster)* Testing Mediators of the Link between the Broad Autism Phenotype and Mental Health: Intolerance of Uncertainty and Friendship Quality

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Background: Compared to the typically developing population, people with autism (autism spectrum disorder) are at much greater risk for having a comorbid mental health diagnosis; particularly anxiety and/or depression (Hollocks, et al., 2019). Likewise, high levels of subclinical features of autism, termed the Broad Autism Phenotype (BAP), are also associated with greater endorsement of depression and anxiety symptoms. Although some evidence points to intolerance of uncertainty (Boulter, et al., 2014) and poor friendship quality (Mazurek, 2013) as potential contributors to mental health concerns in adults with autism, no research to date has taken a broader lens to explore these as mediators between the BAP and mental health.

Objectives: The present study aimed to 1) replicate support for the mediating effect of intolerance of uncertainty on mental health outcomes and extend these findings by examining the BAP, 2) explore friendship quality as a potential mediator between BAP and mental health outcomes.

Methods: 181 college students aged 18-25 (M=18.74) completed measures assessing the BAP (BAPQ; Hurley, et al., 2007), intolerance of uncertainty (IUS; Carleton, Norton, & Asmundson, 2007), friendship quality (FQ; Baron-Cohen & Wheelright, 2004), depression (CES-D; Radloff, 1977), and anxiety (STAI Trait subscale; Spielberger, 1983). R version 3.5.1 was used to estimate direct effects of the BAP on mental health (CES-D and STAI) and indirect effects through intolerance of uncertainty (IUS) and friendship quality (FQ). Bootstrapped confidence intervals were used to interpret indirect effects.

Results: Bivariate pearson correlations revealed greater levels of BAP were associated with higher reports of anxiety, depression, intolerance of uncertainty, and lower friendship quality (Table 1). Mediation analyses indicated significant indirect effects of BAP symptoms to both anxiety (b=4.19, CI: 2.62-6.13) and depression (Figure 1: b=3.41, CI: 2.08-4.88) through intolerance of uncertainty. While there was evidence for full mediation for depression symptoms (i.e., non-significant direct effect from BAP to depression, Figure 1: b=2.14, p=0.14), the effect for anxiety was only partially mediated (i.e., significant direct effect from BAP to anxiety, b=7.47, p<.001). In contrast, although friendship quality was negatively related to BAP, it did not emerge as a significant mediator of the association between BAP and neither depression nor anxiety.

Conclusions: Findings from the present study revealed that intolerance of uncertainty, but not friendship quality, accounted for the association between BAP and mental health outcomes in a sample of college students. This may highlight that individuals with more BAP symptoms are predisposed to greater intolerance of uncertainty, which has implications for mental well-being, especially depression. Surprisingly, friendship quality did not play a mediating role in this association, suggesting that friendship quality does not seem to directly determine mental health outcomes; future work may seek to test whether this link holds true for some, but not all, adults on the spectrum. Given the added burden of living with a comorbid depression and/or anxiety diagnosis, understanding factors that might link symptoms of autism and mental health outcomes has implications for treatment avenues and bolstering quality of life for people with high levels of BAP and adults with autism.

430.064 *(Poster)* The Association between Somatic Comorbidity and Autism Among Discordant Twins—a Nationwide Population-Based Twin Study

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Background: Individuals with autism have higher prevalence of co-occurring somatic disorders than the general population, including immune dysregulation, gastrointestinal (GI) problems, and neurological problems. It suggests the possibility of an underlying genetic and/or environmental perturbation affecting multiple systems that might lead to both somatic disorders and autism. However, except some specific genetic disorders and the current findings of gene pleiotrophy, there is still little information regarding the relationships between somatic comorbidity and autism diagnosis or autistic traits.

Objectives: This study aimed to use a Swedish nationwide population-based twin cohort and co-twin control design, which has the advantage of well-controlled genetic background and other important shared confounders, to investigate if somatic comorbidity is involved in the etiological mechanism of autism symptoms.

Methods: A total of 16,125 twin pairs from the Child and Adolescent Twin Study in Sweden (CATSS) were included for analysis in this study (mean age 9.72 ± 1.21 yrs). The participants with autism diagnosis and the diagnose of any medical problems were identified by the International Classification of Diseases (ICD) codes through the Swedish National Patient Register (NPR). Among them, 56 pairs of monozygotic (MZ) twins and 352 pairs of dizygotic (DZ) twins discordant for autism diagnosis were identified. The ASD module in the Autism–Tics, ADHD and other Comorbidities inventory (A-TAC) was used to quantify the participants' autistic traits. The differences of somatic comorbidity among twins with autism and non-autism twins were examined. The somatic disorders identified with significant within-pair differences were then tested in relation to autistic traits in both MZ and DZ twin pairs quantitatively discordant for autism, which was defined as at least 1 point (SEM) for the intra-pair difference of ASD module score.

Results: In the whole sample analysis, the twins with autism have more infectious diseases, neurological problems, GI symptoms, and immunological dysregulation compared to non-autism twins. In addition, GI symptoms are associated with autism for both categorical diagnosis and dimensional traits, while infectious diseases and neurological problems are only associated with the severity of autistic traits. For the MZ twins quantitatively discordant for autism, the intra-pair differences of neurological problems and infectious diseases are significantly correlated with the differences of ASD module score ($r = 0.18$, $p < 0.001$, and $r = 0.08$, $p = 0.008$, respectively). However, with the conditional model for within-pair effect analysis, there is only significant association between neurological problems and ASD module score ($\beta = 0.49$, $p = 0.003$) after adjusting for ADHD and intellectual disability.

Conclusions: Our findings suggest that neurological problems could be considered as a non-shared environmental factor for MZ twins discordant for autistic traits. It may suggest that the synergic effects of organic neuropathy on a specific genetic background may compound autistic traits. On the other hand, infectious diseases and GI symptoms are also associated with autism, while might not be involved in the biological pathways. To aware these somatic comorbidities and provide adequate management is of paramount importance for clinicians working with individuals of autism.

430.065 *(Poster)* The Effect of Comorbid Anxiety and ADHD on Adaptive Functioning Among Autistic Youth in a Clinic-Referred Sample

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Background: Research indicates that approximately 40% of youth with autism have at least one comorbid anxiety disorder (van Steensel, Bögels, & Perrin, 2011) and 30–85% have comorbid Attention Deficit-Hyperactivity Disorder (ADHD). Anxiety and ADHD are thought to exacerbate core autism symptoms (Duvekot, Ende, Verhulst, & Greaves-Lord, 2017; Leitner, 2014; Renno & Wood, 2013), particularly within the social domain. One recent study of adaptive behavior showed that ADHD symptoms among youth with autism were associated with poorer communication, socialization, and daily living skills (Yerys, Bertollo, Pandey, Guy, & Schultz, 2019).

Objectives: To examine the relation between anxiety and ADHD symptoms and adaptive functioning among autistic youth.

Methods: Twenty-five youth with autism (ages 6–18) were included in this study. The sample was drawn from a clinic database nested in an academic medical center setting. All participants met cutoffs for autism on the *Autism Diagnostic Observation Schedule, 2nd Ed.* (*ADOS-2;* Lord et al., 2012). Parent report of autism symptoms (*Social Responsiveness Scale, SRS*; Constantino & Gruber, 2002), anxiety and ADHD symptoms (*Child Behavior Checklist, CBCL*; Achenbach & Rescorla, 2001), and adaptive behavior (*Vineland Adaptive Behavior Scales, VABS*; Sparrow, Balla, & Cicchetti, 2005) were obtained. Raw scores and empirically validated indices from the SRS were used, as is recommended (Constantino & Gruber, 2012; Frazier, Georgiades, Bishop, & Hardan, 2014; Frazier et al., 2012).

Results: Pearson's correlations demonstrated negative associations between adaptive functioning and autism, anxiety, and ADHD symptoms (Table 1). Namely, the Social Communication Index (SCI) on the SRS was negatively associated with the Socialization domain and the Coping Skills subdomain on the VABS. The Repetitive Behavior Index (RBI) on the SRS was negatively associated with the Receptive subdomain on the VABS. The Anxiety Problems subscale on the CBCL was negatively related to the Receptive subdomain on the VABS, while the ADHD Problems subscale on the CBCL was negatively related to the Socialization domain and the Receptive and Coping Skills subdomains on the VABS. After partial correlations were used to control for SRS SCI and RBI, results showed no significant associations between the CBCL Anxiety or ADHD Problems subscales and the VABS (Table 2).

Conclusions: Findings from the present study demonstrate that autism symptoms explain elevations in adaptive functioning, not comorbid anxiety or ADHD. It is important to note, however, that some evidence suggests the SRS may be artificially inflated in the presence of comorbid symptoms (e.g., McVey et al., 2018). Therefore, interpretation of the original correlations was included and may suggest poorer adaptive functioning for autistic youth with anxiety or ADHD. These findings point to the importance of understanding links between autism, mental health comorbidities, and adaptive behavior in order to best address these challenges in youth to promote better quality of life in adulthood.

430.066 *(Poster)* The Effects of Emotional Control on the Relationship between Social Anxiety and Aggression in ASD

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Background: Children with autism spectrum disorder (ASD) are at elevated risk for aggression (Kanne & Mazurek, 2010) and social anxiety (White & Roberson-Nay, 2009). Previous work has found emotion dysregulation predicts aggression in typically developing populations (Röll et al., 2012; McLaughlin et al., 2011), and there are correlations between social anxiety, physical aggression and anger control in ASD (Gaye Ambler, Eidels, Gregory, 2013). Evidence suggests social anxiety may precipitate aggression due to challenges in emotion regulation abilities (i.e., difficulties in regulating social anxiety in typically-developing youth when in social context may lead that anxiety to manifest as aggression as an escape mechanism; Aldao et al., 2016; Dixon et al., 2016; Kasdan et al., 2009; Kunimatsu & Marsee, 2012; Mazefsky et al., 2013). However, the role of emotion regulation in the relationship between social anxiety and aggression in ASD has rarely been explored.

Objectives: To determine whether emotion regulation partially explains the relation between social anxiety and aggression in children with ASD.

Methods: Participants included 133 individuals (see Table 1) with an IQ ≥ 70; 65 children met criteria for ASD based on the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2012) and prior history of diagnosis. Parent-reported aggression and emotion control and child-reported social anxiety was collected (see Table 1). Two hierarchical multiple regressions were performed with social anxiety (step 1) and emotion control (step 2) predicting aggression in the ASD and non-ASD group.

Results: In the ASD group, social anxiety predicted aggression (Table 2a). However, when emotion control was added, social anxiety no longer predicted aggression, but emotion control did. In the non-ASD group, social anxiety did not predict aggression (Table 2b). When emotion control was added, emotion control predicted aggression.

Conclusions: The current study found that emotion control partially explains the relation between social anxiety and aggression in children with ASD. This relationship has been previously theorized based on the relation between social anxiety and aggression in this population (Pugliese et al., 2013), but had not previously been tested. Furthermore, these findings mirror a study of non-ASD youth in which emotion dysregulation was found to predict aggression (Röll et al., 2012); however, this relationship did not explain any variance in the relationship between social anxiety and aggression (since no such relationship was found) in our non-ASD sample, suggesting the effect of interest in our models may be either unique or especially strong in ASD youth. Thus, emotion control may be a potential intervention target to reduce aggression among youth with ASD and elevated social anxiety. Given the cross-sectional nature of the current study, future work using longitudinal samples may clarify the direction and specificity of the relationship between aggression, social anxiety, and emotion control.

430.067 *(Poster)* The Nature and Impact of Executive Functioning in Mental Health Services for ASD: Perspectives from Mental Health Providers

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Background: Youth with autism spectrum disorder (ASD) have high rates of co-occurring psychiatric conditions, estimated at 70% versus 25% for other youth (Lai et al., 2019). Publicly-funded mental health (MH) services play a significant role in caring for school-aged youth with ASD. Yet, MH providers report limited ASD experience and knowledge (Brookman-Frazee et al., 2012). Youth with ASD in MH services have multiple co-occurring psychiatric conditions, including attention-deficit/hyperactivity disorder (ADHD), disruptive behaviors disorder, and anxiety. Executive functioning (EF) deficits play an integral role in both ASD and commonly co-occurring psychiatric conditions and increase MH symptoms in youth with ASD (Hill, 2004; Lawson et al, 2015). Little research to date has examined EF among youth with ASD receiving MH services. Research examining MH provider experience or knowledge of EF in ASD is also limited. Information from MH providers related to their knowledge and perceptions of EF deficits among youth with ASD receiving MH services is needed to inform efforts to improve MH treatment for ASD.

Objectives: The current study examined community-based MH provider's perspective regarding experience and knowledge of EF and the nature of EF deficits on MH services for youth with ASD.

Methods: Data were drawn from the first phase of a developmental study aimed to adapt and test an evidence-based EF intervention for children with ASD and co-occurring MH conditions for delivery in publicly-funded outpatient MH services. MH providers (n=42) were 83.3% female (M_{age} =32.45) and 45.2% Marriage and Family Therapists. Through a web-based survey, providers were asked about their perspectives regarding their experience and knowledge of EF, the nature of EF in youth receiving MH services, and the impact on MH services.

Results: Descriptive analyses indicated that 64% and 41% of providers report being *knowledgeable* about EF in MH conditions and the impact on EF-consistent behaviors (e.g., challenging behaviors, inflexibility) in youth on their caseload, respectively. Fewer providers (36%) reported being knowledgeable about EF specifically in ASD. Providers also reported *experience* with EF in MH conditions (55%) and EF-consistent behaviors (43%) but more limited experience with EF in ASD (31%). Providers reported that EF difficulties are more common in ASD (M=3.9, SD=2.4, Range 1-6) compared to other MH conditions (e.g., ADHD, disruptive behaviors; M=2.9, SD=1.9, Range 0-6). Difficulties with flexibility and emotion recognition and regulation were most common in ASD. Only 37% of providers reported EF as a target or focus of treatment for youth with ASD compared to 65% for other MH conditions.

Conclusions: These initial findings shed light on provider perceptions of EF deficits among youth with ASD served in MH settings. Results suggest that youth with ASD present with several EF difficulties, more than other with other MH conditions. Further, findings highlight potential targets for provider training, including further training in EF in ASD and addressing EF difficulties as a focus of MH treatment.

Rigor: This study is one of the first to examine provider perceptions of EF, a key factor in ASD, in MH services, a primary provider of services for youth with ASD.

430.068 *(Poster)* The Prevalence of Mental Health Conditions in Autistic Adults in a State Medicaid System

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Background: Mental health conditions are more prevalent in autistic adults compared to adults in the general population. Yet, differences between autistic adults and other developmental disabilities are less understood but have the potential to inform systems level treatment approaches.

Objectives: Our objective was to determine the prevalence of mental health conditions in adults with ASD compared to adults with intellectual disability in a large, single-state Medicaid fee-for-service sample. We then assessed group differences in number of co-occurring mental health conditions.

Methods: We assessed Medicaid claims from 2008-2018 for adults (≥21 years) who had two claims for autism spectrum disorder (ASD) or intellectual disability (ID) on two different days ever during their Medicaid enrollment. Mental health condition claims were extracted from codes from Center for Medicaid Studies Chronic Conditions Data Warehouse for depression, anxiety, bipolar disorder, schizophrenia, and personality disorders. We categorized our case groups into exclusive categories (ASD without ID, ASD with ID, ID). Mental health conditions were considered prevalent if a beneficiary had two or more claims for a mental health condition at any time in the period. We then created a variable to assess the co-occurrence of depression and anxiety. Finally, we created a count variable of co-occurring mental health conditions (range: 1-5) and tested group differences in number of co-occurring mental health conditions using an ANCOVA model adjusting for age and sex.

Results: In the 11-year period assessed, Wisconsin Medicaid had 4775 unique beneficiaries with ASD; 2738 with ASD with ID; and 18429 with ID. Overall, 65.2% of the ASD group, 70.9% of the ASD with ID group, and 48.5% of the ID group had a mental health condition. The most prevalent condition in all groups was anxiety (ASD: 48.5%; ASD with ID: 48.4% ASD: ID: 30.0%). The ASD group had the highest prevalence of depression (37.3%) with similar prevalence for the ASD without ID group (28.7%) and ID group (29.3%). Bipolar disorder was more prevalent in the ASD with ID group (37%) compared to the ASD group (27.4%). Schizophrenia was prevalent in 9.6% of the ASD group; 15.0% of the ASD with ID group; and 15.2% of the ID group. Personality disorders were similar in the ASD group (11.7%), ASD with ID group (13.0%), and the ID group (9.1%). Both depression and anxiety were prevalent in 27.8% of the ASD group; 20.2% of the ASD with ID group; and 18.5% of the ID group. Mean number of mental health conditions was 1.35 (SD=1.30) in the ASD group, 1.42 (SD=1.29) in the ASD with ID group, and 1.27 (SD=1.36) in the ID group, which differed significantly by group.

Conclusions: Autistic adults are likely to have co-occurring mental health conditions. Whether this is intrinsic to autism, clinician diagnostic tendency, a result of disparity, or a yet-to be determined etiology, appropriate treatment is critical. Based on the extent of mental health services, especially in the ASD groups, investment in prophylactic mental health treatment for this population may be a way to improve outcomes and costs for a Medicaid system.

430.069 *(Poster)* The Role of Weight, Shape and Pride in Eating in Autistic Women with Anorexia Nervosa

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Background: Anorexia Nervosa (AN) is a severe, restrictive eating disorder. It has consistently been found that 20-30 % of women in treatment for AN meet diagnostic criteria for autism spectrum disorder (Huke et al., 2013). AN is conventionally understood as being driven by weight and shape concerns, and research has suggested that pride in the ability to control eating and restrict food intake plays a significant role in the maintenance of AN (Skåderud, 2007; Faija et al., 2017). Our previous qualitative research, interviewing autistic women with AN, their parents and clinicians, suggests that these fundamental AN traits may be less apparent in autistic individuals, with their eating difficulties instead often stemming from their autism. Therefore, there may be an autism-specific profile of AN, which differentiates autistic women from typical AN presentations.

Objectives: The current study aims to assess the presence of typical AN behaviours (1) weight and shape concerns and (2) pride in the ability to restrict and control eating, in AN women both with and without autism, as well as in an autistic group without AN.

Methods: The current study compares three participant groups: autistic women with AN; autistic women without AN; and non-autistic women with AN. We plan to recruit 135 participants in total (45 per group), and at the time of writing have recruited more than 25 participants. Participants complete two implicit association tests (IAT; Greenwald, McGhee & Schwartz, 1998) measuring weight and shape concerns and the thin ideal internalisation. These factors are most commonly measured using self-report questionnaires, which can be susceptible to social desirability biases and impression management. Using the IAT measures allows us to disentangle these biases. In addition, participants complete a battery of self-report questionnaires related to weight and shape concerns and pride in eating disordered behaviours. We also measure general autistic and eating disorder traits and potential confounders, such as Body Mass Index, anxiety, depression and IQ. Advisors from the autistic community were consulted when developing the study protocol.

Results: Data is currently being collected and preliminary results will be presented. We hypothesise that autistic women with AN will demonstrate lower levels of weight and shape concerns and pride in eating than the non-autistic women with AN, but that autistic women without AN will show the lowest levels. To test these hypotheses, a one-way ANOVA will be used.

Conclusions: Current AN treatments and care pathways often target body image and concerns with weight and shape, but this could be unhelpful or even detrimental to autistic women's engagement with services, if these factors are not actually underlying their eating difficulties. This study will improve our understanding of AN presentations in autistic individuals and how this might differ from other women with AN. This will help eating disorder services to improve the way they engage with and treat autistic individuals.

430.070 *(Poster)* Unique Perspectives: Understanding Depression in Early Adolescents with and without Autism Spectrum Disorder through Self- and Parent-Reports

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Background: Depressive symptoms are common in adolescence and Autism Spectrum Disorder (ASD). Older adolescents with ASD endorse elevated severity as compared to typically-developing peers, but less is known about depression in early adolescence. Severity may vary by age in older adolescence, but the literature appears mixed for early adolescence. Additionally, differences in adolescent and parent perspectives have been documented. Therefore, it is essential to understand depression from both perspectives to improve conceptualization and intervention.

Objectives: The present study examined self-reported depression in early adolescents with and without ASD on the Children's Depression Inventory, 2nd edition (CDI-2; Kovacs, 2014). Additionally, depression ratings across early adolescents and their parents were compared to identify distinct perspectives, particularly in the ASD group.

Methods: The total sample (N = 230) included early adolescents with ASD without intellectual disability (FSIQ≥70; n = 133) and of typical development (TD; n = 97) who participated in the first year of a longitudinal study of pubertal development in ASD (PI: Corbett, MH111599). Participants were between 10:00-13:5 years old (M = 11.5, SD = 1.11) with 155 males (ASD = 99, TD = 56) and 75 females (ASD = 34, TD = 41). Depression was reported by early adolescents on the CDI-2 and by parents on domains of the Child Behavior Checklist (CBCL). Independent samples *t*-tests were employed to examine CDI scores between early adolescents with and without ASD and CBCL scores between parents in the ASD and TD groups. Intraclass correlation coefficients (ICC) were calculated for T-scores from the CDI-2 Total and CBCL Affective Problems to examine reliability between raters (early adolescent vs. parent) on depression. Additionally, Cohen's κ was calculated to estimate strength of agreement between raters on the ordinal categories of depression severity.

Results: Significant group differences emerged between early adolescents with and without ASD on the CDI for Total depression (p<.01), Emotional Problems (p<.01), and Functional Problems (p<.01) as those with ASD endorsed higher severity. Similarly, significant group differences emerged between parents on the CBCL in Internalizing Problems (p<.01), Depressed/Withdrawn subscale (p<.01), and Affective Problems (p<.01) as parents in the ASD group reported higher severity. In terms of reliability between raters (early adolescent vs. parent), ICC analyses revealed a significant, but "poor" reliability (ICC = 0.293, p<.01) between raters in the TD group, yet reliability between raters in the ASD group was nonsignificant. Furthermore, Cohen's κ analyses revealed a significant, "slight" agreement (κ = 0.132, p<.01) between raters in the TD group on depression severity, yet raters in the ASD group exhibited a nonsignificant level of agreement.

Conclusions: In this study, early adolescents with ASD endorsed greater depression severity than their typically-developing peers, which was both statistically significant and clinically meaningful. This finding was supported by elevated ratings among parents in the ASD group on a similar index of depression. However, discrepancies in severity ratings between early adolescents with ASD and their parents highlights the need for multiple perspectives. Furthermore, findings emphasize multi-informant assessment as an important method in conceptualizing and treating depression in this group.

430.071 *(Poster)* Update on the Effectiveness of Cognitive Behavioural Therapy Treatments for OCD in Individuals with ASD

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Background: Obsessive compulsive disorder (OCD) is prevalent amongst individuals with autism spectrum disorder (ASD), with estimates of up to 37% (van Steelsel et al, 2011; Kent and Simonoff, 2017). Despite this, limited research has been dedicated to developing or evaluating treatments for OCD in ASD specifically; rather, most treatment studies have subsumed OCD under the category of anxiety disorders. Nonetheless, since OCD was distinguished from the anxiety disorders in DSM-V, more OCD-specific treatments for children with ASD are emerging in the literature.

A previous systematic review conducted in 2014 identified three pharmacological studies and one behavioural analysis and modification study as probably efficacious, but no cognitive behavioural therapy (CBT) treatments (despite its status as a well-established treatment for OCD in individuals without autism; APA Presidential Task Force on Evidence-Based Practice, 2006). Since then, a number of studies have been published examining the efficacy of psychosocial treatments for OCD in individuals with ASD. The current review is an update to Neil & Sturmey's (2014) review, using Chambless & Hollon's (1998) criteria to evaluate the efficacy of CBT treatments for OCD in individuals with ASD.

Objectives: The purpose of this review is to critically evaluate the current evidence base for the efficacy of CBT for OCD in individuals with ASD, and to provide recommendations for future research.

Methods: Studies were selected from two previous reviews (Neil and Sturmey, 2014, and Kose et al, 2018), along with a more recent PsychINFO search to include new findings. This search yielded 25 studies that were included in this review. Chambless and Hollon's (1998) criteria were applied to evaluate studies and classify treatments as possibly efficacious, probably efficacious, or well-established, based on the standards of independent replication, methodological rigor, and representativeness of studies.

Results: The present review identified 16 CBT programs for OCD in individuals with ASD that have been evaluated in case reports (13 studies), open trials (6 studies), and randomized control trials (6 studies). Most studies included a good representation of sex, but many did not report ethnicity or socio-economic status. As was found by Neil & Sturmey (2014), no treatment to date meets well-established or probably efficacious criteria. However, two new treatments have emerged in the last four years that have demonstrated promising efficacy and meet possibly efficacious criteria. Of these treatments, a newly-developed functional behaviour-based CBT demonstrated superiority to treatment as usual, and an adapted CBT for individuals with ASD demonstrated superiority to an anxiety management program. For both treatments, comparison to an established alternate treatment and replication by independent research groups is needed for these treatments to be considered well-established.

Conclusions: Though there are still no well-established treatments for OCD in individuals with ASD, attention to this area of treatment research is growing and two new treatments show promise. In general, more RCTs are needed comparing CBT for OCD to alternate treatments in individuals with ASD, as well as multi-site replication of studies examining treatment efficacy.

430.072 *(Poster)* Weight Status and Lipid Profile in Children with Autism Spectrum Disorder

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Background: Pediatric overweight (OWT) and obesity (OBY) are significant public health concerns reaching a prevalence of up to 32% of children and adolescents in developed countries. Little is known about the prevalence and correlates of OWT and OBY among children with autism spectrum disorder (ASD). Although many risk factors for unhealthy weight are the same in ASD patients as in general pediatric population, children with ASD may have additional risk factors. ASD children may present eating disturbed behaviors such as food selectivity; they have less regular physical activities, often take psychotropic medications that can cause weight gain and may present several clinical comorbidities such as anxiety, depression, gastrointestinal problems and sleep disturbances, each one of those potentially predisposing to obesity.

Objectives: Evaluate the weight status and lipid profile in ASD children comparing to healthy controls subjects.

Methods: A comparative cross-sectional study was performed with 236 children diagnosed with ASD (118 classified into mild/moderate and 118 classified into severe autism), and 236 healthy controls. The diagnosis of ASD was confirmed by the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-V) and the severity was assessed by the Childhood Autism Rating Scale (CARS). Measured values for weight and height were used to calculate body mass index (BMI) percentiles while lipids profile (Cholesterol, triglycerides, LDL-C, HDL-C and medication data were reviewed form the medical records.

Results: Obesity was significantly higher among autistic children when compared to healthy controls (16,5% in healthy controls, 28% in mild/moderate and 29,7% in severe autistic patients). Total cholesterol levels, however, were significantly lower in severe ASD children (157,20 ± 27,07 mg/dL) when compared to healthy controls (165,95 ± 38,80 mg/dL). Overall almost 30% of ASD children met the criteria for OBY which was associated with medication use specially neuroleptics. Interestingly, lipid profile did not correlate with BMI in ASD affected population corroborating previous studies indicating hypocholesterolemia as a common feature among autistic patients. Cholesterol has multiple biological functions, some of which could plausibly contribute to ASD. Cholesterol is an important building block for the body's cell membranes and myelination of the central nervous system, it modulates oxytocin receptor function and participates in serotonin function pathways.

Conclusions: The results of this study reinforces the importance of the investigation of anthropometric data in ASD patients among with its clinical and laboratorial correlates with implications in pathophysiological investigation and treatments.

Molecular Genetics

ORAL SESSION — **MOLECULAR GENETICS**
321 - Molecular Dissection in Autism

321.001 *(Oral)* Transcriptomic Alterations Involving Synapse Maturation, Axon Guidance and MAPK Signaling Implicate Activity-Dependent Dysfunction of Isolated Purkinje Cells in the Postmortem Autism Brain

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Background: There is growing consensus that the cerebellum has a major role underlying autism phenotypes. This is mainly due to the consistent neuropathological findings of reduced Purkinje cell (PC) number and altered molecular profile in autism, as well as differences found in imaging studies. PCs have abundant spines, which modify their shape and function in response to stimuli and have been shown to be involved in cerebellar motor learning. In autism, many of the genes implicated by genome wide association studies (GWAS) affect synaptic stability and adhesion molecules. Since PCs have hundreds of thousands of synapses, making their dendritic branching the most complex in the brain, mutations in synaptic proteins may be particularly detrimental to PC signaling and survival and could provide a mechanism behind the PC alterations reported in human postmortem autism studies.

Objectives: To determine differences specifically in the transcriptomic profile of Purkinje cells in postmortem autism brain compared to neurotypical controls.

Methods: Age-matched brain tissue was obtained from the University of Maryland Brain and Tissue Bank. Twenty autism and nineteen control fresh frozen human lateral hemisphere (crus II) cerebellar sections were cut at 8µm onto membrane slides and briefly fixed in 75% ethanol, dipped into RNase free water, exposed to a rapid Cresyl violet solution and placed in a series of alcohols for dehydration. A Zeiss PALM MicroBeam laser capture microdissection system was used to outline PCs by morphology and cerebellar architecture and lift them from the slide to isolate ~1,500 PCs per case from the surrounding cerebellar tissue. The cells were lysed and RNA extraction performed with a Qiagen RNeasy Micro Kit. The resulting total RNA was prepped for sequencing with the NuGEN Ovation SoLo RNA-Seq system and sequenced in single end 100bp reactions on the Illumina NovaSeq 6000 generating ~25M reads. Raw reads were aligned to the hg19 human reference genome and quantified using the STAR algorithm. Differential expression between autism and control samples were determined using DESeq2 adjusting for sex, age, post-mortem interval, and self-reported race.

Results: Overall, we identified 481 differentially expressed genes between autism and control PCs using a threshold of nominal p-value 0.05 and a fold change of +/- 1.5. This includes 57 genes upregulated and 424 downregulated in autism. There are no consistent molecular pathways overrepresented in the up-regulated genes. In contrast, the downregulated genes are over-represented for gene ontology biological processes related to synapse maturation (e.g. *NEUROD2, RELN,* and *DAB2IP*) and semaphorin-plexin guidance signaling (e.g. *NRP1, SEMA3C, SEMA4C, SEMA3B,* and *PLXNA2*). Furthermore, KEGG pathways including MAPK signaling and axon guidance are enriched in the downregulated genes.

Conclusions: Identification of altered gene expression in PCs of autistic individuals compared to controls is a critical step for understanding the complex pathobiology of autism. Our data implicate downregulation of genes involved in synaptic formation, axon extension, and MAPK signaling in PCs that likely result from activity-dependent alterations in pathways reliant on proper synaptic functioning.

321.002 *(Oral)* Genomic Analysis of 10,242 Individuals with Autism Spectrum Disorder (ASD) Recruited Online Identifies 161 Risk Genes and New Insights into the Genetic Architecture of Multiplex Families

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Background: Previous studies have identified ~100 high-confidence risk genes for autism spectrum disorder (ASD). However, modeling of *de novo* variants suggests that the majority of risk genes remain to be discovered. For simplex families, contributions from DNMs are well-established, but this is less clear in multiplex families. Moreover, the relative contribution of rare, inherited variants in either family context has yet to be fully elucidated.

Objectives: To accelerate gene discovery and genotypic-driven research and treatments in ASD, we created SPARK (Simons Foundation Powering Autism Research for Knowledge), and have recruited and collected DNA from 39,981 individuals with ASD in addition to many first degree family members, yielding the largest single collection of autism families to date.

Methods: We have performed exome sequencing and SNP genotyping on 28,757 individuals, including 10,242 with ASD.

Results: We analyzed single nucleotide (SNV)/indel and copy number variants (CNVs) in 6,574 offspring with ASD from 4,824 simplex and 1,080 multiplex families, their biological parents and 3,040 unaffected siblings. A small percentage of families already had a known genetic diagnosis (2.8%) related to their ASD, most of which were well-established CNVs associated with increased risk of ASD. We identified variants in genes and loci that are clinically recognized significant contributors to ASD in an additional 6.7% of families and nearly doubled the number of risk genes associated with ASD. We identified 251 large *de novo* CNVs, which occur at twice the frequency in probands as in unaffected siblings. We also performed a meta-analysis on 7,039 SPARK trios and 9,216 published ASD trios using *de novo* SNVs and indels with TADA. At a false discovery rate (FDR) of 0.1, we identified 161 candidate risk genes that harbor damaging *de novo* variants in ASD cases. Of these genes, 73 are newly discovered ASD candidates. These new candidate genes converge upon functional categories similar to those previously implicated in ASD, including RNA-binding (*HNRNPD, CAPRIN1*), transcriptional regulation (*PBX1, ZBTB45, ZC3H4, RFX8, BRF1, BRF2, INTS7, INTS2,TNPO3*), and neuronal communication (*GABBR2, DLL1, TANC2*). We found evidence supporting greater inherited contribution in multiplex vs. simplex families. Parents in multiplex families carry significantly more rare protein-truncating variants in constrained genes (ExAC pLI>=0.5) than parents in simplex families (rate=0.65 vs 0.60 per person, p=7.8e-3), and multiplex cases have significant contributions from both *de novo* and rare transmitted variants (population attributable risk (PAR)=14% and 7%, respectively), whereas simplex cases have a much higher contribution from de novo (PAR=18%) compared to transmitted variants (PAR=3%).

Conclusions: Genomic analysis of the SPARK cohort has led to the discovery of a substantial number of new genetic risk factors for ASD. We have also identified a greater inherited contribution of rare severe mutations in multiplex families compared to the more heavily studied simplex families. Further analyses of the SPARK dataset will contribute to a deeper mechanistic understanding of the pathways that are disrupted in ASD and enable research studies on rare genetic etiologies.

321.003 *(Oral)* 11,364 Whole-Genome Sequences in the Cloud for Autism Spectrum Disorder Research

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Background: Autism spectrum disorder (ASD) is a highly heterogeneous condition in both clinical presentation and genetic architecture. There are hundreds of loci associated with ASD, with multiple types of rare and common variation contributing to risk. To fully understand the genetic basis of ASD, whole-genome sequence (WGS) data are necessary, which theoretically allow the genome-wide detection of all sizes and types of genetic variants with base-pair resolution.

Objectives: Our objective is to build a WGS resource that allows researchers to better understand the relationships between genotype and phenotype in ASD-affected individuals.

Methods: We have developed MSSNG, a controlled-access resource that contains both WGS data and detailed phenotype data from individuals with ASD and their family members. Hosted on the Google Cloud Platform (GCP), MSSNG is accessible through a web-based portal (https://research.mss.ng) or, for advanced users, via GCP interfaces.

Results: The latest release of MSSNG, termed DB6, contains 11,359 genome sequences. Alignment data (GRCh38/hg38) are available in CRAM format, along with single nucleotide variants, small insertions/deletions, and mitochondrial variants. Additionally, we employed an accurate, previously-published workflow to detect copy number variants (CNVs), making MSSNG the only ASD WGS resource to make sample-level CNV calls available. The CNV data are fully integrated into the portal, allowing users to query by sample, gene, or genomic region and to filter by size, population frequency, and other attributes. Detailed CNV annotations are available, including overlap with genes, exons, and repetitive genomic regions, as well as disease-related annotations from CGD, ISCA, HPO/MPO, OMIM, and others. Users can also visualize CNVs via an Integrative Genomics Viewer browser plugin.

Compared to the previous release, DB6 includes more advanced querying capabilities, especially for phenotypes. Specifically, MSSNG includes detailed phenotype information for most affected individuals in the form of individual responses, subscale totals, and full totals on a variety of psychometric assessments (5,829 measures and growing). DB6 introduces new composite measures for Adaptive Behaviour, Socialization Scores, and General Ability that enable researchers to filter, group, and correlate by these traits without having to identify the relevant scores among the individual measures. Further, DB6 features a new data query and exploration tool that enables researchers to search by genotype and phenotype in a single query. Built atop Global Alliance for Genomics and Health (GA4GH) standards that allow querying across organizational boundaries seamlessly and securely, the data explorer provides researchers even more statistical power through connections to other databases built on the same standards.

Finally, to enable functional analysis of candidate variants, we have generated 66 iPS-derived neuronal cell lines from individuals with ASD and their familial controls, as well as another 25 lines using CRISPR modelling in an isogenic line, all available to qualified researchers upon request.

Conclusions: The Autism Speaks MSSNG project combines high-quality WGS data with detailed phenotype information to allow researchers to study the genetic architecture of ASD. WGS data generation is ongoing, and updates to MSSNG with increased sample sizes, along with additional types of information such as structural variants and epigenetic data, will be made regularly.

321.004 *(Oral)* Variation of hnRNP Encoding Genes and Shared Neurodevelopmental Disorders

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Background: With the number of genes implicated in neurodevelopmental disorders (NDDs), it is unlikely that each gene has a unique molecular pathomechanism. We hypothesize that variation in gene families results in shared clinical spectrums due to shared molecular pathology, which may allow for targeted therapies. We identified a gene family, the heterogeneous ribonucleoproteins (hnRNPs), a large family involved in RNA processing, as a family fitting our model, with significantly more *de novo* variants than expected among 10,927 NDD exomes.

Objectives: We aim to explore the impact of hnRNP variation in neurodevelopmental disorders and determine the molecular consequences of such variation.

Methods: We identified additional hnRNP-variation probands through targeted sequencing data from our Autism Spectrum/Intellectual Disability network (n = 16,377), exome data from the SPARK consortium (n = 6,499), clinical sequencing data generated by Baylor Genetics Laboratories (n = 9,536), collaborations through GeneMatcher and international collaboration (n = 15), exome data from GeneDx (n = 15,180), rare variants from Geno2MP (n = 10,892), as well as the literature (in total, 74,004). We identified 197 probands with variation in 13 hnRNP-encoding genes.

Human fetal transcriptomic data was generated from single cell RNA-seq (scRNA-seq) of cortex samples. Using Cas9 gene-edited induced pluripotent stem cells and differentiated neuronal and glial cells, we are investigating changes in cell viability/proliferation, neuronal morphology and activity, as well as hnRNP-specific functionality, including effects on splicing and expression, as well as RNA/protein trafficking.

Results: Our cohort has significantly higher burden of hnRNP variation compared to gnomAD (non-neuropsychiatric subset, n = 114,704), supporting their pathogenicity. Using two statistical models, three hnRNPs meet genome-wide significance ($p < 5x10^{-7}$) for likely gene disrupting (LGD) and/or missense variants, while and additional five meet nominal significance ($p < 0.05$). Clinically, we have found a shared spectrum of intellectual disability/developmental delay (78%), autism spectrum disorder (ASD, 35.6%), and MRI abnormalities (40.8%). ASD is significantly more prevalent with LGD variants ($p < 0.05$) and seen primarily among *HNRNPUL2* and *SYNCRIP* probands (62.5% and 61.5%, respectively).

scRNA-seq of fetal human cortex samples shows high levels of expression of these NDD-related hnRNPs among excitatory neurons, radial glia, ventral progenitor cells, and intermediate progenitor cells, with decreased expression among inhibitory and newborn neurons. This shared expression is notable, as hnRNPs are implicated in many processes, including neuronal development, and often work cooperatively. Molecular modeling has shown changes in expression of ASD-relevant genes as well as other functional impacts, such as changes in protein localization.

Conclusions: We show that the hnRNPs have clinical relevance for NDDs. Additionally, we have shown that it is effective and efficient to study gene families in order to expedite NDD research. Finally, we have determined some of the molecular characteristics of the hnRNPs as well as pathomechanisms of variation this gene family. These results will contribute to identifying shared, druggable targets that may have utility for NDD probands.

POSTER SESSION — **MOLECULAR GENETICS**

431 - Molecular Genetics Posters

431.001 *(Poster)* An Integrated Deep Mutational Scanning Approach Provides Clinical Insight on PTEN Genotype-Phenotype Relationships

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Background:

Germline *PTEN* variants lead to heterogenous clinical presentations including overgrowth and cancer predisposition syndromes collectively known as PTEN Hamartoma Tumor Syndrome (PHTS) as well as neurological presentations such as autism spectrum disorder, developmental delay, and intellectual disability (referred to here as ASD/DD). Despite decades of research, it remains unclear why certain *PTEN* variants lead to PHTS versus ASD/DD outcomes. Recently, a novel experimental paradigm known as deep mutational scanning (DMS) has been applied to PTEN. These data provide the biochemical effects of thousands of protein variants, which have been measured in parallel. For PTEN, two datasets were generated in which the lipid phosphatase activity (fitness score), or the general cellular abundance (abundance score) were empirically estimated for thousands of variants. These datasets represent measurements for 86% and 54% of all single amino acid substitutions for fitness and abundance scores, respectively.

Objectives:

In this study, we leveraged two DMS datasets, along with the largest well-curated clinical cohort of PTEN-variant carriers, to uncover clinically relevant genotype-phenotype relationships for PTEN.

Methods:

A custom machine learning approach was used to learn patterns of variant tolerance from the measured variants, and then predict scores of un-measured variants with high accuracy. These complete datasets were then explored to identify relationships between variant effect and clinical outcome.

Results:

First, we found that fitness and abundance scores are related to quantitative clinical traits, including head circumference and CC score (Cleveland Clinic score, a semi-quantitative measure of disease burden). These relationships validate that our DMS datasets reflect clinical outcomes. Fitness and abundance scores, along with CADD scores, were used to build a model that accurately identifies pathogenic versus benign *PTEN* variation (AUC = 0.892). Next, we sought to understand how the fitness or abundance score of a *PTEN* variant modulated lifetime cancer risk. We identified a ~10-fold increased lifetime risk of cancer for individuals with compromised fitness and abundance scores versus individuals with wild-type like fitness and abundance scores. We also observed increased risk of early onset cancer in highly damaging missense variants as compared to nonsense, potentially indicating a dominant negative mechanism. Finally, we find that classes of functional scores have significantly different risk levels for developing core features of PHTS with odds ratios ranging from ~10–100 depending on the variant effect. In striking contrast, ASD/DD risk does not change significantly across variant severity classes with odds ratios of 5-10.

Conclusions:

We show here that combining DMS datasets and well-curated clinical cohorts can lead to powerful clinical insights. We generated a *PTEN* pathogenicity predictor that outperforms all prior tools. We find that lifetime risk of cancer is strongly dependent on the severity of *PTEN* variant. This framework can inform clinicians as they make decisions regarding screening and treatment, and will help herald time and resources. Finally, we demonstrate that the risk pattern for developing ASD/DD versus PHTS features is strikingly different, providing further evidence that the penetrance of these phenotypes is driven by different underlying molecular or cellular processes.

431.002 *(Poster)* Characterizing Germline and Mosaic Mutations and Their Integrated Roles in the Biological Mechanisms Underlying Autism Risk

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Background: Studies on autism spectrum disorder (ASD) cohorts have identified a strong burden of germline *de novo*mutations (GDMs). We and other have also identified postzygotic mosaic mutations (PMMs) within these ASD cohorts. From our analysis of data from the Simons Simplex Collection (SSC), we estimated that PMMs contribute risk to at least 3-4% of simplex ASD cases. The roles and overlaps of the targets of these mutation classes remain to be fully elucidated. However, we previously found preliminary evidence that GDMs and PMMs show different geneset enrichments. For example, missense PMMs were enriched for disrupting chromatin remodelers while missense GDMs were not. We hypothesized that germline and mosaic mutations are enriched within distinct biological pathways, developmental time points, and cell types. Here, we test this hypothesis evaluating germline and mosaic mutations in the SSC using new ASD risk gene scoring approaches and single-cell datasets.

Objectives: To characterize the role of mosaicism in ASD and the underlying biological mechanisms altered by germline mutations, mosaic mutations, or both.

Methods: Mutation calls from the SSC were obtained from Krupp et al. 2017. Scores from forecASD, a random forest machine learning framework trained on known risk genes and diverse genome-scale datasets (Brueggeman et al., 2018), were used to rank mutations.Single-cell RNA-seq data of cortex development were obtained across 4,261 cells (Nowakowski et al. 2017). Early newborn excitatory neurons were compared against late newborn excitatory neurons using a Wilcoxon rank sum test. Enrichment analyses were performed for germline and mosaic mutations by comparing probands to unaffected siblings.

Results: Unlike other ASD risk gene approaches,forecASD scores are predictive of risk genes implicated by diverse datasets and have been highly predictive of new ASD risk genes that appeared after the development of the tool [e.g., 12/16 genes new genes in the iHART study are in forecASD's top decile (Ruzzo et al., 2018)]. In the SSC, we found forecASD score rankings were strongly biased for proband nonsynonymous PMMs compared to siblings (Wilcoxon rank sum, p = 0.0049), further suggesting these mutations are contributing to ASD risk. Moreover, proband PMMs were enriched in the top forecASD decile (binomial; pro: 44/195 [22.6%], p = 2.5 x 10^{-7}; sib: 18/138 [13%], p=0.25). Within single-cell RNA-seq data, proband nonsynonymous PMMs showed an ~2-fold enrichment genes that are differentially expressed in early versus later born neurons, while GDMs had no enrichment. We are in the process of replicating these results within the SPARK cohort.

Conclusions: These findings demonstrate that forecASD is robust against preference of genetic risk mechanisms, making it an ideal choice for interpreting putative risk from both GDMs and PMMs. Our integrated approach allows us to validate and capture a wider breadth of mutations contributing to ASD and classify their likelihood of ASD risk, developmental trajectories, and functional cell-types. This increased level of specificity gives deeper insight into the genetic architecture and pathophysiology of ASD and establish an analysis framework for future large-scale ASD datasets such as SPARK.

431.003 *(Poster)* Comprehensive Integrative Analyses Identify TIGD5 As a Risk Gene for Autism Spectrum Disorder

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Background: The past decade has witnessed tremendous progress in genome-wide association studies (GWAS) on autism spectrum disorder (ASD), and a number of genome-wide significant variants/loci have been identified. However, due to the limitations of GWAS, such as the issue of false-positives that results from multiple hypotheses, how to pinpoint the causal genes at the reported loci remains a challenge.

Objectives: This study aimed to pinpoint the potential causal genes for ASD and explored the possible susceptibility and mechanism.

Methods: The convergent functional genomics (CFG) method was used to prioritize the candidate causal genes for ASD by combining the lines of evidence from different analyses. The evidence from different layers included *Sherlock* integrative analysis using large-scale Psychiatric Genomics Consortium (PGC) GWAS and brain eQTL from Myers et al., spatio-temporal expression pattern, expression analysis from Gene Expression Omnibus, protein-protein interaction, and co-expression. Evidence from each analysis contributed one point to the studied genes and a higher total score in CFG approach suggested that more evidence supported this gene as an ASD risk gene. For the identified causal genes with higher CFG scores, we tested whether the variants in the candidate causal genes were associated with ASD in a Chinese Han population with the sample size of 602 ASD cases and 604 healthy controls. The functional effect of risk polymorphisms was characterized with a dual-luciferase reporter assay system. A workflow diagram was provided to illustrate the above analyses in Fig. 1.

Results: We identified five genes (*MAPT, ZNF285, TIGD5, SMAD9, RGS16*) as candidate causal genes for ASD using the CFG approach. The genotyping experiment showed that the *TIGD5* rs75547282 polymorphism was significantly associated with an increased risk of ASD for the T allele and TC genotype (respectively OR=1.253, 95% CI=1.051-1.493, *P*=0.030; OR=1.328, 95% CI=1.036-1.702, *P*=0.042) after adjustment for multiple tests using the Benjamin-Hochberg method. The mutant-type of rs75547282 activated the expression of *TIGD5* comparing to the wide-type in dual-luciferase reporter assay.

Conclusions: The comprehensive integrative analyses suggested that *TIGD5* was the most promising candidate gene for ASD. Rs75547282 polymorphism of *TIGD5* might confer susceptibility to ASD in the Chinese Han population.

431.004 *(Poster)* DNA Copy Number Variants Analysis from Whole Genome Sequencing in Families with Non-Syndromic Autism Spectrum Disorders

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Background: De novo pathogenic DNA copy number variants (CNVs) contribute to the causes of Autism Spectrum Disorder (ASD) in ~10% of cases, standardly identified by chromosome microarray analysis (CMA). Whole genome sequencing (WGS), as a state-of-the art and high throughput technology, has improved ASD diagnosis by an additional 20%, mainly by discovering single nucleotide variants (SNVs) and small insertions and deletions (indels). The ability to detect CNVs from WGS is becoming more and more important in promoting WGS as an all-inclusive first-tier genetic test for neurodevelopmental disorders in the clinic setting.

Objectives: To compare the CNVs identified from WGS and clinical diagnostic CMA in families with ASD.

Methods: A total of 38 probands with ASD were screened for CNVs using both CMA from clinical diagnostic service laboratories (using the Affymetrix CytoScan as the gold-standard platform for CNV detection) and WGS (Illumina HiSeqX)coupled with analysis via commercial VarSeq software from Golden Helix.

Results: By CMA, 42 CNVs (4 de novo, 4 paternal, 11 maternal and 1 unknown origin) were reported as pathogenic or as variants of unknown significance (VUS) in 14 out of 36 patients. The size ranged from 110 Kb to 3.5 Mb. Normal array results were reported in 22 subjects. Using our VarSeq CNV algorithm (WGS-VarSeq) (setting 10Kb segments as minimum detection distance in the genome), all of the 42 CNVs were identified by WGS except one, a 110 Kb duplication at 2q31.2(179397560-179508251, hg19) of unknown origin involving *TTN* found in one of 3 autistic children in one family. In addition, WGS-VarSeq also detected 3 additional non-redundant CNVs in 7 patients who already had VUS CNVs identified from clinical CMA: 1) arr[hg19] Xq11(38480001-38580000)x3, mat, 100 Kb, involving single gene *TSPAN7*. 2) arr[hg19]17p11.2(18560001-18930000)X3 mat, 370Kb in size, shared by all 3 affected, within the Smith-Magenis Syndrome region. 3) arr[hg19]17q11.2(29300001-29330000)X3 pat, 30Kb in size, involving a single gene *RNF135*, shared by all 3 affected children within the NF1-microdeletion syndrome region. However, no additional positive CNVs were detected by WGS-VarSeq among the 22 patients with reported normal CMA results.

Conclusions: CNVs reported by clinical diagnostic service laboratories can be reliably detected from WGS data using VarSeq software. A limited number of additional CNVs were detected by WGS-VarSeq, however, this does not increase the CNV detection rate due to the co-existence of these CNVs with other CNVs reported by CMA in the same patient. In addition, small CNVs, especially <10Kb, cannot be identified using the current algorithm of VarSeq.

431.005 *(Poster)* Differences in the Genetic Background Contribute to Risk and Resilience to Autism

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Background: The genetic architecture of autism spectrum disorders (ASD) is complex. If rare deleterious variants in more than 100 genes are now well-accepted risk factors for ASD, the genetic basis of the incomplete penetrance of the variants remains poorly understood.

Objectives: Here, we investigated the genetic architecture of "resilient" individuals, carrying ultra-rare deleterious variants in ASD-associated genes or loci from the SPARK gene list without being diagnosed with the condition.

Methods: We designed a framework to assess the risk associated to ultra-rare deleterious mutations in parents and children of 1,201 quadruplet families with one affected and one unaffected child of the Simons Simplex Collection. We investigated hallmarks of mutation intolerance (haploinsufficiency, probability of loss-of-function mutation intolerance, z-score for missense mutation or deletion intolerance) to discriminate mutations likely to affect gene function. We also used clinical records available for each family to focus on mutations identified in children displaying a clear discordance in ASD phenotype.

Results: We identified ultra-rare deleterious variants affecting ASD-associated genes in approximately 8% of non-ASD relatives. Within children with inherited ultra-rare deleterious variants, we observed a slight enrichment of girls among resilient individuals, in line with the reported sex-specific penetrance of rare mutations in ASD. In addition, probands received higher genome wide polygenic score for ASD than expected ($p = 4.5x10^{-8}$) whereas the siblings received less ($p = 0.0034$). We propose a model according to which the penetrance of ultra-rare deleterious variants in ASD-associated genes strongly depends on the sex and the genetic background of each individual.

Conclusions: The genetic background significantly influences the clinical trajectory of siblings carrying similar deleterious mutations in ASD-associated genes. We are currently investigating other ASD cohorts as well as control populations to further investigate the genetic factors contributing to resilience for ASD. This work provides new insights into the molecular mechanisms of ASD, ultimately allowing the development of novel therapeutic strategies.

431.006 *(Poster)* Genetic Architecture of Autism Spectrum Disorder without Intellectual Disability

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Background: The genetic architecture of autism spectrum disorder (ASD) is complex and involves a combined effect of common and rare variants that are either inherited or arose *de novo*. Prior efforts to understand the genetic etiology of ASD have focused on the recruitment of children with ASD and their first-degree relatives, specifically parents and siblings. To complement ongoing large-scale efforts, The Autism Spectrum Program of Excellence (ASPE) at the University of Pennsylvania is focusing on the recruitment and genetic analysis of adults with ASD without intellectual disability (ID) and their extended families.

Objectives: The goal of the program is to study the genetic basis of variation in phenotypic expression within and across families with ASD by integrating the effects of common and rare variants on a wide range of ASD behavioral traits, including sleep.

Methods: We have recruited over 200 families and obtained whole genome sequence (WGS) on 189 individuals. Pathogenic and likely pathogenic single-nucleotide variants (SNVs) and insertions and deletions (indels) were identified from WGS data using InterVar, which generates automated interpretation of the clinical significance of each variant based on the guidelines of the American College of Medical Genetics and Genomics and the Association for Molecular Pathology. We also used integrated Copy Number Variation detection algorithm (iCNV) to detect copy number variants (CNVs) in WGS. All SNVs, indels, and CNVs were validated using Integrative Genomic Viewer in the context of family pedigrees. Pathogenic and likely pathogenic SNVs and indels in known ASD risk genes, defined by the Transmitted And De Novo Association test on larger datasets, were identified.

Results: ASPE is ongoing with 189 individuals (81 ASD without ID probands and 108 relatives) with WGS currently. The average age of probands is 35 years old and 67% of them are male. The average age of relatives is 45 years old and 48% of them are male. We identified 299 pathogenic and likely pathogenic SNVs and indels in 160 genes. When comparing probands and relatives, 65% of the probands carried at least one of these variants compared to 44% of the relatives, $\chi^2(1, N=189)=8.194, p=.004$. In 10 individuals in ASPE (5.5%), 7 pathogenic and likely pathogenic SNVs and indels were found in 7 known ASD risk genes (*KMT2C, MAP1A, PTEN, TSC1*, *EIF3G, PHF21A, PHF2*). CNV analysis identified 1568 exonic CNVs that are absent from the Database of Genomic Variants. Of these CNVs, 700 are found in probands (8.64/person) while 868 are found in relatives (8.04/person).

Conclusions: In ASPE, ASD without ID probands are associated with a higher burden of pathogenic and likely pathogenic SNVs and indels compared to their relatives. Among 7 of the pathogenic and likely pathogenic SNVs and indels found in known ASD risk genes, 3 of them are found in *KMT2C*, which is a gene involved in histone methylation activity. The integrative analysis of variants of varying frequency, inheritance pattern and type (SNV, indel, and CNV), and a polygenic load for ASD will help us to better understand the genetic basis of ASD without ID.

431.007 *(Poster)* Integration of Polygenic Scores, Copy-Number Variants, Inbreeding and Ancestry Increases the Yield of Genetic Diagnostics for Neurodevelopmental Disorders in a Large Group of >13,000 Individuals

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Background: Neurodevelopmental disorders (NDDs) are heterogenous, characterized by delays in global development, motor skills, and cognition, as well as intellectual disability and affect more than 3% of children worldwide.

Objectives: Over than 1000 loci have been associated to NDD but delineating the heritable genetic components or defining individual factors that predispose to NDD risk is still a challenge. Our study aims to dissect the genetic architecture of NDD.

Methods: We analyzed the largest group to date of individuals from France with neurodevelopmental disorders (NDD) coming from four hospitals of AP-HP, France (Robert Debré, Trousseau, La Pitié Salpétrière, Jean Verdier). The data from 8,300 patients, 2,000 relatives and 2,955 controls were collected from two Illumina SNP array platforms over 5 years (2013-2017). Patients were grouped according to the biomedicine agency categories: syndromic intellectual disability (S-ID; N=3047), multiple congenital anomalies (N=1025), isolated ID (N=1058), autism (N= 1864) and other (N=1742). The CNVs were called using QuantiSNP and PennCNV and then compared to CNV partition, the algorithm used for diagnosis. Genotyping data were also used to estimate the ancestry and to compute the inbreeding coefficient as well as the polygenic score for different traits such as autism and intelligence.

Results: The analysis of this large sample of patients with NDD revealed several important results: First, QuantiSNP and PennCNV outperform CNV partition for the detection of CNVs. The new algorithms could increase the yield of genetic diagnosis (e.g. three patients with SHANK3 deletions were identified). Second, patients with S-ID, ID or autism had a higher burden of CNV affecting genes associated with NDD/autism or expressed in the brain or intolerant for deleterious mutation (pLI>0.9) compared to controls. Interestingly patients with autism had also higher polygenic scores for autism compared to controls ($p<10^{-22}$) or other diagnostic categories ($p<10^{-3}$), confirming the strong polygenic contribution to autism. Third, we could find that a high level of inbreeding was a risk for S-ID and ID, but not for autism. Finally, the role of several genes will be discussed such as TRPM1, SHANK3, PTGER3, OTUD7A, MTMR10, PTGER3, SDHA, PIGW, HNF1B, GGNBP2, CCDC127, ACACA, KLF13, VPS37D, SPNS1, RIMBP3, BAZ1B and ATXN2L. These genes might be important to understand the shared and specific mechanisms leading to different clinical trajectories.

Conclusions: Our large-scale French study of NDD, combining new genetic approaches, provides a better yield of genetic diagnostic for NDD. It results from the collaboration between clinicians and quantitative geneticists through data sharing, standardization and multi-level analyses. In order to go further, more data such as whole genome sequencing and standardized clinical data from deep phenotyping will be necessary to provide better diagnostic and prognostic insight. We also observed a very high degree of heterogeneity in the ancestry of the population, which will require match ancestry controls in order to provide diagnostic to all individuals attending to the hospital in France, not only those from European descents for which we have control data.

431.008 *(Poster)* Multi-Model Functionalization of 106 PTEN Missense Mutations Identifies Multiple Molecular Mechanisms Underlying Protein Dysfunction

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Background: Sequencing efforts of individuals with autism spectrum disorder (ASD) have identified large numbers of gene variants of unknown significance (VUS) to protein function, yet this knowledge is critical for linking genetic variation to disease expression, outcome and treatment. The utility of investigations to assess variant impact is dependent on application of appropriate assays to evaluate all aspects of a protein's function.

Objectives: Here, we seek to fully assess the effects of 106 missense and nonsense variants of PTEN associated with ASD, somatic cancer and PHTS.

Methods: We take a deep phenotypic profiling approach using 18 assays in 5 model systems spanning diverse cellular environments ranging from protein stability and molecular function to neuronal morphogenesis and behavior. Model systems include yeast, fly, worm, rat primary neuronal culture, and human cell lines.

Results: We find that protein instability is a major mechanism of dysfunction for variants altering amino acids across the entire protein structure. Other variants, located in discrete functional domains including the N-terminus substrate binding and the catalytic domains exhibited impacts ranging from loss of function to dominant negative phenotypes independent of effects on stability. Results indicate that 31 of the 48 variants tested from ASD individuals are likely pathogenic and 2 are likely benign and not causal.

Conclusions: Our results indicate that full characterization of variant impact requires assays sensitive to instability and a range of protein functions.

431.009 *(Poster)* Predictive Impact of Rare Genomic Copy Number Variations in Siblings of Individuals with Autism Spectrum Disorders

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Background: Identification of genetic biomarkers associated with autism spectrum disorders (ASDs) could improve recurrence prediction for families with a child with ASD.

Objectives: To use clinical microarray - the first-tier diagnostic test for developmental disabilities - to assess if copy number variants (CNVs) affecting ASD-related loci correlate (pre- and post-symptomatically) with phenotypic outcomes in the Baby Siblings Research Consortium (BSRC) cohort of infant siblings whose family history is associated with a higher probability of developing ASD.

Methods: We describe clinical microarray findings for 253 longitudinally phenotyped ASD families from the BSRC, encompassing 288 infant siblings.

Results: By age 3, 103 siblings (35.8%) were diagnosed with ASD and 54 (18.8%) were developing atypically. Thirteen siblings have copy number variants (CNVs) involving ASD-relevant genes: 6 with ASD, 5 atypically developing, and 2 typically developing. Within these families, an ASD-related CNV in a sibling has a positive predictive value (PPV) for ASD or atypical development of 0.83; the Simons Simplex Collection of ASD families shows similar PPVs. Polygenic risk analyses suggest that common genetic variants may also contribute to ASD.

Conclusions: CNV findings would have been pre-symptomatically predictive of ASD or atypical development in 11 (7%) of the 157 BSRC siblings who were eventually diagnosed clinically.

431.010 *(Poster)* Umbilical Cord Blood Gene Expression and 36-Month Autism-Related Quantitative Traits from an Autism-Enriched Cohort

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Background: Few studies have used next generation sequencing to examine differential gene expression in cord blood specifically related to autism (ASD)-related outcomes. The EARLI Autism Risk Longitudinal Investigation (EARLI) is an ASD enriched-risk pregnancy cohort that provides a unique opportunity to study this tissue source in a high-risk set of individuals, an approach which might elucidate potential mechanisms of ASD etiology better than might be found in the general population.

Objectives: To examine the potential association between differential gene expression in umbilical cord blood collected at birth and three ASD-related quantitative outcomes assessed at 36 months in the EARLI cohort.

Methods: Cord blood RNA samples from 72 newborns in the EARLI cohort were used to measure genome-wide transcripts via the Illumina HiSeq 3000. Using the *limma* and *edgeR* packages in R we identified genes showing differential expression in relation to three autism-related quantitative traits at 36-months of age: the Social Responsiveness Scale (SRS) total score, the Mullen Scales of Early Learning (MSEL) composite score, and the Vineland Adaptive Behavior Scales (VABS)-2 composite total.

Results: After filtering out genes with low expression levels in preprocessing, only one gene (*EXOC7*) showed differential expression in relation to the MSEL composite total scores and passed a significance threshold of FWER $P < 0.05$. Further comparison of mean expression levels of *EXOC7* in cord blood between 36-month outcomes of ASD versus typical development did not show a significant difference. No differential expression in relation to SRS and VABS scores passed this threshold. However, using a relaxed significance threshold of $p<0.01$, we found 113 and 185 differentially expressed genes for SRS and MSEL, respectively. Further analyses exploring ASD gene enrichment, weighted gene correlation network analysis (WGCNA), and sex-stratified models are currently ongoing and will be reported.

Conclusions: Our work shows promising results in examining potential associations between differential gene expression levels in cord blood samples collected at birth and ASD-related quantitative traits at 36-months, however our ability to detect individual transcripts with global significance may be limited by sample size. Further analyses of gene networks and sex-specific models may identify new mechanisms related to ASD and cognitive development.

Molecular Neuroscience

POSTER SESSION — **MOLECULAR NEUROSCIENCE**
432 - Molecular Neuroscience Posters

432.001 *(Poster)* A Model for Neural Development of FOXP1 Syndrome Using Patient-Derived iPSCs

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Background: Autism Spectrum Disorder (ASD) is characterized by high heritability and both phenotypic and genetic heterogeneity. One way to unravel some of the complexity of ASD is by focusing on single-locus disorders with high penetrance for causing ASD. Haploinsufficiency of the forkhead-box protein P1 (*FOXP1*) gene leads to FOXP1 syndrome, a neurodevelopmental disorder with a broad range of manifestations including ASD, intellectual disability, language impairment and psychiatric features. While animal models have provided valuable insight into the pathways that are dysregulated in *FOXP1* deficiency, human neuronal models are the closest proxy to study its underlying biology in a disease-relevant tissue. Induced pluripotent stem cells (hiPSCs) retain the full genetic background of the individual they derived from and have the advantage of being expandable and the possibility to differentiate into neural progenitor cells (iNPCs) and iNeurons.

Objectives: The overarching goal of this study is to improve our understanding of FOXP1 syndrome and identify candidate genes and pathways that could be targeted pharmacologically to alleviate its symptoms. To do this, we applied a multi-step approach that aimed to: 1) generate high-quality iPSC clones derived from *FOXP1* patients and siblings; 2) differentiate them into iNPCs and iNeurons, to capture their neurodevelopmental phenotype; 3) identify *FOXP1*-associated transcriptomic and methylomic signatures at different stages of development in iNPCs and iNeurons, by RNA sequencing and whole-genome DNA methylation screen.

Methods: Blood samples from 6 individuals with FOXP1 syndrome and their unaffected siblings were reprogrammed to iPSCs using a modified non-integrating Sendai virus to express reprogramming factors. For each individual, 2-3 clones were expanded for quality control (QC) and banking; those that passed QC were i) differentiated into iNPCs using a monolayer approach with PSC Neural Induction Media (Fisher) and ii) differentiated into inhibitory and excitatory iNeurons by viral transfection. To make GABAergic iNeurons, iPSCs were transduced with three viruses expressing a fused Ascl1-T2A-puromycin resistance gene, a Dlx2-hygromycin resistance gene and rtTA. To make glutamatergic iNeurons, lentiviruses expressing rtTA and a fused Ngn2-T2A-puromycin resistance gene were used. RNA and DNA were isolated from iNPC and iNeurons at three different timepoints of neural development, for RNA sequencing and whole-genome methylation screen.

Results: Six FOXP1 patient/sibling pairs were successfully reprogrammed to iPSCs with 2-3 clones per individual, subsequently used for iNPC and iNeuron generation. iNPCs and iNeurons were subjected to RNA sequencing and whole-genome DNA methylation assays for preliminary investigation into the early developmental molecular profiles of *FOXP1* syndrome. We find distinctive transcriptomic and DNA methylation signatures associated with *FOXP1* haploinsufficiency at different developmental stages, consistent with a central role for *FOXP1* in neurodevelopment and ASD etiology.

Conclusions: This is the first report of hiPSCs for FOXP1 syndrome, offering valuable insight into the early neurodevelopmental deficits associated with its etiology. Generating epigenomic and transcriptomic profiles for patient-derived iNPCs and iNeurons provides a unique perspective on the molecular pathways associated with FOXP1 syndrome, which can be used in conjunction with other models of the disease and known drug expression profiles to identify new therapeutics.

432.002 *(Poster)* Changes in the Developing and Mature Brain in Chd8 Heterozygous Mutant Mice

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Background: The gene encoding chromodomain helicase DNA binding protein 8 (*CHD8*) has one of the highest observed de novo loss-of-function mutation rates in patients with autism spectrum disorder (ASD). Mutations to *CHD8* have been suggested to drive pathology through global disruptions to gene expression and chromatin state. Neurobiology and pathological mechanisms associated with CHD8 haploinsufficiency remain to be fully elucidated and appear extend from embryonic development through the mature brain. Mouse models provide a system to examine impacts of ASD-relevant mutations on the mammalian brain, spanning the interval from early embryonic development to mature brain structure and function.

Objectives: We aim to define the pathological mechanisms associated with heterozygous mutation to *Chd8* through identifying convergence between *Chd8*-dependent gene regulation and dysfunction in the developing and mature brain using the mouse as a model. Here we focus on identifying phenotypes present in the mature cortex to determine neuronal pathology in *Chd8*$^{+/-}$ mice.

Methods: We previously identified differential RNA expression across brain development in *Chd8*$^{+/-}$ mice, which continues into the mature brain and is accompanied by increased brain size via structural MRI and neuroanatomy. Here, we have continued to examine phenotypes in the mature brain. In this work, we combined functional genomics, neuroanatomy and experimental characterization of synapse dynamics in adult mice that harbor heterozygous mutation to *Chd8*.

Results: Differential expression signatures were strong in adult cortex and implicate deficits in neuronal maturation and synaptic dysfunction. *In vivo* analysis of spine dynamics in *Chd8*$^{+/-}$ cortex showed that spine density was significantly lower and spine outgrowth was significantly increased with no change in spine elimination. Previously reported brain overgrowth in *Chd8*$^{+/-}$ mice was validated via stereological analysis of cerebral cortex, finding increased volume but no change in neuronal cell counts or nuclear volume. Studies in conditional mice with neuron-specific Chd8 haploinsufficiency are ongoing.

Conclusions: From these data we conclude that impacts of *Chd8* haploinsufficiency extend to mature brain and specifically in cortical neurons. Understanding underlying molecular mechanisms and the connection between stage-specific requirements for *Chd8* and ASD pathology will be important to help overcome current barriers in elucidating mechanisms underlying neurodevelopmental disorders.

432.003 *(Poster)* Hydrogen Peroxide and Estradiol Might be Associated with Autism Via Altered BCL2 Expression Level

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Background: Our previous studies investigated the overlaps between autism spectrum disorders (ASDs) and cancer in genes, signaling pathways, and mitochondria, and we found that BCL2 might play an important role in autism/cancer mechanisms. Several published studies found that the expression level of BCL2 was significantly decreased in autistic brain (45-47% less). Further, a study reported that rats with rapid eye movement (REM) sleep deprivation had decreased level of Bcl-2; while another study found that children with autism have less time in or even no REM sleep at all. These evidences showed that BCL2 had multi-level linkage to ASDs at gene, protein, pathway, and symptom.

Objectives: To examine the role of BCL2 in ASD pathophysiology, we set out to identify the compounds that may alter the expression level of BCL2 and their associations with ASDs.

Methods: We used a chemical-gene-disease database, Comparative Toxicogenomics Database (CTD), as our data source to investigate gene-chemical interactions in relation to BCL2-associated chemicals. 1) We used “BCL2” as the search term under the “Gene” category in CTD. Gene-chemical interaction data was downloaded under the “Chemical Interactions” sub-category for BCL2, we chose the top 10 chemicals that were intensively studied, which indicates that these gene-chemical interactions have been well-established. 2) Then, for each top interacting chemicals of BCL2, we investigated the interaction type “decreases^expression” and “increases^expression”. 3) We examined the “reference count” for each interaction type and determined if the chemical was more likely to decrease or increase the expression level of BCL2. 4) We searched PubMed for those top 10 interacting chemicals to see if they had any association to ASDs.

Results: The top 10 interacting chemicals to BCL2 are Arsenic Trioxide, Doxorubicin, Resveratrol, Cisplatin, Quercetin, Sodium Arsenite, Hydrogen Peroxide, Curcumin, Paclitaxel, and Estradiol. Among them, estradiol is more likely to increase the expression level while others are more likely to decrease the expression level of BCL2. arsenic trioxide, doxorubicin, cisplatin, sodium arsenite or paclitaxel have no published evidence suggesting any links to ASDs. Resveratrol and curcumin are reported to suppress neuroinflammation in animal models of ASD, while quercetin is reported to have anti-inflammation effect in children with ASDs when included in a luteolin-containing dietary intervention. Most interestingly, children with ASDs had higher (2 fold) mitochondrial rates of hydrogen peroxide production comparing to normal children, while hydrogen peroxide is more likely to decrease the expression level of BCL2. Estradiol is a form of estrogen (a sex hormone), which could reverse autism-like features in mice.

Conclusions: Overall, estradiol results in increased expression of BCL2 and may reverse autism-like features in mice; hydrogen peroxide results in decreased expression of BCL2 and its level in autistic children were found to be twice as high as in normal children. This is logically consistent with the finding that BCL2 level is decreased in autism brain by 45-47% less from previous studies. These findings support the idea that Bcl-2 level might be altered in autism and it could be a potential biomarker and therapeutic target.

432.004 *(Poster)* Shankopathies from Mechanisms to Treatments

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Background: The SHANK protein family is composed of three proteins SHANK1-3, which are synaptic scaffolding proteins located at glutamatergic synapses. Mutations in all SHANK genes have been associated with neurodevelopmental disorders (NDD), but with a gradient of cognitive severity. *SHANK1* mutations are associated with autism without intellectual disability (ID), *SHANK2* mutations are associated with autism and mild cognitive deficits and *SHANK3* mutations cause ID with autism in >60% of the cases. SHANK3 point mutations or deletions are detected in 1-2% of patients with autism and ID. The gene is located on chromosome 22q13.3, a region deleted in patients suffering from Phelan-McDermid syndrome (PMS), characterized by ID, severe language deficit, dysmorphic features and frequently autism (>60%). Remarkably, *de novo SHANK3* mutations were also detected in patients with schizophrenia and bipolar disorders, but the prevalence of these mutations remains to be better estimated.

Objectives: To develop better diagnostic and new treatments, our collaborative groups investigate SHANKOPATHIES from patients to mouse models. We aim at better understanding the variance in the clinical severity of patients with SHANK3 mutations. We use the mouse model mutated in exon 11 of Shank3 to explore the molecular bases of the phenotype. Finally, we aim at setting up a framework for the future clinical trial with Shank3 patients.

Methods: We first hypothesized that the variance in the clinical severity of the patients carrying SHANK3 point mutations or 22q13.3 deletions could be due to additional mutations. We therefore performed the whole genome sequence (WGS) of 20 patients with *SHANK3* point mutations/deletions. We then characterized the behavior of *Shank3Δ11* mutant mice at 3, 8 and 12 months of age, and performed transcriptome analyses on different brain regions of adult male mice after behavioral testing. Finally, we will present the framework of a new clinical trial that will be launched in 2020 using lithium in patients with autism carrying SHANK3 point mutations/deletions.

Results: The pilot WGS study on a relatively small sample could already identify multiple hits including one patient with a *de novo* mutation of the *MED13L* gene. The complete list of the most relevant multiple hits as well as the computation of the polygenic scores of the patients for ASD will be presented. In *Shank3Δ11* mice, male and female *Shank3Δ11* mutant mice display excessive grooming that exacerbates with increasing age as well as reduced exploratory activity. RNAseq analyses revealed that, while the cortex, the hippocampus and the cerebellum display few genes differentially expressed, the striatum displays a massive change of its transcriptome. The genes differentially expressed will be presented and their role on the excessive grooming of the mice will be discussed.

Conclusions: Our collaborative group investigate SHANKOPATHIES at different levels from genes to clinical trials and a website to share the data with the scientific and medical community will be soon available. We are now extending this study to other European countries to increase the statistical power and to identify knowledge-based treatments for SHANKOPATHIES. More information to join the collaborative group can be found here: https://research.pasteur.fr/fr/project/phelan-mcdermid-syndrome-from-mechanisms-to-treatments/

432.005 *(Poster)* Signal Transduction through the mTOR Protein Interaction Network Is Disrupted in Fragile X Syndrome

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Background: The mTOR pathway is a central signaling cascade that is linked to many types of autism. Multiple syndromic forms of autism such as TSC, PTEN, and Fragile X syndrome are the result of mutations in genes involved in mTOR signaling. Mouse models of Fragile X syndrome have shown an increase in phosphorylation of AKT, mTOR and p70S6K as well as an upregulation of PI3K and PIKE expression (Sharma et al 2010; Hoeffer et al 2012). This suggests that a key part of the Fragile X phenotype is abnormal signal transduction in the mTOR pathway.

Objectives: To test the hypothesis that disruptions in the mTOR protein interaction network contribute to abnormal signaling outcomes in Fragile X syndrome.

Methods: We have developed a proteomic method known as Qualitative Multiplex Immunoprecipitation (QMI) that can simultaneously measure changes in hundreds of protein interactions. Target proteins for the mTOR QMI antibody panel were chosen based on two criteria. The first is the target's importance to the mTOR pathway and the number of known interactions with other pathway members. The second criterion is the target's association to autism as determined by their SFARI gene score, where highly associated autism genes were added to the panel. We screened for a pair of commercially available antibodies that could capture a target onto CML beads and probe for that target through flow cytometry. We screened the detergents NP40, Deoxycholate, Digitonin, and Lubrol to determine the optimal detergent for solubilizing the proteins of interest. We stimulated cortical slices of wildtype and FMR1 knock-out mice with Insulin Growth Factor-1 (IGF-1) and DHPG to characterize how the loss of FMRP affects signaling through the mTOR protein interaction network.

Results: We successfully identified antibody pairs for seventeen key signaling or autism related proteins. We found that Digitonin best captured the protein interactions that occur between our selected targets. The loss of FMRP produced a pattern of protein interactions that was distinct from the wildtype when given no stimulation. Stimulation with DHPG or IGF produced unique rearrangements of the mTOR network in wildtype slices. However, these rearrangements were different in FMR1 mutant mice.

Conclusions: We developed a QMI antibody panel that can quantify changes in protein interactions between member proteins of the mTOR pathway. We found that the detergent Digitonin was best used to solubilize the targets of our panel after screening for the most effective detergent. Different stimulating inputs yielded different patterns in the protein interaction network. Fragile X mice displayed different protein network states than their wildtype counterparts. We hypothesize that the differences in protein network states leads to abnormal signaling outputs and contribute to deficits in protein translation observed in Fragile X syndrome.

432.006 *(Poster)* Synaptic Scaffolding Proteins Associated with Autism Are Required for Homeostatic Plasticity in Vitro and In Vivo

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Background: In order to adapt to changes in input, neurons adjust their synaptic strength and/or firing rate up or down so that cell-wide excitability remains stable. This capacity is known as homeostatic plasticity and is disrupted in several mouse models of autism. Recent studies have used high-throughput methods to identify newly synthesized transcripts and proteins after homeostatic up-scaling and down-scaling; however, how such changes interact to maintain homeostasis remains unclear. Moreover, how protein interaction networks critical for homeostatic plasticity are disrupted in autism has not been demonstrated.

Objectives: We aim to establish a ground truth for the synaptic protein network state during homeostatic synaptic up-scaling, homeostatic synaptic down-scaling, and whisker deprivation of the barrel (somatosensory) cortex. We will compare the protein network state during the above modes of homeostatic plasticity in mice mutant for the autism-associated genes Homer1 and Shank3.

Methods: We use quantitative multiplex immunoprecipitation (QMI), a semi-high-throughput method, to detect widespread changes in multi-protein complexes during homeostatic up- and down-scaling in cultured mouse cortical neurons, thereby establishing a ground truth for the protein network states that modulate synaptic homeostasis. We then use QMI to evaluate changes in multi-protein complexes in the whisker-deprived barrel cortex, an established model of in vivo homeostatic plasticity. Finally, we evaluate protein network state in the whisker-deprived barrel cortex of mice lacking the autism-associated genes Shank3 and Homer1.

Results: We find that many multi-protein complexes change bidirectionally with up-scaling versus down-scaling in cultured neurons over time, while the overall level of several key proteins stabilizes by 48 hours. Many of these multi-protein complexes involve Homer1, Shank1, and Shank3. Moreover, the whisker-deprived barrel cortex replicates many of the changes observed with in vitro down-scaling. Mice lacking Homer1 or Shank3 do not undergo normal protein interaction changes in response to whisker deprivation, demonstrating that disruption of a structural hub protein broadly inhibits protein network activity.

Conclusions: These results highlight the extensive, interconnected network of structural alterations that constitute homeostatic plasticity and demonstrate that in vitro and in vivo models of homeostatic plasticity engage similar mechanisms and require the autism-associated genes Homer1 and Shank3.

Neuroanatomy

POSTER SESSION — **NEUROANATOMY**
433 - Neuroanatomy Posters

433.001 *(Poster)* Chandelier Cells and an Altered Gabaergic Synaptic System in the Human Prefrontal Cortex in Autism

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Background: Autism has been correlated with dysregulation of the excitation/inhibition balance in the cerebral cortex. We previously found a significant decrease in the number of a GABAergic inhibitory interneuron subtype called the chandelier cell (Ch) in the human prefrontal cortex in autism. Ch cells play a synchronizing role in regulating excitation, as a single Ch cell forms synapses with hundreds of excitatory pyramidal cells and does so exclusively on the axon initial segment (AIS) of pyramidal cells. We herein investigated this crucial link between chandelier cells and pyramidal cells to help uncover changes leading to imbalanced brain activity in autism.

Objectives: Currently available data indicates a downregulation of GABA system components in autism, but cellular localization of these alterations is not yet known. Thus, we hypothesized that in autism, the postsynaptic pyramidal cell contains reduced $GABA_A$ receptor subunit α2 protein in its AIS. We also hypothesized that there is a decreased number of Ch cell terminal boutons on each pyramidal cell AIS in autism.

Methods: Using human prefrontal cortex tissue from 20 control and 20 age- and sex-matched cases with autism, we performed immunohistochemistry to label Ch cell terminal boutons as well as $GABA_A$ receptor subunit α2 protein in the pyramidal cell AIS, and we used ImageJ (NIH) to quantify the amount of protein. We are examining Brodmann Areas (BA) 9, 46, and 47, as these are areas associated with the cognitive abnormalities in autism.

Results: We found a reduction of $GABA_A$ receptor subunit α2 protein in the pyramidal cell AIS in specific areas of the prefrontal cortex in autism. In addition, our preliminary findings show no difference in the number of Ch cell terminal boutons on each pyramidal cell AIS in control cases vs. cases with autism.

Conclusions: The downregulation of receptor protein in pyramidal cells may be a response to the overall decreased GABA synthesis in the prefrontal cortex, or a compensatory response to modified activity among remaining Ch cells. Overall, reduction of receptor protein may contribute to an excitation/inhibition imbalance in autism, and our findings support the potential for GABA receptor agonists as a therapeutic tool for autism.

433.002 *(Poster)* Patterns of Cortical Gyrification in Individuals with 22q11.2 Deletion Syndrome and Idiopathic Autism Spectrum Disorder

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Background: In order to fully capture the complex neuroanatomical underpinnings of autism spectrum disorder (ASD), it is important to consider the neurobiological determinates of ASD across disorders. For example, 22q11.2 deletion syndrome (22q112.DS) is a genetic condition that is associated with a high prevalence of ASD (Schneider et al., 2014). Even though recent studies suggest that individuals with 22q11.2DS and ASD are neuroanatomically distinct from 22q11.2DS without (Gudbrandsen et al., 2019; Jalbrzikowski et al., 2017), no studies to date have examined how closely the neurobiological phenotype of ASD in 22q11.2DS resembles the phenotype of ASD in idiopathic ASD. Moreover, no studies to date have focused on regional differences in cortical folding across disorders, which is key to both 22q11.2DS and idiopathic ASD.

Objectives: To establish whether ASD symptomatology in 22q11.2DS is underpinned by the same or different regional patterns of cortical folding compared to those without the micro-deletion.

Methods: We measured cortical gyrification based on the local gyrification index (*l*GI) across 131 individuals (6-25 years). These included (1) 50 individuals with 22q11.2 deletion syndrome (n=25 with ASD and 25 without), and (2) 81 non-deletion individuals (n=40 with ASD and 41 without). In accordance with previous studies (Gudbrandsen et al., 2019; Jalbrzikowski et al., 2017), all individuals with ASD met diagnostic cut-offs in the reciprocal social interaction and communication domain of the Autism Diagnostic Interview (ADI-R: (Lord, Rutter, & Lecouteur, 1994)), but were allowed to fall below threshold in the repetitive behaviors domain. We employed a multivariate approach using canonical correlation analysis (CCA), which allowed us to treat ASD as a continuous clinical construct spanned by multiple symptom domains assessed via the five subscales of the Social Responsiveness Scale (SRS; (Bölte & Poustka, 2008; Constantino & Gruber, 2012)), and to examine the multivariate association between inter-individual clinical profiles and neuroanatomical variability between 22q11.2 deletion carriers and non-carriers.

Results: In both groups (i.e. carriers and non-carriers) clinical variability across the five subdomains of the SRS could be reduced to a single latent trait variable that was (1) highly predictive of group (i.e. ASD vs. non-ASD), and (2) significantly associated with neuroanatomical variability in *l*GI (see Fig. 1 for ASD vs Controls & Fig. 2 for 22q11.2DS). However, although clinical variability was represented by a similar factor structure in both groups, the multivariate association between ASD symptomatology and neuroanatomical variability in *l*GI was significantly reduced in individuals with 22q11.2DS. Furthermore, we found that the spatially distributed patterns of neuroanatomical variability associated with this latent trait clinical factor significantly differed between groups, particularly in the left anterior cingulate cortex, the bilateral inferior parietal cortex, and the bilateral superior parietal cortex.

Conclusions: Our results suggest that while there is a high degree of clinical similarity between groups, ASD symptomatology appears to be mediated by different patterns of cortical folding in individuals with 22q11.2DS compared to those without.

433.003 *(Poster)* Serotonergic Innervation of the Amygdala Is Increased in Autism Spectrum Disorder and Decreased in Williams Syndrome

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Background: Williams syndrome (WS) and Autism Spectrum Disorder (ASD) are neurodevelopmental disorders that demonstrate overlapping genetic associations, dichotomous sociobehavioral phenotypes, and dichotomous pathological differences in neuronal distribution in key social brain areas, including the prefrontal cortex and the amygdala. The serotonergic system is critical to many processes underlying neurodevelopment, and is additionally an important neuromodulator associated with behavioral variation. The amygdala is heavily innervated by serotonergic projections, suggesting that the serotonergic system is a significant mediator of neuronal activity. Disruptions to the serotonergic system, and atypical structure and function of the amygdala, are implicated in both WS and ASD.

Objectives: To quantify the density of serotonergic axons in the four major subdivisions of the amygdala in the postmortem brains of individuals diagnosed with ASD and WS, and neurotypical (NT) brains.

Methods: Serial sections through the amygdala from 22 postmortem human brains (six age-matched pairs of ASD, WS, and NT) ranging from 19-69 years of age were immunohistochemically stained for the serotonin transporter (SERT) involved in serotonin reuptake into the presynaptic terminal. Adjacent sections were stained with cell-body stain (nissl) to determine amygdala nuclei boundaries, which were then overlaid onto SERT-ir stained sections. Stereological methods were used to estimate SERT-ir axon length and density. Nonparametric statistical methods were employed due to small sample size.

Results: We found opposing directions of change in serotonergic innervation in the two disorders, with ASD displaying an increase in SERT-ir axon density compared to NT, and WS displaying a decrease. Significant differences ($p<0.05$) were observed between WS and ASD data sets across multiple amygdala nuclei.

Conclusions: Differential alterations to serotonergic innervation of the amygdala may contribute to differences in sociobehavioral phenotype in WS and ASD. These findings will inform future work identifying targets for future therapeutics in these and other disorders characterized by atypical social behavior.

Neurochemistry

POSTER SESSION — **NEUROCHEMISTRY**
434 - Neurochemistry Posters

434.001 *(Poster)* Children with Autism Spectrum Disorder Show Differential Glutamatergic Response in the Pons during Affective Face Discrimination Task.

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Background: Children with ASD often face challenges with interpreting emotion from faces and motor ability. It is possible that an imbalance of neural excitation and inhibition underlies both of these symptoms (Rosenberg et al., 2015). In order to investigate the role of affective context on the relationship between neurochemistry and motor ability, we assessed the neurochemical signature of bilateral hand gripping in response to pictures of hands and faces (neutral and emotional) using event-related, high-temporal resolution functional Magnetic Resonance Spectroscopy (ht-fMRS). ht-fMRS has the capacity to quantify second-by-second accumulation of neurotransmitters within a specific brain voxel. The present study focused on the neurochemistry of the median pontine nuclei during grip due to its known role in integrating top-down motor cues with visual and emotional information and prior findings of microstructural pontine abnormalities that were related to motor ability and core symptoms in ASD (Travers et al., 2015).

Objectives: 1) Characterize the glutamatergic pontine neural signature of grip responses in children with ASD and TD, and 2) examine the differential pontine responses to affective versus non-affective visual stimuli in children with ASD and TD.

Methods: While collection is ongoing, data reflect functional spectroscopic and behavioral information collected from 18 children with ASD and 25 children with typical development (TD), ages 6-10 years. Participants completed a task that involved squeezing dynamometers (hard or light) in response to visual cues (hands, neutral faces [non-affective], or emotional faces [affective]). While participants performed the task, glutamatergic concentrations were measured with a jittered 1.5 second repetition time. A general linear model was applied to the raw spectroscopic data that deconvolved glutamatergic signatures associated with the presentation of cues.

Results: No significant group differences in maximum grip were found during responses to hands (p=.14), neutral faces (p = .26), or affective faces (p = .41). However, children with ASD showed unique glutamate signatures in all conditions (Figure 1). For hands, there was an interaction between diagnostic group and hard vs. light grip trials (p = .008). Specifically, the ASD group showed elevated glutamate compared to the TD group in the “grip hard” trials, but diminished glutamate during the “grip light” trials. For faces, there was an interaction between diagnostic group and hard vs. light trials (p = 0.02) and glutamatergic signatures were similar in directionality to those of the hand trials.

Conclusions: This study found that pontine glutamate in ASD differed as a function of squeezing hard or light. Despite similar behavioral performance, elevated glutamate response in the brainstem during hard grips and diminished glutamate response during light grips suggests an altered subcortical mechanism of motor execution in ASD. Results also indicate that this glutamatergic pontine activity in ASD is not affected by the affective context of visual stimuli, thus indicating that this altered mechanism is relatively emotion-independent. However, it is possible that emotional cues affect the neuronal behavior elsewhere in the circuit, therefore further characterization of the neurochemical dynamics of the motor circuit may help to fully elucidate the underlying impact of emotion on motor ability.

434.002 *(Poster)* Correlation of Oxidative Damage Associated with Glutathione Status and Attention Switching/Tolerance of Change in ASD.

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Background: Autism is a complex, behaviorally defined neurodevelopmental disorder characterized by significant impairments in social interaction, verbal and non-verbal communication, and by restrictive, repetitive and stereotypic patterns of behavior. Numerous indicators of oxidative stress have been documented previously in the blood from children with autism, including decreased antioxidant enzyme activities. Glutathione (GSH; γ-L-glutamyl-L-cysteinyl-glycine) is the primary antioxidant responsible for maintaining the reducing intracellular microenvironment that is essential for normal cellular function and viability. Previously, we described the kinetic imbalance of glutathione biosynthesis in the cingulated cortices as target of oxidative stress in individuals with ASD. Taken together, the findings of this study support our hypothesis and a role for glutathione redox imbalance and oxidative stress in the attention switching/tolerance of change in autism, which lead the next step in our investigation to correlate of imbalance neurochemistry linked to cingulated cortices with attention switching/tolerance of change in the autism spectrum disorders.

Objectives: To study imbalance of glutathione in the cingulated cortices correlated with the AQ domains attention switching/tolerance of change associated with ASD using ^{1}H-MRS.

Methods: Single voxel (^{1}H-MRS) in bilateral ACC and PCC, in adults with a clinical diagnosis of ASD (n=21) and controls (TD) typically development (n=46), matched for age, gender. Autism quotients (AQ) score were assessed. Statistic one-way ANOVA and Bonferroni correction were applied.

Results: The results of the Pearson correlation were represented graphically, where it was observed that there is no correlation between the change in attention and the deregulation of glutathione in the ACC in ASD (Fig.1). These results make us suggest the relation of the deficit in the change of attention with the deficiencies in the network of the executive function; in accordance with that described by (Pascualvaca et al., 1998); who demonstrated the relation of the deficits in the care path with the deficiencies in the network of the executive function. Comparatively, the subjects of the control group were negatively correlated with the relative proportions of glutathione in both cortices. On the other hand, it was recently demonstrated that the deficiencies of the executive network in the subjects with ASD originate in the central lobes, being one of its central nodes the ACC (Watanabe & Rees, 2016); what sustains our neurochemical findings.

Conclusions: This imbalance in the levels of GSH in ACC and PCC, could contribute to the decrease of antioxidant defenses and therefore increase the susceptibility of astrocytes, generating a poor glial defense, contributing to the existing neuronal damage in ASD caused by oxidative stress, mitochondrial dysfunction and neuroinflammation that have been identified as determining causes in the appearance of ASD.

434.003 *(Poster)* Parietal GABA in Children with Autism Spectrum Disorder and Typically Developing Peers: Distinct Age-Related Changes

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Background: Gamma-Aminobutyric acid (GABA) acts as the brain's primary inhibitory neurotransmitter for most of life. A lack of GABA-mediated inhibition has been proposed to contribute to the development of Autism and explain specific behavioural differences. Previous research has found reductions in GABA concentrations for children and adolescents with Autism across a number of brain regions. The younger the participants, the more consistent the reductions appear to be. Further, no differences in GABA concentration have been found in adults. This suggests a potential influence of age on GABA concentration. The impact of age has shown inconsistent results, with some studies reporting age-related changes, while others did not find these associations.

Objectives: We sought to investigate the developmental trajectory of GABA concentration in the left parietal lobe, a region key for social cognition and language. A cross-sectional design was used to compare children with Autism to their typically developing peers to assess group differences and age-related effects on GABA concentration to better understand the brain biology accompanying Autism.

Methods: Twenty-four children with Autism (age 9.11± 2.3, range: 4-12 years) and 35 typically developing children (age 8.81 ± 2.26, range: 4-12 years) participated in the study. Imaging was conducted on a 3-Tesla GE Discovery MR750 scanner. A T1-weighted detailed anatomical scan was completed for voxel placement and segmentation. A single voxel (size: 3x3x3 cm^3) MEGA-PRESS was acquired in the left parietal lobe for GABA quantification. A typical voxel placement and example spectrum is shown in Figure 1.

Processing was conducted using Gannet, version 3.1 to estimate the concentration of GABA within the voxel. The voxel is segmented using spm12, with the proportion of grey matter, white matter and cerebrospinal fluid used to correct for differences of tissue type contribution to the measured GABA signal. An ANCOVA was used to examine group differences in GABA concentration, with age included as a covariate to investigate its influence on GABA.

Results: There was a significant influence of diagnosis ($p = 0.033$), age ($p = 0.005$) and interaction of diagnosis and age ($p = 0.029$) on GABA concentration. Participants with Autism showed lower GABA concentrations at younger ages compared to TDC ($B = -0.835$, $p = 0.033$) and participants with Autism show a significant increase in GABA with age ($B = 0.092$, $p = 0.029$) whereas GABA levels in TD children do not change with age. The GABA and age association is illustrated in Figure 2.

Conclusions: This study provides further evidence for differences in GABA concentration in children with Autism compared to their typically developing peers. Specifically, children with ASD showed age-related increases in GABA concentration while TD participants did not. Our data suggests GABA levels in younger children with ASD are lower when compared to TD but in older groups, this group difference does not persist. We found that at age 9, the ASD group attained typical GABA levels. This finding offers a potential explanation for why reductions in GABA are seen in children and adolescents with ASD but not in adult populations.

Neuroimaging

PANEL SESSION — **NEUROIMAGING**

218 - Disentangling Clinical and Biological Heterogeneity in ASD Using Data-Driven Approaches

Panel Chair: Stephanie Ameis, *The Margaret and Wallace McCain Centre for Child, Youth, & Family Mental Health, Campbell Family Mental Health Research Institute, Centre for Addiction and Mental Health, Toronto, ON, Canada*

Discussant: Evdokia Anagnostou, *Holland Bloorview Kids Rehabilitation Hospital, Toronto, ON, Canada*

Heterogenity in autism remains an enormous barrier to the biomarker discovery needed for clinical innovation. Here, four speakers will present on different approaches to parse heterogeneity in autism using different large neuroimaging datasets including infants, children, and youth with autism, and related neurodevelopmental disorders (NDDs, attention-deficit/hyperactivity disorder, ADHD, obsessive compulsive disorder, OCD). Presenter #1 will present studies of relationships between distinct functional brain connectivity patterns and specific behavioural domains from the Infant Brain Imaging Study that set the stage for testing whether first-year-of-life fcMRI can be used to predict autism behaviors at 24 months. Presenters #2 and #3 will each present clustering results from two different samples indicating that verbal/nonverbal IQ profiles (Presenter #2: ASD sample) and executive function/ADHD symptoms (Presenter #3: ASD/ADHD sample) can be used to identify subgroups of children featuring distinct clinical presentations and brain imaging profiles (including structural and functional connectivity measures). Presenter #4 will present 4 novel participant similarity subgroups cutting across children with ASD, ADHD or OCD identified using integration of multimodal structural imaging and behavioural data that feature distinct behavior profiles not found using diagnostic labels. The discussant will discuss the potential clinical relevance of presented efforts to disentangle heterogeneity across NDDs.

218.001 *(Panel)* fcMRI Correlates for ASD-Related, Intervention-Relevant Behaviors in Infants and Toddlers

***J. Pruett**, *Co-senior author, **For the IBIS Network, Washington University School of Medicine, St. Louis, MO*

Background: Recent research on brain and behavior development in infants at risk for autism spectrum disorder (ASD) has identified group-based differences in infants at high familial risk (HR: have an older affected sibling) who do and do not later develop ASD and also in comparison to low risk (LR) control infants. The field, however, has yet to identify clinically actionable first-year-of-life predictive behavioral features. On the other hand, investigators in the Infant Brain Imaging Study (IBIS) Network have reported MRI findings in HR infants in the first year of life that have over 80% positive predictive value for a later diagnosis. In addition to replicating these important categorical outcome prediction results, it will be crucial to identify MRI-based biomarkers for dimensionally measured aspects of ASD-related behaviors that are candidate targets for future presymptomatic interventions.

Objectives: We seek to understand better associations between brain functional connectivity and ASD-related behaviors that may fit these criteria.

Methods: Infant Brain Imaging Study (IBIS) investigators collected fcMRI scans during natural sleep from HR and LR infants (overlapping sets of subjects for different analyses with Ns ranging from 87-130 per age group: 12 and 24 months). Image processing included rigorous motion artifact mitigation procedures. fcMRI correlates of ASD-related behaviors, joint attention (the coordinated orienting of two people toward the same object), motor function, and restricted and repetitive behaviors, were characterized using a novel-for-fcMRI statistical approach, fcMRI enrichment, and significance was evaluated using randomization.

Results: We have produced initial descriptions of functional brain networks that associate with initiation of joint attention (IJA), walking and gross motor behavior, and three different subcategories of restricted and repetitive behavior: e.g., visual network – dorsal attention network (DAN) connectivity and visual network – default mode network connectivity for IJA at 12 months ($p < 0.05$ at the brain-wide level via randomization). Unpublished preliminary findings with N=37 subjects contributing clean fcMRI at both ages suggest we may be able to model fcMRI associations with multiple developmentally linked behaviors, e.g., IJA at 12 months and expressive language at 24 months: within DAN connectivity ($p = 2.38 \text{ X } 10^{-8}$ using FDR).

Conclusions: fcMRI-behavior associations across multiple studies in infants at risk for ASD implicate specific functional brain networks at different ages that are specific for different domains of behavioral functioning – IJA, motor function, RRB – and for specific subtypes of behavior within these broader domains, e.g., walking, reaching and grasping; and restricted, stereotyped, and ritualistic-sameness behavior. The demonstration of fcMRI correlates for ASD-related behaviors suggests the future possibility of predicting individual behavioral profiles with an eye to personalized interventions. These initial fcMRI-behavior findings need to be replicated, and we have new funding that will allow us to do so in an independent sample of 250 HR infants, where we will test the power of first-year-of-life fcMRI to predict individual levels of language, social responsiveness, joint attention, and repetitive behaviors at 24 months.

218.002 *(Panel)* Functional Random Forest Reveals Transdiagnostic Hyperactive and Inattentive Subtypes Tied to Executive Function

***E. Feczko**, Emory University, Atlanta, GA*

Background: Overlap between Autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) diagnoses exemplifies the heterogeneity problem, where different mechanisms may lead to the same diagnosis, and childhood outcomes may depend on factors unrelated to mechanism. Multifactorial approaches hope to identify sub or biotypes that overcome this heterogeneity problem, however, most methods employed do not assess whether newly discovered subtypes are relevant to a given childhood outcome.

Objectives: To model the association between executive function and ADHD symptoms across ADHD and ASD children, assess model robustness and then identify subtypes from the model. Subtypes are assessed for stability and characterized by clinical diagnosis and executive function measures, and measures of functional brain organization are used to assess subtype validity.

Methods: Executive function (EF) measures derived from parental assessments (e.g. BRIEF) and cognitive tasks were acquired on an OHSU sample of children aged 7-16 with research-reliable diagnoses with ASD and ADHD. T1-weighted and resting state functional magnetic resonance imaging data were acquired on a subset of these participants alongside a typically developing (TD) sample for a comparative analysis. A Functional Random Forest was used to identify subtypes tied to ADHD hyperactive and inattentive symptom totals from 158 children. EF measures were used as inputs to predict the ADHD symptom totals using a random forest model. The models were assessed via cross-validation and compared to null models. A proximity matrix was derived from each model and Infomap, a community detection algorithm, was used to identify subtypes from the proximity matrix. Subtype stability was assessed via a modularity permutation test. An enrichment analysis and ANOVA tests were used to measure differences in resting state functional connectivity between subtypes and the TD cohort to assess the external validity.

Results: Two sets of transdiagnostic subtypes were identified from hyperactive and inattentive ADHD symptoms. The modularity permutation test showed that subtypes were stable (Q=0.234, p = 0.001). For both hyperactive and inattentive model subtypes, one subtype showed consistently lower performance on tasks and greater severity on assessment measures when compared to the other subtype. Functional connectivity differences between subtypes showed variable patterns, where some networks were more similar to controls for one subtype but not another.

Conclusions: Hybrid methods like the functional random forest provide a framework to discover and assess unknown subtypes relevant to mental health outcomes. Because multifactorial approaches and subtypes remain controversial within the field, such hybrid methods can provide statistical frameworks for resolving this controversy. Here, we found two sets of transdiagnostic subtypes with consistent differences in executive function. However, differences in functional connectivity patterns suggest that these subtypes are not merely examples of more and less severe, but rather may arise from different mechanisms. Out of sample replication of these subtypes remains critical for validation; large-scale samples such as from the adolescent brain cognitive development (ABCD) study may be ideal for such replication.

218.003 *(Panel)* Cognitive Imbalances in Autism Differentially Affect Macroscale Brain Organization

***S. J. Hong**, Child Mind Institute, New York, NY*

Background: Autism spectrum disorder (ASD) is characterized by heterogeneity in a wide range of cognitive functions such as language and perception. Notably, the strengths in one domain appear to co-exist with deficits in other domains, indicating potential atypical cross-modal plasticity. One important example is reduced language skills that tend to co-occur with normal or increased perceptual abilities in non-syndromic ASD. Previous work has assessed a relationship between these behavioral competencies by analyzing verbal and nonverbal intelligence quotient (IQ) in ASD. Yet, its neurobiological underpinnings have not been systematically investigated.

Objectives: To find macro-scale brain substrates for atypical verbal/nonverbal IQ (vIQ/nvIQ) profiles in ASD, and to decompose their variable patterns to find multiple homogeneous subtypes.

Methods: The vIQ/nvIQ measures, symptom severity (calibrated Autism Diagnostic Observation Schedule [ADOS] scales) and magnetic resonance imaging (T1-weighted and resting-state fMRI) in 155 individuals with ASD and 151 neurotypical controls. We assessed the ratio of vIQ/nvIQ to see its imbalance in individuals with ASD, comparing to the neurotypical controls. We also clustered the individuals with ASD based on this ratio using hierarchical clustering. We then associated these cognitive phenotypes to whole-brain cortical thickness and functional connectivity, and decoded the significant brain areas using Neurosynth to identify related cognitive terms.

Results: Compared to neurotypical individuals, ASD showed reduced vIQ/nvIQ ratio, and the lower scores generally correlated with overall symptom severity. Assessing interactions between vIQ/nvIQ and diagnostic group on cortical thickness observed a strong effect in the language areas (*i.e.* inferior frontal areas) in ASD, which functional specificity was confirmed by Neurosynth. Moreover, ASD showed decreased functional connectivity in bilateral temporal areas when seeding from the areas showing thickness associations. Unsupervised clustering of vIQ/nvIQ profiles converged on two different subtypes (ASD1: a group of severely affected vIQ/nvIQ ratio, ASD2: a group of a normal range of the IQ ratio), each related to differential whole-brain cortical thickness and functional connectivity patterns.

Conclusions: Our multimodal imaging correlation analyses suggest convergent anatomical and functional network substrates underlying verbal and non-verbal dimensions of IQ in ASD. Atypical maturation and incomplete pruning of frontal and language-related networks in ASD may be associated to intrinsic functional reconfigurations, and may contribute to autism subtypes with verbal impairment yet relatively intact visuospatial components of intelligence.

218.004 *(Panel)* Integration of Brain and Behavior Measures for Identification of Data-Driven Subgroups Cutting across Children with ASD, ADHD, or OCD

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Background: Autism spectrum disorder (ASD), obsessive-compulsive disorder (OCD) and attention-deficit/hyperactivity disorder (ADHD), are heterogeneous neurodevelopmental disorders (NDDs) with overlapping clinical and biological features. Conventional case-control research using current DSM labels have failed to yield opportunities for clinical translation.

Objectives: To integrate different structural brain imaging and behavioral measures and then apply clustering to define subgroups of children with different NDDs featuring similar brain-behavior profiles and evaluate subgroup stability, validity, and prospective clinical utility.

Methods: Cross-sectional T1-weighted and diffusion weighted magnetic resonance imaging, as well as behavioral/cognitive measures were acquired through the Province of Ontario Neurodevelopmental Disorder (POND) Network (Sick Kids, Holland Bloorview Kids Rehabilitation Hospitals, Toronto, Canada). POND participants aged 6-to-16 with primary ASD, ADHD, or OCD clinical diagnoses were included. Cortical thickness, subcortical volume, and white matter fractional anisotropy neuroimaging metrics, as well as behavioral scores from 182 children with different NDDs were integrated using Similarity Network Fusion. Spectral clustering was applied to a fused participant similarity matrix to delineate data-driven participant similarity subgroups. Normalized mutual information was used to determine top contributing model features. Data-driven subgroup stability, distinguishing features, and potential validity using out-of-model outcome measures were examined. Supervised machine learning was used to examine subgroup identification using top contributing model features.

Results: Four transdiagnostic data-driven subgroups were identified featuring neurobiological distinctions not present in DSM-defined groups. Subgroup differences were stable across resampling and independent of age effects. Identified subgroups also featured distinctions in adaptive (everyday) functioning and structural covariance network efficiency measures that were not included in the subgroup detection model. Using subsets of top contributing model features, participant similarity subgroups were identified with sensitivities ranging from 60-90%.

Conclusions: Integration of multivariate imaging and behavioural data across different NDDs yielded novel transdiagnostic data-driven subgroups that were stable and featured more distinct brain-behaviour profiles on both in and out-of-model outcome measures suggesting their potential utility outside of the current sample. Out of sample replication and longitudinal outcome tracking is needed to evaluate whether data-driven participant similarity subgroups feature the diverging prognostic/treatment response trajectories needed for clinical translation.

ORAL SESSION — **NEUROIMAGING**
322 - Brains, Genes, and Behaviour

322.001 *(Oral)* Non-Replication of Functional Connectivity Differences in ASD across Multiple Sites and Denoising Strategies

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Background: Resting-state functional connectivity MRI (fcMRI) has often been used to describe differences in the functional organization of the brain in ASD, and is touted as an approach that may identify biomarkers of ASD. However, despite over 10 years of investigation and hundreds of studies, findings remain largely inconsistent and robustly replicable results have yet to be identified. It remains an open question whether inconsistencies across studies are primarily due to differences in methodology (i.e., denoising strategy/preprocessing pipeline), or whether site-level effects (e.g., non-harmonized procedures and sample characteristics) may account for discrepancies.

Objectives: Our goals were to: (1) determine the relationships between the different denoising strategies, (2) determine whether ASD-control differences are replicable across independent sites when the same preprocessing pipelines are applied, and (3) determine whether any particular denoising strategy leads to greater replication across sites.

Methods: We analyzed 4 datasets (sites) from the Autism Brain Imaging Data Exchange (ABIDE I and II) comprised of equally-size control and ASD groups ranging from 34 to 44 participants per group. Groups were well-matched within and across sites on multiple characteristics including age, IQ, handedness, and motion. Each of the 4 datasets were analyzed according to 33 different denoising procedures, which included combinations of common preprocessing steps (e.g., motion regression with 6, 12, or 24 parameters, global signal regression (GSR), scrubbing, spike regression, white matter and CSF signal regression, ICA-AROMA). Correlations between functional connectivity matrices were calculated, and the results were visualized using multidimensional scaling (MDS).

Results:

Across sites, we found clear and reliable relationships between different denoising strategies, with the largest effects for the use of GSR vs. not. We also found that the basic functional architecture of the brain was highly replicable across pipelines and across sites, with mean correlations of r = 0.92 (0.06) and r = 0.88 (0.02), respectively. However, group differences, while consistent across pipelines within a single site, were highly inconsistent across sites, regardless of the choice of denoising strategies [mean r = 0.07 (0.04)]. The MDS plot shown in Figure 1 shows that the effect of pipeline is dwarfed by the much larger effect of site. The lack of replicable differences persisted when examining the data at the large-scale network level or when only considering the edges with the largest effect sizes.

Conclusions:

Our results help to identify the sources of variance that likely underlie the inconsistent findings in the literature. While there are reliable effects of the various preprocessing strategies employed, these effects are quite small relative to the large site effects (which may include scanner, acquisition, procedural or cohort differences). Another possibility that should be considered is that functional connectivity differences are small, hard to detect, heterogeneous, or even possibly non-existent at the spatiotemporal scales measured. These results highlight the importance of examining replicability in future studies of ASD, and call for extra caution when interpreting results based on single datasets.

322.002 *(Oral)* Genetic and Environmental Influences on White Matter Integrity in Twins with Autism

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Background: Reduced white matter (WM) integrity is reported in a multitude of studies comparing individuals with autism spectrum disorder (ASD) to typically-developing (TD) controls. However, the type and degree of these alterations are heterogeneous across individuals, which may be associated with the variable effects of genetic and environmental influences on brain development.

Objectives: The primary objective of this investigation was to examine WM integrity in twins with ASD compared to TD control twins to identify tract-specific differences in the impact of genetic and environmental factors.

Methods: Same-sex monozygotic (MZ) and dizygotic (DZ) twin pairs in which at least one twin was diagnosed with ASD or both were TD controls (aged 6-15 years) were recruited to participate. Diffusion weighted MRIs were obtained and processed with the FSL Diffusion Toolbox to extract skeletonized fractional anisotropy (FA) images from each participant. Intra-class correlations were computed within twin pairs and compared between the diagnostic and control groups. ACE modeling for broad sense heritability (a^2=additive genetics) and environmental influences (c^2=shared family environment, e^2=unique environment) was also examined to provide estimates for the proportions of variation associated with genetic and environmental factors. FA was best fit with either the AE or CE model in all instances for both groups.

Results: Good quality data were available from 154 twins [29 concordant ASD twin pairs (15 MZ,14 DZ); 15 discordant ASD twin pairs (3 MZ,12 DZ); and 33 concordant TD twin pairs (20 MZ,13 DZ)]. Average FA was reduced in twins with ASD compared to TD controls (M_{diff}=-0.01, 95% CI [-0.02,-0.004]) as well as in twins with ASD compared to unaffected co-twins (M_{diff}=-0.01 [-0.02,-0.002]). Although average FA was primarily genetically-mediated in both the TD (a^2=0.80 [0.57,1.02]) and ASD twin pairs (a^2=0.71 [0.33,1.09]), there were also ASD-related differences in the impact of genetic and environmental influences on tract-specific measures. FA in all of the tracts that were assessed was primarily genetically-mediated in TD twins (a^2=0.52 to 0.80), except for the superior longitudinal fasciculus, corticospinal tract, and cerebellar peduncles (c^2=0.41 to 0.74). Conversely, tract-specific FA was predominantly associated with environmental factors in twins with ASD, including the superior longitudinal fasciculus, corticospinal tract, and cerebellar peduncles (c^2=0.56 to 0.77) as well as the posterior thalamic radiation, sagittal stratum, and internal/external capsules (c^2=0.34 to 0.60). Twin pair differences in FA were also associated with differences in symptom severity.

Conclusions: Previous twin studies reported that WM is predominantly genetically-mediated in TD adults but our findings suggest that some WM tracts may be more heavily influenced by environmental factors earlier during typical development. Environmental factors may also have a more pervasive impact on WM development in children and adolescents with ASD, which in addition to our preliminary examinations of structural grey matter measures in this pediatric twin sample suggest that children with ASD may be more susceptible to environmental influences during development. Future studies should examine the critical periods and specific environmental factors that are associated with this increased susceptibility to help identify new potential therapeutic pathways for children with ASD.

322.003 *(Oral)* Examining Neural Habituation to Repeated Sounds in Children, Adolescents and Adults with and without Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is often characterised by behavioural rigidities and sensory processing atypicalities that can significantly impact daily functioning and quality of life. These behaviours may manifest as a result of reduced habituation to sensory stimuli. Habituation describes the process whereby neural responses to frequently repeated stimuli diminish over time. If habituation is reduced, the stimuli may be experienced as repeatedly novel, prompting sensory overload/hypersensitivity. Insistence on sameness behaviours may in turn be coping responses to atypical experiences of sensory sameness.

Objectives: To examine neural habituation to repeated sounds in ASD and comparison individuals and investigate whether reduced habituation relates to sensory atypicalities and/or restricted, repetitive behaviour (RRB) in ASD.

Methods: Participants were individuals from the EU-AIMS LEAP cohort both with (N=256) and without (N=191) ASD, aged 6-30 years (*M*=16.37, SD=5.49) with IQs ranging from 40-148 (*M*=99.2, SD=19.45). EEG was recorded during an auditory oddball paradigm, comprising 82% 'standard tones' (1000Hz, 50ms) and 18% 'deviant tones' (3 deviant types: 6% frequency, 6% duration, 6% combined frequency/duration). Event-related brain responses were compared across first, second and third presentations of standards after a deviant and between diagnostic groups using linear mixed-effects models to investigate habituation to repeated sounds (S1, S2, S3). Both amplitude and latency of the P1 component were estimated at Fz from the most positive amplitude within the time period of 50ms to 150ms. Sex, age and IQ associations were also examined. In the ASD group, associations between S1-S3 difference scores and both RRB (Repetitive Behaviour Scale-Revised, RBS-R) and sensory atypicalities (Short Sensory Profile, SSP) were analysed using Spearman's correlations.

Results: For amplitude, a significant interaction between diagnosis and response type was observed ($F_{(2,888)}$=5.36, p=.0050; Fig1A). Post-hoc tests revealed a larger amplitude on first responses compared to second responses in the control group (t=3.45, p=.0077, d=0.23; Fig1B), but no significant differences between responses 1 and 3 or 2 and 3 (p=.2 and p=.9, respectively). In the ASD group, no differences between response types were observed (ps>.9). For latency, the effect of diagnosis was approaching significance ($F_{(1,443.91)}$=3.58, p=.059, d=-0.12), however there was no main effect of response type nor interaction (ps>.2). Older age was significantly associated with larger amplitude (b=-0.12, p=6.72e-16) and did not interact with diagnosis (p=.8), whilst diagnosis interacted with IQ on latency, such that higher IQ was related to shorter latency only in the control group (b=-0.30, p=0.017). In the ASD group, reduced habituation (a smaller S1-S3 difference) was significantly associated with more RRB symptoms (RBS-R total r_s=-0.19, p=.0052), specifically RBS-R Ritualistic-Sameness (r_s=-0.18, p=.0074; Fig1D) and RBS-R Restricted Interests (r_s=-0.21, p=.0017; Fig1E). These correlations remained significant when controlling for age (Ritualistic-Sameness r_s=-0.16, p=.019; Restricted Interests r_s=-0.19, p=.0046). Associations with sensory symptoms were not significant (SSP total r_s=0.11, p=.2).

Conclusions: There was evidence of initial habituation in the TD group but not in the ASD group. Within the ASD group, reduced habituation was associated with increased ritualistic-sameness behaviour and restricted interests. Behavioural rigidities may act as coping strategies for reduced neural habituation, here in the auditory domain.

322.004 *(Oral)* ADHD Comorbidity Modulates the Association between Cumulative Genetic Load for Autism Spectrum Disorder and Amygdala Structural Development

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Background: Autism Spectrum Disorder (ASD) is a highly heritable disorder with a complex polygenic architecture(Huguet, Benabou, & Bourgeron, 2016). Polygenic scores for ASD (PS-ASD) measure the cumulative genetic load for ASD at an individual level, allowing the investigation of the association between the polygenic component of ASD and its biological features. Core social symptoms have been associated to alterations in brain regions modulating social behaviour, like the amygdala, a central structure in emotional cognitive processing. In particular, neuroimaging studies have reported lower amygdala volume in ASD(van Rooij et al., 2018).

Objectives: To test the potential role of amygdala structural alterations as intermediate phenotype for ASD, we investigated the association between polygenic scores for ASD and amygdala volume. Furthermore, given the high genetic overlap between ASD and attention-deficit/hyperactivity disorder (ADHD), we investigated the effect of ADHD comorbidity on the association between PS-ASD and amygdala volume.

Methods: Polygenic scores for ASD were computed on 343 ASD cases and 241 typically developed controls from the EU-AIMS Longitudinal European Autism Project (Loth et al., 2017). Amygdala volumes were obtained from automatic subcortical segmentation on 348 individuals between 7 and 31 years of age (240 males), from four different outcome groups: typically developed individuals (TD, n=137), ASD cases (n=176), individuals with intellectual disability but not ASD (ID-controls, n=9), and ASD cases with intellectual disability (ID-ASD, n=26). We used a regression model to test whether PS-ASD would predict amygdala volume while accounting for age, gender, intelligence quotient (IQ), outcome group, site of data acquisition, and ADHD comorbidity. Amygdala volumes were corrected for intra-cranial volume.

Results: We found a significant correlation between polygenic liability for ASD and for ADHD ($r=0.23$, $p<10^{-3}$), supporting the idea of shared genetic liability between the disorders. The regression model showed a significant interaction between PS-ASD and ADHD comorbidity ($b=12.25$, $p=0.04$). In particular, PS-ASD had a negative marginal effect on amygdala volume in non-ADHD individuals ($b=-0.35$, $p=0.06$), while the effect was reversed but not significant in individuals with ADHD ($b=0.38$, $p=0.22$; Figure 1). We also found a significant main effect of site ($b_{site2}=-0.33$ and $b_{site5}=-0.25$ $ps<10^{-3}$), and a marginal effect of IQ ($b=-0.12$, $p=0.065$). Of note, adding PS-ADHD as a covariate did not improve model fit ($F(1,333)=1.82$, $p=0.18$), and its main effect was not significant ($b=-0.07$, $p=0.18$).

Conclusions: We conceptualize that cumulative effects of common genetic variants associated with ASD lead to changes in amygdala structure, in turn influencing social development and resulting in the ASD social phenotype. ADHD comorbidity interplays with the cumulative genetic load for ASD to modulate its association with amygdala structure. In particular, there was a marginally significant association only without ADHD comorbidity, with higher polygenic load for ASD linked to smaller amygdala volume. While previous studies report no difference between ASD and ADHD in subcortical volumes(Baribeau et al., 2019), our findings suggest a more complex interaction between the two disorders at a genetic level, affecting the resulting association with the structural brain phenotype. Further analysis of single variants might help disentangle the comorbidity effect on amygdala structure.

POSTER SESSION — **NEUROIMAGING**
435 - Neuroimaging Posters

435.001 *(Poster)* A Cross-Species Link between mTOR-Dependent Deficient Synaptic Pruning and Functional Hyper-Connectivity in Autism

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Background: Post-mortem examinations have revealed an excess of excitatory synapses in the brains of children with autism spectrum disorders (ASD). Recent investigations have linked this trait to hyper-activity of the mTOR pathway, resulting in synaptic pruning deficits [1]. ASD is also characterized by alterations in brain functional connectivity as measured with resting state functional MRI (rsfMRI). These observations raise the question of whether and how mTOR-related deficient pruning affects rsfMRI dysconnectivity observed in ASD.

Objectives: Our work probes a mechanistic link between mTOR dysfunction and fMRI dysconnectivity in ASD. To this aim, we mapped dendritic synaptic density, rsfMRI connectivity [2] and social behavior in tuberous sclerosis 2 deficient ($Tsc2^{+/-}$) mice, a mouse line that mechanistically reconstitutes mTOR-dependent dendritic spine surplus observed in ASD [1]. A separate cohort of animals was subjected to a daily treatment with the mTOR inhibitor rapamycin with the aim to rescue the synaptic surplus, and establish a link between synaptic traits and brain-wide connectivity.

Methods: ***Mouse studies***. Animal studies were conducted in accordance with the Italian Law (DL 26/2014). We used a cross-sectional treatment protocol with four cohorts of n=20 animals each: control $Tsc2^{+/+}$ mice treated with rapamycin; control $Tsc2^{+/+}$ mice treated with vehicle; mutant $Tsc2^{+/-}$ mice treated with rapamycin; mutant $Tsc2^{+/-}$ mice treated with vehicle. After daily treatment during pre-pubertal phase [1], $Tsc2^{+/-}$ and control mice underwent rsfMRI mapping as previously described [2]. Inter-group differences in rsfMRI connectivity were mapped using weighted degree centrality (WDC) and seed-based analysis (SBA) [3]. Post-mortem dendritic spine density was measured as in [1]. ***Human studies:*** We used WDC and SBA to map rsfMRI connectivity in pre-pubertal (age range 7-13) children with ASD (n=163) and typically developing controls (n=168) from ABIDE-1 collection [4].

Results: We observed increased spine density and long-range rsfMRI over-connectivity in basal ganglia and polymodal cortical areas of $Tsc2^{+/-}$ mice, and found that hyper-synchronization of insular and striato-prefrontal regions was predictive of motor sterotipies in these mice. Developmental treatment with rapamycin completely normalized synaptic density, rsfMRI hyper-connectivity and behavioral alterations in $Tsc2^{+/-}$ mice. These results implicate a possible causal link between mTOR-related pruning deficits, rsfMRI hyper-connectivity and fronto-insular dysfunction. Given the prominent implication of mTOR pathway dysfunction for human ASD [1], we hypothesized that a similar hyper-connected phenotype should be identifiable in clinical ASD populations. In keeping with mouse findings, rsfMRI connectivity mapping in pre-pubertal children revealed increased long-range connectivity in the anterior insula, basal ganglia and prefrontal cortices in children with ASD with respect to typically developing controls. Furthermore, insular prefrontal over-connectivity was significantly associated with repetitive behaviors, reconstituting the phenotype observed in $Tsc2^{+/-}$ mice. We finally found that TSC2/mTOR-network genes appear to be expressed in a similar topological pattern as the identified ASD hyper-connectivity phenotype, establishing a putative mechanistic link between the observed hyperconnectivity and mTOR-related aberrant activity in ASD.

Conclusions: Taken together, our results establish a possible mechanistic link between mTOR-dependent deficient synaptic pruning and rsfMRI over-connectivity in ASD.

435.002 *(Poster)* A Longitudinal Diffusion Weighted Imaging Study of White Matter Development in Autism across Early Childhood

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Background: Diffusion weighted magnetic resonance imaging (DWI) studies of autism indicate atypical white matter (WM) microstructure in autism spectrum disorder (ASD). While a large body of evidence suggests older children, adolescents and adults with autism have decreased fractional anisotropy (FA) across several commissural, projection, and associative fiber tracts, a smaller literature in young preschool aged children (i.e. <30-50 months) suggests autistic individuals have increased FA earlier in development.

Objectives: We sought to characterize the longitudinal trajectory of WM diffusion properties associated with autism in a sample of male and female children across early childhood.

Methods: We analyzed 135 individuals with ASD diagnoses (91♂,44♀) and 83 typically developing controls (46♂,37♀), who successfully completed at least two DWI acquisitions over the course of three annual follow-up visits from ~2-6½ years of age. DWI were acquired in 30 independent directions with five interleaved *b*0 images. Images were pre-processed using MRtrix3, including; 1) image denoising, 2) Gibbs artefact correction, 3) eddy current correction, 4) outlier detection and replacement, and 5) between and within volume motion correction. A longitudinal registration protocol was used to map individual's FA maps to the JHU-ICBM WM atlas and extract median FA values across 13 tracts of interest. Linear mixed effects modeling was used to investigate diagnostic differences in developmental trajectories. Each model included diagnostic group, sex, pre-post scanner update, and ROI as categorical fixed effect factors, age, cerebral volume, absolute and relative movement as continuous covariates, and individual as a random effect with age as a random slope. For each tract, age was modeled by selecting from series of fractional polynomials [-3, -2, -1, -0.5, 0.5, 1, 2, 3] shown to have the lowest log likelihood and thus provide the best fit.

Results: The corpus callosum and bilateral cingulum, superior longitudinal fasciculi (SLF), internal capsules, and sagittal striatum all showed significant (FDR $p<0.05$) age-by-diagnosis interactions in measures of FA. By 6½ years of age, these tracts showed decreased FA in both males and females with ASD. However, trajectories within several WM regions including the body and splenium of the corpus callosum, SLF and internal capsules suggest an inflection point around 30-35 months where younger individuals with ASD showed increased FA.

Conclusions: Our findings provide longitudinal evidence that individuals with ASD have an altered WM developmental trajectory characterized by increased FA in young childhood and decreases later in life. The inflection point for this transition appears to be around 30-35 months of age, but varies by tract and for some regions may occur prior to the age of diagnosis. Next steps will be to investigate the behavioral consequences associated with altered WM development in autism, including associations with autism severity and intellectual ability.

435.003 *(Poster)* A Machine Learning Approach for Grading Autism Severity Levels Using Task-Based Functional MRI

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Background: Some autism characteristics can be observed as early as 12 months old with the advent of brain medical imaging modalities and the recent state of the art machine learning algorithms. In general, task-based fMRI is used for addressing evoked blood oxygen level-dependent (BOLD) signals in all brain regions with response to certain tasks belonging to a range of different task domains. Studies in literature statistically examined the hemodynamic effects associated with task-control using the general linear model (GLM). The focus of previous studies was to analyze or diagnose autism disorder in two groups of ASD or normal, which is not sufficient for addressing differences among subjects across the wide autism spectrum.

Objectives: The goal of this study is to utilize brain processing and analysis tools as well as machine learning algorithms for developing an autism severity grading approach to diagnose each autistic subject as mild, moderate or severe autistic. Hence, presenting a more specialized objective computer aided diagnosis (CAD) system to provide a better early diagnosis and treatment plan for each autistic subject individually having different autism severity.

Methods: A novel framework for grading the severity level of autistic subjects using task based fMRI in a speech experiment (Fig. 1), consisting of four audio stimulus, is presented with the following steps: 1) preprocessing using fMRI expert analysis tool (FEAT) included in fMRIB's software library (FSL). 2) feature extraction with multi-level general linear model (GLM) averaged for each brain area according to the Brainnetome atlas (BNT). 3) classification and severity grading according to ADOS reports using recursive feature elimination (RFE) and random forest (RF) classifier. To validate our results, we applied higher level analysis to have more insightful analysis about the overall group differences and match with selected features of each brain area

Results: This study is conducted on" Biomarkers of Autism at 12 Months: From Brain Overgrowth to Genes" dataset obtained by the National Database for Autism Research (NDAR). The adopted dataset consists of 39 subjects (13 subjects per group). we use random forest classifier in both RFE and classification. We used a 10-folds cross validation technique and calculated the accuracy of classification. The achieved accuracy is 76%. We have validated our selected features in our classification by comparing them with the most activated areas in the group analysis. High intersection between the selected areas by RFE, in the feature selection step, with the top activated areas in each group is revealed.

Conclusions: In this study, we introduce a machine learning based approach for autism severity grading on the autism spectrum. To the best of our knowledge, this is the first effort to utilize task based fMRI for this goal. With a limited number of subjects (n = 39), our algorithm achieved accuracy of 72% using random forest classifier following recursive feature elimination. We also applied group analysis to validate selected features and study common group brain activation.

435.004 *(Poster)* A Twin Study of Sensory Processing in Children with Autism Spectrum Disorder

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Background: Differences in sensory processing are associated with autism spectrum disorder (ASD) and may be related to structural differences in the primary sensory processing regions in the brain, such as auditory processing difficulties and the primary auditory cortex. Neurobiological variation across individuals in these brain regions is linked with different genetic and environmental factors during brain development.

Objectives: The primary objective was to examine the relationship between sensory processing difficulties and brain regions involved in sensory processing in twins with and without ASD to determine whether brain-behavior relationships are related to genetic or environmental factors.

Methods: Monozygotic (MZ) and dizygotic (DZ) twin pairs aged 6-15 years participated in this study. FreeSurfer was used to process T1-weighted MRI scans and generate structural neuroimaging measures of the brain. The Short Sensory Profile (SSP) was used as a measure of sensory processing. Intra-class correlations and ACE modeling (a2=additive genetics, c2=shared environment, e2=unique environment) for broad sense heritability was used to estimate the influence of genetic and environmental factors these measures. Brain-behavior relationships were also examined between structural brain measures and the domain-specific subscales of the SSP.

Results: Analyses included data from 148 twins [26 concordant ASD twin pairs (13 MZ,13 DZ), 17 discordant ASD twin pairs (3MZ,14DZ), and 31 concordant TD twin pairs (18 MZ,13 DZ)]. Brain-behavior relationships were observed across several sensory domains but one of the most prominent was between auditory filtering and the superior temporal gyrus, a region integral to auditory processing. Auditory filtering difficulties were more severe in twins with ASD (M=13.33,SD=5.12) than TD controls (M=24.98,SD=3.65); $p<0.001$. These difficulties were also more severe in twins with ASD (M=18.75,SD=4.55) compared to their unaffected co-twins (M=26.44, SD=3.61); $p<0.001$. Grey matter (GM) in the left and right STG was also thicker in twins with ASD (M_{left}=3.18,SD=0.19; M_{right}=3.18,SD=0.18) compared to TD twins (M_{left}=3.09,SD=0.17, $p<0.04$; M_{right}=3.09,SD =0.17, $p<0.05$) as well as twins with ASD (M_{right}=3.21,SD=0.13) compared to their unaffected co-twins (M_{right}=3.09,SD=0.19); $p<0.03$. Additionally, GM thickness exhibited significant genetic contributions in TD twins (a2=0.44[0.11,0.78]) but was primarily environmentally mediated in twins with ASD (c2=0.80[0.68,0.93]). GM differences between twin pairs were also associated with auditory filtering differences in MZ (r=-0.36,p=0.003) but not DZ twin pairs, $p>0.05$, further supporting environmental influences on these brain-behavior relationships.

Conclusions: Our findings indicate that the presence of some sensory processing difficulties in children with ASD may be associated with the impact of environmental factors on GM development in the primary sensory processing cortices in the brain. These observations also support previous studies implicating the STG with differences in auditory processing as well as our preliminary examination of global level GM thickness in which twins with ASD exhibited greater environmental influences across the brain compared to TD controls. Future research into the specific environmental factors that impact sensory processing difficulties in children with ASD may provide useful therapeutic targets for minimizing these difficulties.

435.005 *(Poster)* Absence of White Matter Abnormalities in Males with Autism: A Quality-Controlled, Diffusion Tensor Imaging Study

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Background: Diffusion Tensor Imaging (DTI) has been used to investigate the neural phenotype of autism spectrum disorder (ASD) by detecting potential differences in structural brain connectivity. Previous DTI studies report widespread, although heterogeneous, white matter (WM) differences in individuals with ASD. Many of these studies supported reductions Fractional Anisotropy (FA) in males with ASD compared to typically developing (TD) controls (Aoki et al., 2013). However, in later studies which follow stringent data quality control protocols (Kwondelyn et al., 2014; Yendiki et al., 2014), these findings were not replicated. In fact, Lei et al. (2019), which implemented stringent data quality control, suggests that females with ASD exhibit widespread reductions in FA compared to female TD controls, while males with ASD exhibit no differences when compared to male TD controls. These inconsistent findings highlight the need for future investigation on differences between the neural phenotype of males with ASD compared to TD males.

Objectives: To evaluate differences in WM between males with ASD and TD males using DTI.

Methods: Subjects included 35 males, 21 subjects with ASD (age = 21 ± 7.7 years), and 14 TD controls (age= 25.4 ± 7.6 years). T1-weighted and diffusion-weighted MRI (directions = 6 and b0 = 1) were acquired using a 1.5-Tesla scanner. FMRIB Software Library (FSL) was used to process/analyze diffusion-weighted data and compute the following WM microstructure metrics: fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD) and radial diffusivity (RD). Voxel-wise analysis of multi-subject diffusion data was conducted using FSL's Tract Based Spatial Statistics (TBSS). Areas of significant difference were computed using Threshold-Free Cluster Enhancement (TFCE) and displayed as p-value images, where $p < 0.05$ corrected for multiple comparisons across space.

Results: The groups did not differ on age ($p = .076$). ASD males had significantly lower FSIQ (M=103.1+/-10.9) than TD controls (M=112.6+/-9.8) ($p=.013$). There were no significant group differences on FA, MD, AD, or RD between ASD groups and TD controls.

Conclusions: No significant between group effects were observed between male ASD and TD participants. These null results are consistent with recent findings by Lei et al. (2019) suggesting that using stringent data quality control measures, abnormalities exist between ASD females and TD females, but are not apparent between ASD males and TD males. Lack of statistically significant differences does not preclude that aberrant WM microstructure exists in ASD males, especially if the effects are small. Future studies should investigate whether current findings replicate in much larger studies with closely-matched comparison groups.

435.006 *(Poster)* Altered Social Cognition and Connectivity of Default Mode Networks in the Co-Occurrence of Autistic Spectrum Disorder and Attention Deficit Hyperactivity Disorder

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Background: As two common neurodevelopmental disorders, autistic spectrum disorder and attention deficit hyperactivity disorder frequently occur together.

Objectives: Until now, only a few studies have investigated the co-occurrence of attention deficit hyperactivity disorder and autistic spectrum disorder, this is due to restrictions associated with previous Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision. Most previous research has focused on the developmental trajectories for autistic spectrum disorder and attention deficit hyperactivity disorder separately, while the neural mechanisms underpinning the co-occurrence of autistic spectrum disorder and attention deficit hyperactivity disorder remain largely unknown.

Methods: We studied 162 autistic spectrum disorder individuals (including 79 co-attention deficit hyperactivity disorder and 83 non-attention deficit hyperactivity disorder patients) and 177 typical developing individuals using resting-state functional magnetic resonance imaging data from the Autism Brain Imaging Data Exchange II, an aggregated magnetic resonance imaging dataset from 19 centers. Independent component analysis was used to extract sub-networks from the classic resting-state networks. Functional connectivity values within (intra-iFC) and between (inter-iFC) these networks were then determined. Subsequently, we compared the ASD_coADHD group with the ASD_nonADHD group in relation to the abnormal intra-iFC and inter-iFC of autistic spectrum disorder group relative to the typical developing group.

Results: The ASD_coADHD group showed more severe social impairment and decreased intra-iFC in the bilateral posterior cingulate cortex of the default mode network (independent component 17) and increased inter-iFC between the default mode network (independent component 8) and the somatomotor networks (independent component 2) compared to the ASD_nonADHD group. In addition, the strength of the intra-iFC in the default mode network was associated with the severity of autistic traits across the entire autistic spectrum disorder group and particularly the ASD_coADHD group.

Conclusions: Our results showed that dysfunction of the default mode network is a central feature in the co-occurrence of autistic spectrum disorder and attention deficit hyperactivity disorder, including connectivity within the default mode network as well as between the default mode network and the somatomotor networks, thus supporting the existence of a clinically combined phenotype (autistic spectrum disorder + attention deficit hyperactivity disorder).

435.007 *(Poster)* Anomalous Auditory Object Binding in Autism Spectrum Disorder

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Background: Auditory processing deficits have been extensively documented in ASD, and neurophysiological signatures of these abnormalities have been mapped using a variety of paradigms. To date, the vast majority of such studies focused on the neural signatures resulting from the processing of stimuli such as tones or speech sounds. Tones, simple or complex, presented in isolation, do not elicit synchronous activity or require binding. Speech sounds, in contrast, are highly complex and meaningful auditory structures, and can be referred to as "auditory objects". Organizing auditory information into coherent auditory objects, i.e. the binding of acoustic features into auditory objects, is fundamental to the proper decoding of auditory information, but we do not fully understand the nature of the deficits associated with type of processing in ASD.

Objectives: The objective of the study was to understand the extent to which abnormal perceptual binding of acoustic features may contribute to perceptual auditory deficits in ASD.

Methods: A novel auditory stimulus was developed, where the temporal coherence of different acoustic features could parametrically manipulated such that the acoustic features formed into auditory objects with increasing salience as the temporal coherence was increased. We then used magnetoencephalography (MEG) to study the neurophysiological responses to this stimulus at varying levels of temporal coherence, in 26 typically-developing (TD) children and 21 children with ASD, who were age (8-17), sex, and IQ matched.

Results: We found that children with ASD showed impaired sensitivity to the temporal coherence that promotes perceptual binding of acoustic features into auditory objects. The extent of the auditory processing deficits varied directly with the ability to neurophysiology bind auditory objects. While evoked responses increased in magnitude with increasing coherence in the TD group, the evoked responses flattened with increasing coherence in the ASD group. The extent to which this was the case correlated significantly with both the sensory processing score, obtained using the Sensory Processing Questionnaire, and the severity of communication deficits, measured using the ADOS communication subscore.

Conclusions: These findings offer novel insights into the mechanisms underlying auditory perceptual deficits of ASD. Given that temporal coherence is an important binding cue in natural sounds, the reduced sensitivity in ASD to temporally synchronized auditory stimuli likely contributes to poorer object binding. In scenarios with multiple sound sources, this could lead to poorer segregation of the sounds into individual objects, contributing to sensory overload and impaired auditory selective attention. The reduced ability to bind the stimulus into objects in the ASD group is also consistent with the atypical activity of GABAergic neurons, given the role of the GABAergic system in object binding. Our observations thus also contribute to our understanding of the specific mechanisms underlying the ways in which abnormal GABAergic function might ultimately lead to some of the most common sensory processing deficits in ASD.

435.008 *(Poster)* Anxiety but Not Sensory over-Responsivity Is Associated with Attrition in Resting State fMRI Research in School Age Children with Autism and Developmental Delay

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Background: Prevalence studies suggest 40% of children with autism spectrum disorders (ASD) will develop an anxiety disorder. One pathway through which anxiety disorders are hypothesized to develop is sensory over-responsivity. Children with developmental delay (DD), while experiencing similar levels of sensory over-responsivity, exhibit lower rates of anxiety than children with ASD, while still higher than the general population. Resting state fMRI (rs-fMRI) research could provide an essential lens into neurobiological mechanisms through which sensory over-responsivity differentially contributes to the development of anxiety. However, due to the nature of MRI acquisition, it's possible anxiety and sensory over-responsivity could also uniquely contribute to attrition in this sample of children.

Objectives: This study aims to investigate patterns of attrition within a sample of children with ASD and DD participating in a rs-fMRI protocol, and to examine if clinical profiles predict which children will be unable to attempt or complete an MRI.

Methods: This sample consisted of 86 school-age children (M=110mo; SD=22mo) participating in a study exploring shared neurobiological etiology between ASD and DD. Participants completed clinical assessments, a mock scan, and an rs-fMRI protocol lasting approximately 25 minutes involving a fixation crosshair and a standardized movie. Autism diagnosis and severity were obtained using the ADOS, with additional diagnoses collected via parent checklist. Anxiety, sensory over-responsivity, and sensory over-responsivity to sound were measured using the CBCL, SSP, and SensOR, respectively.

Attrition occurred in 3 distinct ways: 1) ten families declined to participate in the MRI protocol, including the mock session, 2) six participants completed a mock session but declined an MRI visit, and 3) six participants attempted an MRI but were unable to complete the full rs-fMRI protocol. As participants in these attrition groups demonstrated relative homogeneity across variables of interest (p's > 0.5), we collapsed these participants into a singular group to compare to children who completed the full rs-fMRI protocol. Fisher's exact tests and generalized linear models were used to determine if clinical variables predicted scan completion.

Results: When comparing MRI completers to the attrition group, no statistically significant differences were found related to age, elevated sensory over-responsivity, sensory over-responsivity to sound, or number of co-occurring diagnoses. Participants unable to attempt or complete the scan were significantly more likely to have elevated anxiety scores than those who completed the MRI (72% versus 46%; p= 0.035; OR: 0.33). For participants with ASD, ASD symptom severity did not significantly predict MRI completion rates.

Conclusions: Although 91% of our sample of children with ASD and DD who attempted an MRI successfully completed our rs-fMRI protocol, 29% of children from the original sample were lost to attrition in various forms. Children with elevated anxiety were at greater risk for attrition, however, sensory over-responsivity did not predict attrition. Future research should target approaches for engaging participants in MRI research during various stages of the process, and explore additional desensitization procedures that effectively reduce the effects of anxiety on MRI participation.

435.009 *(Poster)* Association of Self-Regulation with White Matter Microstructural Property in Boys with and without Autism Spectrum Disorder

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Background: Self-regulation, the ongoing and dynamic modulation of action, emotion and cognition, plays an important role in co-occurring psychopathology in individuals with autism. Previous studies demonstrated distinct neural correlates underpinning impaired self-regulation (dysregulation) between individuals with autism spectrum disorder (ASD) and typically developing controls (TDC). However, white matter (WM) correlates of dysregulation in ASD and TDC remain unclear.

Objectives: To investigate WM correlates of dysregulation in intellectually able boys with ASD and TDC boys, we leveraged recent advances in multivariate analysis, canonical correlation analysis, CCA, and the diffusion spectrum imaging (DSI) tractography.

Methods: Diffusion spectrum imaging was acquired in 59 ASD and 62 TDC boys. We investigated the relationship between participants' dysregulation levels and microstructural property of 76 WM tracts in a multivariate analysis (canonical correlation analysis), across diagnostic groups. CCA was used to identify the maximum co-variation between individuals' behavioral characteristics related to self-regulation and WM property.

Results: The application of CCA identified one significant mode (r = 0.59, FWE-corrected p = 0.005) of interdependences between WM property patterns and the diagnosis, diagnosis by dysregulation interaction and general cognitive function (FIQ). his mode corresponds to diagnosis-distinct correlates underpinning dysregulation, which showed higher generalized fractional anisotropy (GFA) associated with less dysregulation in ASD but greater dysregulation in TDC, in the tracts connecting limbic and emotion regulation systems. Moreover, higher GFA of the tracts implicated in memory, attention, sensorimotor processing, and perception associated with less dysregulation in TDC but worse dysregulation in ASD. No shared WM correlates of dysregulation between ASD and TDC were identified.

Conclusions: These findings not only support a notion that self-regulation encompasses multiple cognitive processes, but also suggest indispensable diagnosis-specific strategies when advancing therapeutics for dysregulation in individuals with ASD.

435.010 *(Poster)* Associations between Elicited Motor Imitation and Visual-Motor Cortical System Morphology in Children with and without Autism Spectrum Disorder

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Background: Studies show that children with Autism Spectrum Disorder (ASD) demonstrate poorer elicited motor imitation compared to typically-developing (TD) controls, with associations of greater symptom severity and impaired social behaviors. Investigations of the neural correlates involved in elicited motor imitation reveal recruitment of motor and visual-motor networks. However, there lacks brain-behavior investigations using objective, quantitative assessment of motor imitation.

Objectives: To examine diagnostic effects on motor imitation, measured using a novel, highly-reliable, Computerized Assessment of Motor Imitation (CAMI), and associations with brain morphologies of motor and visuomotor network regions in children with ASD and TD controls.

Methods: The present study included data from 52 participants (27 ASD) ages 8-12 years old. Motor imitation was assessed using CAMI applied to a task during which children imitated a sequence of limb and whole-body movements performed by an avatar. Volume, surface area (SA), and thickness of the inferior parietal lobe (IPL), superior temporal sulcus (STS), supplementary motor complex (SMC) and primary motor cortex (M1) were defined in FreeSurfer v6.0 for both hemispheres (LH and RH). All analyses covaried for total cerebral volume. ANCOVAassessed effects of diagnosis on CAMI and brain morphologies.

Results: A multivariate GLM revealed a significant diagnostic effect on CAMI ($p<0.001$), such that children with ASD demonstrated worse imitation than TD controls ($\bar{X}_{ASD}=0.31$, $\bar{X}_{TD}=0.54$). Analyses also revealed a significant diagnostic effect on RH STS SA ($p=0.014$), RH SMC SA ($p=0.042$), and LH M1 thickness ($p=0.044$), such that children with ASD show greater SAs and thickness ($\bar{X}_{ASD}=4166.15$, $\bar{X}_{TD}=3855.17$; $\bar{X}_{ASD}=1749.25$, $\bar{X}_{TD}=1603.17$; $\bar{X}_{ASD}=2.76$, $\bar{X}_{TD}=2.67$ respectively). No significant correlations between CAMI and brain morphology were observed in the whole group. Looking within diagnostic groups, a significant positive correlation was found in TD controls between CAMI and LH SMC SA ($r=0.36$, $p<0.05$). Further, positive correlations trending toward significance were observed between CAMI and the following morphologies in the TD group: RH SMC SA ($r=0.35$, $p=0.05$), LH SMC volume ($r=0.32$, $p=0.07$), and RH M1 SA ($r=0.34$, $p=0.06$). Positive and negative correlations trending toward significance were found in between CAMI and the following morphologies in the ASD group: LH STS volume ($r=0.361$, $p=0.059$), RH STS volume ($r=0.365$, $p=0.057$), and RH M1 SA ($r=-0.349$, $p=0.066$).

Conclusions: Findings confirm previous reports revealing increased regional visuomotor cortical system SA and thickness in children with ASD compared to TD controls. Examination of motor imitation correlates suggest that for children with ASD poorer imitation is associated with reduced STS volume but increased M1 SA. In contrast, associations for TD children appear localized to motor/premotor regions with poorer imitation associated with reduced SA in SMC/M1. The findings suggest dissociable brain-behavior relationships underlying motor imitation in children with ASD vs. TD children.

435.011 *(Poster)* Associations of Inferior Parietal Cortex Structure with Behavioral and Linguistic Measures of Social Communication Impairments in Children with Autism

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Background: Social communication impairments in autism spectrum disorders (ASD) manifest in both behavioral and linguistic domains. Within the behavioral domain, mimicry of others' gestures, known to facilitate prosociality and interpersonal rapport is observed less frequently and synchronously in individuals with ASD as compared to typically-developing (TD) individuals (Helt et al., 2010). Within the linguistic domain, children with ASD produce more poorly-constructed narratives than their TD peers (Baixauli et al, 2016). Individuals with ASD show increased gray matter volume (GMV) and thickness in the inferior parietal cortex (IPC) (Brieber et al, 2007; Hyde et al, 2010), an area implicated in social cognition, language, and gesture imitation/praxis. Given these differences in early brain development in ASD, altered IPC structure may be associated with these behavioral and linguistic social-communicative impairments.

Objectives: This study examined the relationships among mimicry, narrative storytelling structure, and IPC structure (i.e., thickness and GMV), and how these relationships differ in children with ASD compared to TD children.

Methods: Participants included children aged 8-12 years (22 ASD, 24 TD); groups did not differ on age, sex, or total cerebral volume. Participants completed a story narration activity, during which they watched a video of a narrator telling a brief story and performing specific actions (yawning, arm scratching, face rubbing). Children's retellings were coded for the *proportion of story elements retold* (narrative structure) and *frequency of mimicked actions*. Structural metrics of IPC morphology were derived using FreeSurfer, applied to T1-weighted images acquired using a 3T Phillips scanner.

Results: Children with ASD showed reduced mimicry (p=.04) and presented fewer story events (p=.02) than TD children. There was a significant group difference in IPC, with increased thickness (p=.04) and GMV (p=.03) across hemispheres in the ASD group. A multiple regression test revealed a significant interaction between IPC GMV and diagnosis on story event production, such that increased IPC volume was associated with *poorer* story event production in children with ASD, but *better* story event production in TD children (F(1,45)=5.37, p=.03). The opposite pattern was found for the interaction effect of IPC thickness and diagnosis on story event production: TD children with increased IPC thickness produced fewer story events (F(1,45)=5.64, p=.02). Additionally, there was a significant interaction effect of IPC thickness and diagnosis on mimicry, such that TD children with increased IPC thickness showed increased mimicry (F(1,42)=4.35, p=.04). Figure 1 illustrates the diagnosis effect on, and interactions between IPC volume, IPC thickness, story event production and mimicry.

Conclusions: Children with ASD exhibited less spontaneous mimicry, produced fewer story events, and had increased IPC GMV and thickness relative to TD children. Examination of brain-behavior associations indicated that volumetric differences in the IPC may contribute to poorer narrative structuring abilities and impaired gesture mimicry in children with ASD. These findings elucidate the involvement of the IPC in behavioral and linguistic impairments in ASD.

435.012 *(Poster)* Atypical Deactivation Order Associated with Posterior Default Mode Network in Autism Spectrum Disorder

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Background: Earlier studies have reported differences in resting state network (RSN) function between individuals with autism spectrum disorder (ASD) and neurotypical (NT) individuals but have not fully considered the temporal propagation patterns across the brain. Recent studies have shown atypical time lag variations across brain regions in ASD. These studies have analyzed the lag structure by computing cross-correlation function for the full-time series (Mitra et al. 2015) or by dynamic lag analysis (DLA) method (Raatikainen et al. 2019) which measures time lag variations peak-by-peak between RSNs and statistically defines how the lag patterns are altered between NT and ASD. Despite the growing interest in temporal propagation patterns, the nature of dynamic deactivation patterns in ASD is still unknown.

Objectives: The aim of this study was to investigate dynamic negative phase lag variations between RSNs in ASD compared to NT individuals by utilizing the DLA method.

Methods: The study population consists of 20 young adults (age 23.7[3.2]; 5 females) who had been diagnosed with ASD in their childhood based on ICD-10 criteria and 20 NT controls (age 25.3[6.2]; 4 females). Resting state data were acquired using a Siemens 3T Skyra scanner with fast fMRI sequence (10Hz). Preprocessing was performed using a typical FSL pipeline as described in Raatikainen et al. (2019). Group level ICA (independent component analysis; model order 40) was used to identify 16 resting-state networks (RSNs) for dynamic lag analysis (DLA). DLA was applied to groupwise concatenated very low frequency (VLF) time signals to reveal the time lag variation between RSNs pairs as in Raatikainen et al. (2019), in exception that lags were measured between negative peaks of the time signals (Fig.1A).

Results: After investigating 120 combinations of RSNs pairs applying the DLA method, statistically significant differences in negative-to-negative lag patterns between the NT and ASD groups were found in three network pairs including posterior default mode network (DMN): DMN_{pcc} (posterior cingulate cortex) - V1 (primary visual network; p= .001), $DMN_{precuneus}$ – Salience network (p< .001) and $DMN_{precuneus}$L (left) – CEN (central executive network; p= .002), see Fig.1B. When examining dynamic lag distributions in these network pairs, there was a distinct directionality in the deactivation pattern in the NT group: in majority of the lags negative phase of the posterior DMN follows negative phase of V1, Salience network and CEN (median lag positive). Furthermore, order between these RSNs was less evident in ASD, especially between interplay of $DMN_{precuneus}$-Salience network pair. Moreover, the lag count was 29%, 20% and 9% higher in the NT than ASD group in DMN_{pcc}-V1, $DMN_{precuneus}$L-CEN and $DMN_{precuneus}$-Salience, respectively.

Conclusions: The NT group showed a robust directionality in deactivation where the posterior DMN deactivation followed deactivations of three other RSNs. In the ASD group the directionality was more random between the posterior DMN and other networks. Weaker directionality in connectivity may be linked to restricted attention shifting in ASD.

435.013 *(Poster)* Atypical Development of Language Network Functional Connectivity in Infants at High Risk for ASD

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Background: Altered functional connectivity is characteristic of developmental disorders involving language impairment such as autism spectrum disorder (ASD). Individuals with ASD show altered connectivity in several resting-state networks compared to neurotypical controls. In particular, youth with ASD show altered interhemispheric functional connectivity between primary and secondary auditory cortices as well as atypical temporo-thalamic connectivity associated with social behavioral symptoms. Toddlers with ASD display disrupted synchronization of language areas, suggesting that early disruptions in functional connectivity may be predictive of later language impairments associated with the disorder. Prior studies have examined the emergence of functional network atypicalities in infants at high familial risk for ASD, but little is known about the development of functional connectivity within auditory-language networks in at-risk infants.

Objectives: We used resting-state fMRI (rsfMRI) to characterize the development of functional connectivity networks underlying auditory and language processing during the first year of life in infants at high (HR) and low familial risk (LR) for ASD.

Methods: During natural sleep, 8-minute rsfMRI scans were collected in infants at 1.5 and 9 months of age. Preprocessing was performed using FSL. To correct for effects of head motion, an advanced ICA-based strategy for automatic removal of motion artifacts (ICA-AROMA) was used. We first examined seed-based connectivity of primary and secondary auditory cortices (left/right Heschl's gyrus and posterior superior temporal gyrus) at 1.5 and 9 months of age. Time-series extracted from processed residuals in standard space were correlated with every other voxel to generate functional connectivity maps. We examined group differences for functional networks associated with each seed separately. Next, we modeled longitudinal changes over time in network connectivity using linear mixed models in R to examine emerging differences in the functional connectivity between auditory and language-processing regions as well as the thalamus. More specifically, we investigated the effects of risk group within each time point, the effects of time point within each risk group, and the interaction between risk group and time point.

Results: As early as 1.5 months of age, functional connectivity underlying the integration of auditory and motor representations, which is crucial for language development, was already atypical in HR infants. By 9 months of age, HR infants showed hyperconnectivity with somatosensory regions whereas LR infants displayed greater connectivity with higher-order cortical regions. Over the first year of life, widespread changes with increasing long-range connectivity and decreasing short-range connectivity were observed in the LR group, whereas HR infants showed limited developmental changes. More specifically, the LR group exhibited increasing connectivity between frontotemporal language regions and decreasing temporo-thalamic connectivity from 1.5 to 9 months of age, whereas HR infants displayed relatively static developmental profiles.

Conclusions: Extending prior work showing altered functional connectivity in infant siblings at high risk for ASD, this is the first study to characterize longitudinal development of language-related networks in this population. Collectively, our findings suggest that emerging differences in language-related network connectivity can be detected across the first year of life, which may provide an early marker of risk for ASD or other suboptimal developmental outcomes.

435.014 *(Poster)* Atypical Intrinsic Visual Motor Functional Connectivity Is Associated with Imitation Deficits in Autism

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Background: Motor imitation, commonly reported to be impaired in autism spectrum disorder (ASD), is critical for social-communicative skills and requires simultaneously integrating visual and motor input. Abnormal functional connectivity (FC) between networks comprising brain regions responsible for higher-order visual processing and motor control has been shown in children with ASD (Nebel et al., 2016). Moreover, this visuo-motor asynchrony was found to be associated with increased autism severity and predicted better imitation of recognizable hand gestures in typically developing (TD) children. In this study, we explored how visual-motor processing deficits are related to motor imitation during a task comprising unfamiliar, limb and whole-body movements and measured using a novel and highly reliable, Computerized Assessment of Motor Imitation (CAMI).

Objectives: To investigate the relationship between visual-motor FC and imitation ability using a novel, highly-scalable videogame task.

To explore the relationship between visual-motor FC and autism severity.

Methods: Resting-state functional magnetic resonance imaging (rsfMRI) scans were acquired from 30 children (14 ASD and 16 TD) aged 8-12 years. Imitation performance was assessed using CAMI applied to a brief, highly-engaging task, during which children imitated unfamiliar dance moves of a video avatar in three one-minute trials. CAMI algorithm, validity-checked by comparisons with human coding in a previous study, automatically detected the important joints and returned a score considering the spatial and temporal differences between the child and the avatar. Group Independent Component Analysis (ICA) was applied to rsfMRI data. Previously-generated spatial map templates corresponding to visual components (VC1, VC2, VC3) and two motor components (upper-limb: UL, and lower-limb: LL) were used to extract those components with the highest spatial similarity to each component of interest. FC between each pair of participant-specific motor and visual component time-courses was computed. Brain-behavior associations were examined between FC of each visual-motor component pair and: (1) motor imitation (mean CAMI score), and (2) impaired social-communicative function core to autism (Social Responsiveness Scale, SRS-2). Age, mean framewise displacement, and number of image volumes used to calculate FC were included as covariates in the regression models.

Results: As compared to TD, children with ASD displayed poorer imitation (p=0.0001) and greater FC between the VC2-UL visual-motor pair (p= 0.06, d= -0.70; Figure 1A). In addition, children with ASD who demonstrated more in sync VC2-UL intrinsic activity were worse at imitation (t= -2.380, p= 0.041; Figure 1B), such that a 0.1 increase in VC2-UL synchrony in the ASD group was associated with a 0.15 decrease in imitation score compared with the TD group. No other visual-motor pair was a significant predictor of imitation (all ps> 0.14) and no visual-motor pair significantly predicted SRS-2 scores.

Conclusions: Our findings reveal that children with ASD show an anomalous pattern of increased visuo-motor synchrony. Moreover, this increased visuo-motor synchrony significantly predicted poorer motor imitation of unfamiliar, limb and whole-body movements in ASD as compared to the TD group. These findings add to our understanding of the interplay of altered visual-motor integration and imitation skills in ASD.

435.015 *(Poster)* Auditory Evoked Magnetic Fields and Language Performance in Young Children with ASD

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Background: Atypical auditory neuromagnetic responses have been reported in children who have autism spectrum disorder (ASD). Some studies have reported the relationship between these brain responses to sounds and human voices and language ability. However, there are still many questions regarding the relationship between language development and brain function in young children with ASD.

Objectives: The purpose of this study is to investigate brain responses evoked by sound using magnetoencephalography (MEG) in young children and to investigate the relationship with language ability.

Methods: 35 typically developing (TD) children (70.8±4.0 month) and 38 children with ASD (73.4±10.4 month) participated in this study. MEG data were recorded using a 151-channel superconducting quantum interference device (SQUID), whole-head coaxial gradiometer MEG system for children (PQ 1151R; Yokogawa/KIT, Kanazawa, Japan). We used the oddball paradigm consisting of two types of sinusoidal tone (standard 523Hz and deviant 1046Hz). Brain responses (P1m, N1m and N2m) evoked by standard stimuli were used in this analysis. The intensity and latency in P1m, N1m and N2m were compared between TD children and children with ASD. Furthermore, the relationship between brain responses (P1m and N2m) and language abilities were investigated in each group. As an index of language abilities, we used the language subtest (i.e. riddles) in K-ABC and Japanese version of picture vocabulary test – revised (PVT-R).

Results: For P1m, components met the criteria were detected 28/35 in the left hemisphere and 17/35 in the right hemisphere in TD children, 32/38 in the left hemisphere and 25/38 in the right hemisphere in children with ASD. For N1m, 5/35 in the left hemisphere and 12/35 in the right hemisphere in TD children, 6/38 in the left hemisphere and 8/38 in the right hemisphere in children with ASD. For N2m, 34/35 in the left hemisphere and 35/35 in the right hemisphere in TD children, 33/35 in the left hemisphere and 31/35 in the right hemisphere in children with ASD. As a result of independent samples t-test, there was no significant difference in any brain responses in both hemispheres between TD children and children with ASD. In the relationship between the brain response and language abilities, there was a significant positive correlation between N2m intensity in the left hemisphere and the standard score of PVT-R (N= 33 r=0.444 *P*=0.010) and negative correlation between N2m latency in the right hemisphere and standard score of PVT-R (N=34 r=-0.412 *P*=0.016) in TD children. In children with ASD, there was no significant correlation between brain responses and language abilities in children with ASD.

Conclusions: The current results showed that there was no significant difference in brain responses (P1m, N1m and N2m) to tone between TD children and children with ASD children aged 5 to 8 years. In TD children, the shorter latency and larger intensity in N2m components correlated with the higher the language comprehension ability, however the same relationship was not seen in children with ASD. This result suggests that the possibility that an abnormality of maturation of infantile myelination affects language development.

435.016 *(Poster)* Autism Diagnosis Framework Using Diffusion Tensor Imaging

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Background: Autism Spectrum Disorder (ASD), commonly known as autism, is developmental disorder associated with a broad range of symptoms depicted as difficulties in social interaction, communication skills, and behavioral patterns. Being caused by differences in the brain, numerous studies were presented suggesting abnormal development of neural networks in the brain in shape, functionality, and/ or connectivity. The aim of this work is to present our automated computer aided diagnostic (CAD) system for accurate diagnosis of autism based on the connectivity of the white matter (WM) tracts. To achieve this goal, two levels of analysis are provided for local and global scopes, where diffusion tensor imaging (DTI) data is utilized. A local analysis using Johns Hopkins WM areas' atlas is exploited for DTI segmentation. The proposed system was tested on a large data set of 263 subjects.

Objectives: To use DTI to achieved global accuracy and local diagnostic accuracies to allow for a better understanding of ASD-related brain abnormalities.

Methods: Anonymized MRI scans were obtained for 263 subjects (131 females and 132 males, 122 autistics and 141 typically developed) from NDAR database. The framework mainly consists of three stages: first, a preprocessing step to reduce artifacts and eliminate non-brain tissues, including skull stripping and eddy current correction. In the second stage, feature extraction, WM integrity is examined by extracting most prominent features representing WM connectivity from DTI. Six different features (fractional anisotropy, axial and radial diffusivities, mean diffusivity, and skewness) are calculated based on the 3 eigenvalues λ_1; λ_2, and λ_3 on each voxel, and atlas-based segmentation technique is used to allocate features for each area, on John-Hopkins white matter atlas. After that, interactions of WM features between different areas in the brain, demonstrating correlations between WM areas' features were used, and feature selection among those correlations are made. Finally, a Leave-one-subject-out classifier is employed to get the final diagnosis, as well as spotting the brain areas correlations with ASD vs normal behavior.

Results: To ensure system robustness, we used Leave one subject out approach (LOSO) for validation at all runs. For each WM area, overall accuracy, sensitivity, and specificity were calculated. To obtain the subject global diagnosis decision, two steps are used. First, features are ranked based on the s2n score, then iteratively first *n* is fed to next step, with n starting from 1 to 250. Selected features are concatenated, and SVM classifiers are used to obtain probabilities of being autistic given these features, providing a single global decision per subject, which achieved a diagnostic accuracy of 71%, sensitivity of 0.72, and specificity of 0.7.

Conclusions: This promising work provides not only fast and high early-stage diagnostic accuracy, but also allows identifying the localized abnormalities for each individual subject, characterized by the areas of highest rank, which may aid in understanding the autistic subject behavior and help the clinician to deliver a tailored personalized treatment. More medical interpretation to map the impacted regions to the corresponding expected behaviors is needed to validate the personalized maps.

435.017 *(Poster)* Autism Polygenic Risk Is Associated with Larger Caudate and Cerebellar Cortex Volume in Youth with ASD

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Background: Genetic liability for autism spectrum disorder (ASD) is mostly conferred through the additive effects of common genetic variants across the genome (Gaugler et al., 2014). Only very recently have genome-wide association studies (GWAS) of ASD achieved sufficient power to detect ASD-associated single nucleotide polymorphisms (SNPs) reaching genome-wide significance (Grove et al., 2019). A number of previous imaging-genetics studies have investigated the effects of common SNPs on neuroimaging measures in ASD, but have been limited by small sample sizes and/or have focused on ASD candidate genes. To date, there has been no large-scale study incorporating well-powered ASD GWAS to examine the effects of polygenic risk for ASD on brain structure in children.

Objectives: To examine the relationship between polygenic risk for ASD and magnetic resonance imaging (MRI) measures of brain volume, surface area (SA), and cortical thickness in a large sample of youth with/without ASD.

Methods: Participants were of European ancestry and consisted of 81 youth with- and 4,465 unrelated youth without ASD. Data were acquired and processed as part of the multi-site Adolescent Brain and Cognitive Development study; curated data were accessed through the National Data Archive. Genetics data were imputed to the TOPMed reference panel using the Michigan Imputation Server (Das et al., 2016). Polygenic risk scores (PRS) were computed from publicly available summary statistics (Grove et al., 2019) using PRSice-2 (Choi et al., 2019), covarying for age, sex, and 20 ancestry principal components. To test the association between PRS and 80 bilateral measures of brain structure, linear mixed effects models were generated using the lme4 package in R, covarying for age, sex, 20 ancestry principal components, IQ, whole brain volume (WBV), and scan site as a random effect. FDR corrected results at $q<0.05$ and standardized betas (B) are reported.

Results: ASD youth had higher PRS for ASD relative to non-ASD youth ($t=-2.02$, $q=0.04$); ASD PRS explained 0.7% of the variance in case-control status (Nagelkerke R^2). In ASD youth, higher PRS was associated with reduced mean SA (B= -0.200) and WBV (B=-0.204). At the regional level, higher PRS was associated with greater volume in the left and right cerebellar cortices (B=0.319 and 0.316, respectively) and left caudate (B=0.322). No significant associations were observed in youth without an ASD diagnosis between PRS and brain structure measures.

Conclusions: These findings indicate that, in high-functioning 9-10-year-old youth with an ASD diagnosis, polygenic risk for autism is associated with increased volume of subcortical brain regions, particularly of the cerebellar cortex. These findings are in agreement with mounting evidence from human postmortem studies, animal models, and molecular neuroscience suggesting a critical role for the cerebellum in the etiology of ASD (Fernandez et al., 2019).

435.018 *(Poster)* Characterizing Cerebellar-Thalamic-Cortical Structural Covariance in 125 Mouse Models of Autism Spectrum Disorder

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Background: The cerebellum is a frequent site of dysfunction in Autism Spectrum Disorder (ASD). It is also a highly integrated structure with connections throughout the brain, particularly to the cortex via the thalamus. Deficits within this circuitry have been shown to negatively affect neurodevelopment and lead to ASD-related behaviours such as social withdrawal (Wang et al., 2014).

By measuring how changes in volumes covary between regions, the strength of covariance can be used as a proxy for connectivity (Alexander-Bloch et al., 2013). This could provide insight into how cerebellar connectivity differs in ASD compared to typically developing brains. This exploratory analysis is well-suited for brain imaging using mouse models of ASD, which can be imaged at high resolution and high throughput.

Objectives: To characterize patterns of cerebellar-thalamic-cortical structural connectivity across mouse models of ASD.

Methods: 125 ASD models comprised of 3231 adult mice (32.8% female) were imaged on a 7-Tesla MRI scanner with a T2-weighted fast spin echo sequence. A 40um isotropic atlas with 434 segmented structures (Watson et al., 2017; Dorr et al., 2008) was registered to the brain scans using ANTS (Avants et al., 2010). Pairs of cerebellar and cortical structures were tested for statistically significant covariance by fitting a linear model to the volumes. If a pair of structures were found to significantly covary, thalamic regions were tested to assess whether they mediated this covariance (Barron & Kenny, 1986). An interaction model was used to compare 10 clusters of ASD mouse models against their respective wild-type controls (clusters were established using hierarchical clustering based on median change in regional volumes, originally presented in an Ellegood et al. 2018 INSAR abstract). P-values were False Discovery Rate-adjusted across all tests. To validate this approach, positive and negative controls were also tested, consisting of well-established thalamus-mediated pathways (e.g. medial lemniscus, ventroposteromedial thalamic nucleus, somatosensory cortex) and random trios of brain regions, respectively.

Results: 96.2% of all significantly mediated cerebellar-thalamic-cortical trios were attributed to cluster nine (Table 1), which also had the greatest median mediation effect size. Effect size was defined as the difference in the normalized absolute values of $\beta_{Crus1,a}$ and $\beta_{Crus1,b}$ from the equations in figure 1, where V denotes volume and m_{mut} is a binary factor for mutant/wild-type status. Figure 1 illustrates the most significant cortico-cerebellar covariance from this cluster and its mediating thalamic nucleus ($|\beta_{Crus1,b}|<|\beta_{Crus1,a}|$, and the difference plus-or-minus its standard error did not contain zero). Crus 1 volumes covaried with the right cingulate cortex with the greatest statistical significance compared to other cortico-cerebellar pairs. Mediating thalamic nuclei included the ventral anterior nucleus, paraxiphoid nucleus, anteromedial nucleus, paracentral nucleus (which have connections to the prefrontal cortex), ventral lateral nucleus, and pregeniculate nucleus. 87% of positive control pathways were significant, and all negative control pathways were non-significant.

Conclusions: Crus 1 volumes significantly covary with the cingulate cortex in a cluster of ASD models, particularly left crus 1 to right cingulate cortex. This covariance is mediated by thalamic nuclei with diffuse connections throughout the frontal, prefrontal and cingulate cortices.

435.019 *(Poster)* Children with ASD Show Atypical Electrophysiological (EEG) Responses to Processing Pragmatic and Semantic Incongruencies.

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Background: Studies have demonstrated that even with intact language skills people with autism spectrum disorder (ASD) still experience difficulties with processing contextual linguistic information and pragmatic language prossesing. ERP studies have previously reported a negative deflection in the ERP signal around 400 milliseconds post-stimulus onset (the N400) in participants who were typically developing (TD) and diagnosed with Asperger's syndrome, but not in those diagnosed with autism (Pijnacker, Geurts, van Lambalgen, Buitelaar & Hagoort, 2010).

Objectives: The present study used event-related potentials to investigate potential alterations in how children with ASD process semantic and pragmatic (contextual) incongruencies when compared to TD children.

Methods: Data were collected from multiple children during four single-day summer camps using methods previously developed by our research group (Moreno et al., 2015, 2011). We recruited a population of 75 children, 33 ASD participants (mean age [years] 9.7 ±5.6) and 42 TD participants (mean age [years] 9.3 ±2.51). Individuals with an IQ less than 70 were excluded from the study. The EEG was recording using ENOBIO systems with eight channels (EOG1, EOG2, Fz, Cz, Pz, F7, F8, CP6). On each trial, participants saw an image on a computer screen and listened to two word sentences that might describe the present image correctly (congruent condition, e.g. “rubbing eyes”), might make no sense (semantic incongruent condition, e.g “rubbing sky”) or would make sense but not correspond to the image (pragmatic/context incongruent condition e.g. “rubbing lips). Participants were asked to respond by selectinga tick if the sentence corresponded to the image, and a cross, if it did not, as schematically illustrated in the Figure 1. EEG data were band-pass filtered between 1 and 30 Hz, epoched between 200 ms before and 600 ms after the onset of second word presentation, and filtered using Independent Component Analysis (ICA) by removing components which were highly correlated with the EEG dynamics recorded by ocular channels (EOG1 and EOG2). The ERPs were computed for each participant, condition, and channel. A multivariate analysis was applied to compare the ERP signals across conditions, separately for each group and EEG channel.

Results: Our preliminary results showed no statistically significant differences in the ERP across conditions in the ASD group for any of the EEG channels. However, we found robust differences in the ERP between conditions in the TD group, for four out of six EEG channels. Specifically, performing the congruent task condition elicited a greater positive response when compared to the semantic incongruent and pragmatic incongruent conditions in the TD group. The most robust differences in the ERP response across conditions were observed between 300 and 600 ms after the onset of the second word presentation.

Conclusions: The children with ASD showed an atypical electrophysiological response to the semantic and pragmatic incongruencies (i.e. showed larger N400 for incongruent than congruent conditions). These results support clinical observations of the difficulties that individuals with ASD often have understanding the meaning of words in context and point to potential differences in language processing between children with and without ASD.

435.020 *(Poster)* Corneal Confocal Microscopy: A Surrogate Marker for Neuro-Degeneration in Autism

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Background: Autism spectrum disorder (ASD) is a developmental disorder characterised by difficulty in communication and interaction with others. Most studies have focused on central alterations with postmortem studies showing cerebral neuronal loss and diffusion tensor imaging showing small fibre loss in face-perception and inter-hemispheric regions of the brain. However, recent studies show altered peripheral sensory perception thresholds and intraepidermal nerve fibre loss in ASD.

Objectives: To determine whether there is corneal nerve loss in children with ASD.

Methods: Corneal confocal microscopy is a rapid non-invasive ophthalmic imaging technique that has demonstrated corneal c-fibre loss in peripheral (diabetic neuropathy, CIDP, CIPN) and in central (Parkinson’s disease, multiple sclerosis, stroke, dementia) neurodegenerative disorders.

Results: Eight children with ASD (age: 14.13 ± 3.30 years) and eighteen age-matched children without ASD (age: 13.55 ± 2.82 years) underwent corneal confocal microscopy (CCM) to quantify corneal nerve fiber density (CNFD), corneal nerve branch density (CNBD) and corneal nerve fiber length (CNFL).

There was a significant reduction in CNBD (46.03 ± 24.00 vs. 85.97 ± 26.71, $p = 0.0001$), CNFL (16.51 ± 3.58 vs. 24.71 ± 4.06, $p = 0.01$), with no difference in CNFD (29.75 ± 5.58 vs. 33.21 ± 7.60, $p = 0.277$) in children with ASD compared to children without ASD.

Conclusions: Corneal confocal microscopy identifies distal corneal nerve fibre loss in children with ASD compared to children without ASD. Larger studies are required to determine the utility of CCM as a surrogate imaging biomarker for neuronal loss in relation to MRI abnormalities and behavioral alterations in patients with ASD.

435.021 *(Poster)* Correlations between fNIRS-Based Cortical Activation and Synchronized Sway, Social Communication Skills, Adaptive Functioning, and Motor Skills in Children with and without Autism Spectrum Disorder (ASD)

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Background: Children with ASD have impaired social communication skills and motor performance that together affect their ability to engage in socially-embedded actions, such as interpersonal synchrony (IPS). Using functional near infrared spectroscopy (fNIRS), we have reported atypical cortical activation in children with ASD as they synchronized whole-body sway motions with an adult over the Observation-Execution Matching Systems (OEMS) including lower activation in the Inferior Frontal Gyrus (IFG) and Superior Temporal Sulcus (STS) and greater activation in the Inferior Parietal Lobe (IPL) activation. However, we do not know the relationships between cortical activation patterns and their IPS behaviors, social communication skills, adaptive functioning, and motor skill performance in children with/without ASD.

Objectives: We correlated cortical activation during synchronized sway to IPS variables (coherence and phase lag), social communication, adaptive functioning, and motor performance in children with/without ASD.

Methods: Seventeen school-age children with and without ASD participated in this study. The children were asked to a) sway face to face with an adult partner (Face condition), and b) sway with an adult and with their fingertips touching (Touch condition). Each participant wore a cap embedded with a 3x11 fNIRS probe set that covered the bilateral middle frontal gyrus (MFG), pre- and postcentral gyrus (PCG), IFG, STS, and IPL. Inertial measurement units were placed on the center of mass of the child and the adult to calculate the coherence and phase lags between partners during synchronized sway. The caregivers of the children completed the Social Communication Questionnaire (SCQ) and Vineland Adaptive Behavioral Scales (VABS) questionnaires. We also administered the manual dexterity and the upper-limb coordination subtests of the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) to assess the children's manual coordination skills. Parametric and non-parametric correlations were conducted to investigate associations between cortical activation and sway behaviors, SCQ, VABS, and BOT-2 scores.

Results: We are still analyzing our data. Our pilot data are based on correlation findings in children with ASD. For the IPS behaviors, we found that children with ASD who showed greater phase lag during Touch had greater left MFG activation (r=0.34, $p<0.01$). Children with ASD with greater SCQ scores (more impairment) had lower right IPL activation during Face (r=-0.38, $p<00.1$). Children with ASD with lower VABS total scores had lower left IPL, right PCG, and right STS activation during Face and lower left STS and lower right IFG activation during Touch (rs>0.30, $p<0.05$). Lastly, children with ASD with lower manual coordination scores had lower left PCG activation during Face (r=-0.353, $p<0.01$) and lower left MFG and right STS activation during the Touch (r=0.31 and -0.34 respectively, $ps<0.05$).

Conclusions: Children with ASD who had greater IPS impairments relied on greater executive functioning. Children with ASD who showed lower OEMS activation also had lower social communication scores, lower adaptive functioning, and poor motor coordination skills. We may have identified fNIRS-based cortical neurobiomarkers that could be used as treatment response measures to determine who will benefit and what to expect following synchrony-based interventions.

435.022 *(Poster)* Cortical Gyrification Morphology in Individuals with ASD and ADHD across the Lifespan: A Systematic Review and Meta-Analysis

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Background: Autism Spectrum Disorder (ASD) and Attention-Deficit Hyperactivity Disorder (ADHD) are relatively common neurodevelopmental disorders (NDDs) with a high rate of symptom overlap. Magnetic Resonance Imaging (MRI) has been used extensively to study atypical brain development in both NDDs, however, cortical gyrification as a specific measure derived from MRI has not been thoroughly investigated in ASD and ADHD literature.

Objectives: To the best of our knowledge, no systematic review or meta-analysis has been conducted to qualitatively and quantitatively synthesize cortical gyrification findings simultaneously in ASD and ADHD literature. We are conducting a systematic review to synthesize existing literature on cortical gyrification morphology in both NDDs with the aim of enhancing our understanding of what is known regarding shared and disorder-specific gyrification features in these two disorders. We are also quantitatively synthesizing local gyrification findings in ASD literature by conducting a meta-analysis, and further conducting a meta-regression to explore whether differences found in gyrification between individuals with ASD and typically developing (TD) peers depend on the potential contributing effects of age, sex, intelligence (IQ) and/or sample size.

Methods: Guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology was implemented for study identification and selection. Seed-based d Mapping, formerly "Signed Differential Mapping" (SDM), meta-analytic software was used for conducting the meta-analysis on ASD studies focusing on the computation of the local gyrification index (lGI) measure.

Results: Twenty-nine studies, investigating cortical gyrification morphology in ASD and ADHD relative to typical development across the lifespan, met the inclusion criteria for the systematic review. The findings are highly contradictory with evidence of greater, reduced, or no different cortical gyrification in individuals with ASD and ADHD relative to TD peers across different cohorts. Although the direction of change and specific regions of atypicality are not clear, studies in this review point towards heterogeneity in the atypicality of cortical gyrification in both NDDs. Ten ASD studies met the inclusion criteria for the meta-analysis, consisting of a total of 527 participants with ASD and 450 TD participants. The results are not statistically significant after correction for multiple comparisons, perhaps due to insufficient statistical power resulting from the limited number of included studies. However, with a more liberal threshold ($p<0.1$) trends are observed, specifically greater lGI in individuals with ASD compared to TD peers in clusters located in the temporal (p=0.06), frontal (p=0.07) and occipital (p=0.07) lobes. The meta-regression yielded no significant effects of age, sex, IQ or sample size.

Conclusions: The highly contradictory findings of the systematic review and null results of the meta-analysis may reflect insufficient statistical power as a result of the limited number of included studies, the heterogeneous nature of ASD and ADHD or high variability of cortical gyrification construct itself observed even in normative data. Future large-scale studies are needed to identify specific regions of large effects and to adequately address contributions of age, sex and intelligence in this phenomenon in ASD and ADHD.

435.023 *(Poster)* Cortical Volume Truncation – a New Freesurfer Measure to Capture the Asymmetric Distribution of Grey Matter Volume between Brain Surfaces

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Background: Autism Spectrum disorder (ASD) is a complex neurodevelopmental condition accompanied by manifold differences in brain morphometry. Among others, neuroanatomical abnormalities in ASD include differences in the development of grey matter volume, which has extensively been studied in the past (Courchesne et al., 2001; Hazlett et al., 2011; Ecker et al., 2017). However, traditional analyses do not assess how grey matter volume is distributed along the depth of the cortical mantle (i.e. across cortical layers). This is of importance as ASD-related genes have been shown not to be equally expressed across all cortical layers, but may affect either the superficial (Parikshak et al., 2013) or the inner (Willsey et al., 2013) layers differentially, which in turn may impact on cortical lamination and folding.

Objectives: In the present study, we aimed to (1) develop a new feature assessing the surface-based distortion of grey matter volume across cortical surfaces, and (2) to utilize this feature to characterize differences in brain morphometry between individuals with ASD and typically developing controls (TD).

Methods: We included 92 adults with ASD and 92 neurotypical controls, aged 18-52 years. For all 184 participants, T1-weighted volumetric images were acquired. Cortical surface models were extracted using FreeSurfer (http://surfer.nmr.mgh.harvard.edu/). Vertex-wise estimates of 'Cortical Volume Truncation' (CVT) across layers were calculated as the ratio of the expected volume based on the outer grey-matter surface (V_E) and the actual (i.e. analytical) volume (V_A) (Winkler et al., 2018). Initially, we examined the relationship between CVT and other cortical measures to explore its biological plausibility. Subsequently, we examined differences between ASD and TD by regression of a GLM at each vertex with (1) group, gender, and site as categorical fixed-effects factors, (2) an age-by-group interaction term, and (3) age and FSIQ as continuous covariates.

Results: The spatial distribution of CVT appeared to approximate the normal distribution, capturing information on both cortical volume and brain geometry, and followed the outline of primary and secondary gyri and sulci (Figure 1A). More specifically, measures of CVT were significantly positively associated with surface area, cortical thickness, and cortical volume ($p<0.05$), and significantly negatively correlated with mean curvature (Figure 1B). Following correction for multiple comparisons (RFT-based cluster-corrected, $p=0.05$), we found that the degree of CVT was significantly increased in ASD relative to TD in many cortical clusters, including inferior parietal, superior temporal, and cingulate regions (Figure 2A). In several areas, vertex-wise measures of CVT were also significantly positively correlated with symptom severity measured by the Autism-Spectrum Quotient (AQ) (Figure 2B). Furthermore, we were able to replicate the results of the between-group differences in gender-specific analyses (Figure 2C&2D).

Conclusions: Our findings suggest a larger contribution of supragranular, rather than infragranular, layers to regional differences in cortical volume in ASD compared to TD. We also replicated our initial finding in males and females with the condition. The degree of CVT might therefore serve as a novel in vivo proxy measure assessing volumetric gradients along the depth of the cortical mantle and may guide future studies into the genetic underpinnings of ASD.

435.024 *(Poster)* Decreased Activation of Executive Control Network during Driving Hazard Detection in Autism Spectrum Disorder

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Background: Driving difficulties of adult drivers with autism spectrum disorder (ASD) are well documented in the literature, including difficulty responding to hazards on the road. In particular, previous studies have indicated that individuals with ASD have difficulty responding to social hazards (e.g., pedestrians) within the traffic environment compared to other hazard types (objects on the road). Differences in several social and cognitive skills have been purported to underlie driving difficulty in ASD, including attention, executive function, and theory of mind. The purpose of this study was to characterize the neuropsychological and neurobiological mechanisms underlying driving hazard detection in ASD drivers using functional neuroimaging.

Objectives: To examine differences in functional brain responses between ASD and typically developing (TD) adult drivers in response to various hazards during a driving hazard detection task.

Methods: Twenty-nine participants (13 ASD, 16 TD, 16-30 years, matched on age and sex) completed a driving hazard detection task in a Siemens Prisma 3 Tesla MRI scanner. Participants watched a video of a simulated driving scene from the perspective of a driver in which potential hazards approached the roadway intermittently. Hazard events were presented in a jittered, event-related design. Hazards differed in whether they contained a human component (social versus nonsocial hazards). Social hazards consisted of pedestrians, bicyclists, and other drivers; nonsocial hazards consisted of a barrel, ball, and tumbleweed. Participants pressed a button, akin to braking while driving, at the time that they would react to hazards if they were actually driving. Whole-brain within-group and between-group differences in functional activation for the social versus nonsocial condition were examined (Monte Carlo Simulation correction p=.005, cluster=84).

Results: Within-groups results indicated that the ASD participants recruited regions within the bilateral temporal/parietal lobes and bilateral inferior frontal gyrus. The TD group exhibited broader activation patterns, encompassing inferior, medial, and superior frontal regions, temporal/parietal regions, as well as cerebellar and occipital regions. Compared to the TD group, the ASD showed greater activation in the right inferior parietal lobule (RIPL) for the social versus nonsocial hazard contrast. On the other hand, the ASD group showed reduced activation, relative to TD, in the bilateral medial prefrontal cortex (MPFC), right cingulate gyrus, and the right pre and post central gyri for the social versus nonsocial contrast.

Conclusions: The ASD group showed greater RIPL recruitment while processing social hazards; this region has been implicated in bottom-up attention processes and social cognition. In comparison, the TD group seemed to rely more on brain regions commonly implicated in cognitive control, including executive function and motor planning regions. This suggests different cognitive approaches between the ASD and TD groups, with ASD participants devoting more resources to lower-order attention and social processing and TD utilizing higher order cognitive processes to predict and plan for social hazards. Findings provide insights into the difference in quality of driving performance in ASD drivers compared to TD drivers.

435.025 *(Poster)* Delayed Auditory Evoked Responses in Autism Spectrum Disorder: Across the Lifespan

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Background: Previous magnetoencephalographic (MEG) studies have shown abnormal auditory cortical responses in superior temporal gyrus (STG) such as delayed auditory response components in primary/secondary auditory processing (e.g., M50, M100) in Autism spectrum disorder (ASD) cohorts compared to typically developing (TD) peers. Although a number of studies have revealed delayed early auditory responses in ASD, prior work has measured MEG in different developmental stages (i.e., age range) or using different paradigms (i.e., different types of stimuli, duration, frequency, inter stimulus interval).

Objectives: To better understand neural correlates of auditory processing in ASD *across the lifespan*, the present study used MEG to measure cortical responses to auditory tone stimuli identical to those used in Roberts et al., (2010), and compared them with responses from a TD cohort with similar age-range.

Methods: One hundred and thirty-two participants (aged 6 to 42 yrs) were included into the final analyses (children and adolescents; TD, n=36, 9.21±1.6 yrs; ASD; n=58, 10.07±2.38 yrs, adults; TD, n=19, 26.97±1.29 yrs, ASD, n=19, 23.80±6.26 yrs). Social Responsiveness Scale, Wechsler Intelligence Scale - Fourth Edition, Wechsler Abbreviated Scale of Intelligence-II were used. 200, 300, 500 and 1,000 Hz sinusoidal tones of 300 msec duration (105 at each frequency) were presented binaurally. MEG data were obtained in a magnetically shielded room using a 275-channel whole-cortex CTF magnetometer (CTF MEG, Coquitlam, Canada). Left and right M50 (50-125ms) and M100 (100-250 ms) peaks in STG were defined from the source waveform using BESA. The study was approved by the Children's Hospital of Philadelphia IRB.

Results: A linear mixed model (LMM) revealed statistically significant main effects of group on M50/M100 latency ($p < 0.001$) over hemisphere and frequency across the lifespan. Delayed M50/M100 latencies were found in participants with ASD compared to the TD group and earlier M50 /M100 latency were associated with increased age. Furthermore, there was a statistically significant association between verbal aptitude (VIQ) and both M50/M100 latency ($p < 0.001$).

Conclusions: In the present study, delayed M50/M100 latencies were found across the lifespan and suggest that findings of latency delays in both M50/M100 perhaps indicate that abnormalities in maturation of the local neural circuits generating these responses persist into adulthood. Another finding is the association between verbal aptitude and M50/M100 latencies. The M50/M100 responses are primarily generated in the STG, and activation of this region has figured prominently in models of receptive language function and impairment, suggesting basic non-speech auditory processing is specifically linked to oral language functioning, and that latency delays evident at this early stage of auditory perception may specifically contribute to impaired language development across the lifespan.

435.026 *(Poster)* Development of Visual Evoked Responses in Typically Developing Infants and Implications for at-Risk Infant Studies

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Background: Visual processing abnormalities are a common sensory impairment in autism spectrum disorder (ASD) (Siper et al., 2016), specifically primary visual evoked responses (VERs). Few studies, however, have examined the maturation of primary visual responses in typically developing (TD) infants, particularly changes in the latency of VERs. To understand visual processing deficits in infants at risk for ASD, studies characterizing the maturation of VERs in TD infants are needed.

Objectives: Study goals were: (1) to determine maturation rates for left and right primary visual latency; (2) to explore associations between cognitive abilities and the speed of VERs via a cross-sectional sample (2 to 40 months).

Methods: MEG data were obtained from 58 TD infants (mean age=346±307 days, 27 males) using an infant MEG system (Artemis 123). Cognitive composite scores were obtained using age equivalent scores from Mullen Scales of Early Learning (MSEL) -Visual Reception domain or Bayley Scales of Infant and Toddler Development -III (BSID) - Cognitive domain. VERs were measured in response to black-and-white checkerboard stimuli contrast reversing at a 1Hz rate, and with each square subtending a visual angle of 1°. MEG data were co-registered to an age-appropriate MRI template. Artifact-free epochs 200ms pre- to 500ms post-stimulus were averaged. Peak latency of the infant left and right hemisphere VERs were obtained by fitting dipoles at left and right primary visual cortex. Associations between left and right VER peak latency and age evaluated whether the latency of the M100 VER decreased as a function of age. Associations between left and right VER peak latency and cognitive composite scores evaluated whether the speed of VERs was related to cognitive ability.

Results: The infant's VERs were composed of a positive peak (~50 to 100ms post-stimulus), a negative trough (~100 to 180ms post-stimulus, infant M100 VER), and a positive peak (~160 to 300ms post-stimulus). Given that the infant M100 VER was the largest component, analyses focused on the infant M100 peak latency. The peak latency of the M100 response decreased as a function of age between 2 to 12 months (R^2=0.38 ($p<.0001$) and 0.32 ($p<.0001$), left and right respectively). No age-related M100 latency change was evident after 12 months. No Hemisphere by Age interaction on M100 latency was observed. In the full sample, the peak latency of the M100 response was associated with cognitive ability (R^2=0.24 (p=.001) and 0.22 (p=.002), left and right respectively).

Conclusions: The peak latency of the infant M100 VER decreased at a rate of 4.64ms/month for the left hemisphere and 4.31ms/month for the right hemisphere between 2 and 12 months, and then stabilized at an adult-like M100 latency by ~1 year of age in both hemispheres. Earlier M100 responses were associated with better cognitive ability. Present data indicate that studies seeking to examine the maturation of visual M100 responses in infants at risk for ASD should focus on at-risk infants from birth to 1 year old.

435.027 *(Poster)* Distinct Effects of Sensory over-Responsivity and Anxiety on Brain Response to Aversive Sensory Stimuli in Youth with Autism or Anxiety Disorders

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Background: Heightened sensory over-responsivity (SOR) is common among individuals with an autism spectrum disorder (ASD), and is associated with increased anxiety (Bitsika et al., 2016). SOR symptoms are evident in toddlers with autism and predict later emergence of anxiety symptoms (Green et al., 2012). SOR in autism has been linked to over-active brain responses to aversive sensory stimulation after covarying for anxiety (e.g. Green et al., 2015) but the unique effects of anxiety and SOR symptoms on brain responses to sensory stimulation have not been examined. While SOR and anxiety symptoms are correlated in other clinical groups, including those with anxiety disorders (Hofmann et al., 2007), it remains unclear whether the neural mechanisms underlying these symptoms are similar across diagnostic groups.

Objectives: To examine the unique contributions of anxiety/SOR to brain activation during exposure to aversive tactile/auditory stimuli in children with autism compared to children with anxiety disorders.

Methods: Participants were 19 youth (13F) with anxiety disorders (social, separation, or generalized anxiety; ANX), and 19 age-, IQ-, and sex-matched youth (13F) with ASD, aged 8-17. A matched typically-developing (TD) group was used to compare behavioral SOR and anxiety. While undergoing fMRI, participants experienced six 15-sec blocks each of auditory, tactile, and joint (auditory+tactile) aversive sensory stimulation. Stimuli consisted of pulsing white noise and a scratchy sponge rubbed on participants' inner left arm at 1-sec/stroke. Parent-reported SOR (Sensory Over-responsivity Inventory; Miller et al., 2004) and anxiety symptoms (Screen for Child Anxiety Related Disorders; Birmaher et al., 1995) were entered as simultaneous regressors in bottom-up, whole-brain analyses to examine the relative contributions of SOR and anxiety to neural activation during the joint condition in each group. Contrasts were thresholded at $z>2.3$, corrected for multiple comparisons at $p<.05$.

Results: Anxiety and SOR were significantly elevated in the ANX and ASD groups compared to the TD group, but the ANX and ASD groups did not differ on either symptom type. Anxiety and SOR were highly correlated across the sample ($r=.53$, $p<.01$).

SOR was correlated with increased activation to sensory stimulation in the precuneus and occipital cortex for the ASD group, but was not significantly correlated with brain response for the ANX group. Anxiety symptoms were associated with increased activation in the insula, temporal regions, and the postcentral gyrus for the ASD group, and the lingual gyrus and occipital regions for both the ASD and ANX cohorts. In the ANX group, anxiety symptoms were correlated with increased activation in multiple subcortical regions, including amygdala, hippocampus, and thalamus, and these correlations were significantly stronger in ANX compared to ASD.

Conclusions: While both groups showed atypically elevated anxiety and SOR, these symptoms related differently to neural sensory processing in each group. SOR and anxiety symptoms uniquely contributed to brain responses to aversive sensory stimulation in ASD, but only anxiety symptoms related to brain responses during sensory stimulation for ANX participants. Results suggest that anxiety may play a primary role in sensory responsivity for children with anxiety and support the development of targeted treatment approaches.

435.028 *(Poster)* Divergent Connectivity Patterns in a Social Hub Region in Youth with Autism Spectrum Disorder Compared to Early Onset Psychosis

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Background: The anterior cingulate cortex (ACC) is thought to be an integrative social brain hub (Lavin et al., 2013), critically implicated in social cognition (Apps et al., 2016; Mao et al., 2017). Cross-sectional neuroimaging studies have found that altered functional and white matter connectivity of the ACC has been implicated in developmental neuropsychiatric disorders characterized by social impairments, notably autism spectrum disorder (ASD) and psychosis (Demonte et al., 2013; Yan et al., 2012). However, few studies have examined ACC connectivity in a group of ASD adolescents relative to age-matched individuals with early-onset or adolescent-onset psychosis (EOP) to identify any shared or distinct patterns of ACC connectivity unique to each diagnostic group.

Objectives: The goal of the current study is to examine whole-brain resting-state functional connectivity of the ACC with the whole brain in age-matched adolescents with ASD and EOP, compared to typically developing (TD) adolescents.

Methods: Resting-state functional magnetic resonance data were acquired on a 3T Siemens scanner for 25 adolescents with ASD aged 12-21 years (Mean age = 15.87; % female = 12%), 9 age-matched EOP adolescents (Mean age = 16.37; % female = 55%), and 12 age-matched TD controls (Mean age = 16.45; % female = 50%). Data were preprocessed in FSL (Smith, 2004), and ICA-AROMA (Pruim et al., 2015) was used to remove motion confounds. Nuisance regressors (mean white matter, cerebrospinal fluid, as well as their derivatives) were included to further reduce potential confounds. A bilateral ACC mask was derived from the Harvard-Oxford Cortical Atlas in FSL. Global timeseries were extracted from this ACC mask using AFNI for whole brain analysis. *t*-tests were conducted between each group separately to examine group differences in ACC connectivity. These whole-brain analyses were thresholded at $Z>2.3$ and corrected for multiple comparisons at $p<.05$.

Results: Between-group comparisons revealed that the ASD group exhibited underconnectivity of the ACC with the precuneus compared to both the TD and EOP groups. Additionally, the EOP group exhibited ACC overconnectivity with the precuneus and posterior parietal cortex (PPC), compared to the ASD and TD groups.

Conclusions: Our results suggest distinct patterns of disrupted ACC connectivity in both the ASD and EOP groups. While the ASD group evidenced underconnectivity of the ACC with the precuneus, the EOP group showed overconnectivity with the precuneus and PPC regions. Notably, the ACC and precuneus are both part of the default mode network (DMN), and these findings may suggest that disrupted connectivity within the DMN network may be relevant to the social impairments common to both these neuropsychiatric groups. Additionally, the EOP group also demonstrated overconnectivity between the ACC and the PPC- a brain region involved in attention and working memory (Behrmann et al., 2004; Nee & Brown, 2012). This suggests further disruptions in connectivity in the EOP group that may potentially underlie cognitive deficits observed in this disorder, and this hypothesis will be investigated in our ongoing studies.

435.029 *(Poster)* Effects of Oxytocin on Neural Response to Social and Non-Social Reward in Autistic and Neurotypical Women

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Background: Intranasal administration of oxytocin has been shown to promote social interactions, leading to interest in its therapeutic potential for autism spectrum conditions. However, the neurological underpinnings of oxytocin's effects on social behaviour remain unclear. One hypothesis is that oxytocin enhances social motivation via effects on neural reward processing, although this has not been tested in diverse autistic samples.

Objectives: To test the effect of intranasal oxytocin relative to placebo on brain responses to social and nonsocial rewards in autistic and neurotypical women and to explore biomarkers predictive of individual responses to oxytocin.

Methods: In this randomized, double-blind, cross-over functional magnetic resonance imaging (fMRI) experiment, 40 women (24 neurotypical, 16 autistic) underwent scanning (3T Siemens scanner, TR = 2400 ms, TE = 12, 29, 46 ms, FOV = 40 mm; alternating slice acquisition, slice thickness 3.8 mm, 11% slice gap; flip angle 80°) once after intranasal administration of 24 IU oxytocin and once after placebo. During scanning, participants completed 30 rounds each of the monetary incentive delay (MID) and social incentive delay (SID) tasks. Each round comprises presentation of a symbol indicating whether a successful response earns a reward; a variable time window during which participants must press a button; and, in case of successful response, presentation of an image indicating the reward (MID = money; SID = smiling face). Task-based neural activation in response to the anticipation and outcome of monetary and social rewards was denoised using multi-echo independent component analysis and analysed using fMRI Expert Analysis Tool v6.00 (part of FSL). Whole brain analyses were thresholded using clusters determined by Z>2.3 and a corrected cluster significance threshold of P=0.05. Pre-treatment salivary oxytocin levels were quantified by radioimmunoassay.

Results: Under placebo, neurotypical women showed significantly greater neural activation during both tasks compared to autistic women in brain regions including the ventral striatum, amygdala, cingulate cortex, and orbitofrontal cortex (Fig 1a,b). Among autistic women, there were significant increases in brain activation under the oxytocin vs. placebo condition for the anticipation of social and monetary rewards and the outcome of monetary reward (Fig 1c,d). Notably, the regions showing increased activity under the oxytocin condition in autistic women overlapped with the areas in which neurotypical women showed significantly greater activity under placebo. Finally, pre-treatment salivary oxytocin level had a significant negative effect on changes in brain activation under the oxytocin condition among autistic women, such that individuals with lower salivary oxytocin levels showed greater increases in neural activation in response to receipt of social reward in the cingulate cortex and medial prefrontal areas associated with theory of mind.

Conclusions: This study extends the evidence of reduced neural responses to both social and nonsocial reward in autistic relative to neurotypical individuals to specifically include women. The observed effects of oxytocin relative to placebo support that oxytocin influences reward processing, but that the effect is not specific to social reward. Finally, this study provides further evidence that pre-treatment oxytocin levels may be a useful predictor of responses to oxytocin administration in autistic individuals.

435.030 *(Poster)* Emerging Atypicalities in Cortico-Cerebellar Connectivity across the First Year of Life in Infants at High Risk for ASD

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Background: Cerebellar atypicalities are a consistent finding in autism spectrum disorders (ASD). While the cerebellum is traditionally known for its role in motor control, it is also involved in many non-motor functions including higher order cognition, language, and social learning. There is great heterogeneity in the specific regions of the cerebellum recruited to support these different behaviors. Youth with ASD show altered functional connectivity in cortico-cerebellar networks, but the development of these networks in early infancy remains poorly characterized. Specifically, little is known regarding the emergence of distinct cortico-cerebellar networks underlying separate social/cognitive and sensorimotor functions in infancy and how these networks relate to later ASD symptomatology.

Objectives: We used resting-state fMRI to characterize developing functional connectivity in two distinct cortico-cerebellar networks during two timepoints in the first year of life in infants at high (HR) vs. low familial risk (LR) for developing ASD. We then examined how early group differences in cortico-cerebellar networks that support sensorimotor vs. social/cognitive functions predict social and language skills as well as ASD symptomatology in the second year of life.

Methods: Eight-minute rs-fMRI scans were collected during natural sleep in infants at 1.5 and 9 months of age. ICA-AROMA was used to correct for head motion. Seed-based connectivity of bilateral crus I (social/cognitive) and lobule I-IV (sensorimotor) cerebellar ROIs was examined at each time point. Group differences in functional networks associated with each seed were examined separately. Next, early differences in cortico-cerebellar connectivity were related to measures on the Early Social Communication Scales collected at 12 months and the MacArthur-Bates Communicative Development Inventories and the Autism Diagnostic Observation Schedule–Toddler Module collected at 18 months of age.

Results: At 1.5 months, whole-brain connectivity maps generated from lobule I-IV demonstrated functional connectivity with subcortical regions and sensorimotor cortex in both groups. LR infants additionally showed robust connectivity between crus I and subcortical regions and sensorimotor cortex. At 9 months, connectivity maps in both groups indicated a functional segregation of these networks, with robust connectivity between lobule I-IV and both subcortical and sensorimotor regions, as well as emerging connectivity between crus I and both subcortical and higher order frontal regions (Fig.1). At 1.5 months, the LR group showed greater connectivity between crus I and thalamus and basal ganglia compared to HR infants. Within LR infants, greater connectivity between these regions at 1.5 months was related to better joint attention and language comprehension at 12 and 18 months respectively. By 9 months, LR infants showed greater connectivity between lobule I-IV and supplementary motor area compared to the HR group. Within HR infants, greater connectivity between these regions at 9 months was related to better joint attention at 12 months and less severe ASD symptomatology, including fewer restricted and repetitive behaviors, at 18 months (Fig.2).

Conclusions: Taken together, these findings demonstrate that the emergence of cortico-cerebellar networks is already atypical in infants at high risk for developing ASD. Early differences in functional connectivity may predict altered developmental trajectories before overt behavioral delays and the onset of ASD symptomatology.

435.031 *(Poster)* Examining Relations between Anxiety Symptoms and Amygdala Activity Among Autistic Adolescents Using fMRI

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Background: Approximately 40% of youth with autism experience at least one anxiety disorder (van Steensel, Bögels, & Perrin, 2011). A budding area of research demonstrates links between anxiety and amygdala activity among autistic youth (Herrington et al., 2017; Herrington, Miller, Pandey, & Schultz, 2016), preschool-aged children (Ventola et al., 2014), and adults (Corden, Chilvers, & Skuse, 2008; Kleinhans et al., 2010). Findings thus far are sparse and therefore further exploration is necessary to clarify these potential associations.

Objectives: To examine links between self- and parent-reported anxiety symptoms and amygdala activity among youth with autism. We hypothesized that anxiety symptoms would be positively associated with amygdala activity.

Methods: Thirty-eight autistic adolescents ages 11–16 were included in the present study. This subsample was drawn from a larger randomized clinical trial of a social skills intervention for autistic youth. All adolescents underwent an fMRI at two timepoints; only data from the first timepoint are included here. Given the difficulty of measuring anxiety in autism and following prior recommendations (Spain, Sin, Linder, McMahon, & Happé, 2018), several measures of anxiety were collected including the Anxiety Problems subscale on the *Child Behavior Checklist* (CBCL; Achenbach & Rescorla, 2001) and *Youth Self-Report* (YSR; Achenbach & Rescorla, 2001), *Spence Children's Anxiety Scale* (SCAS; Spence, 1998), *Social Anxiety Scale for Adolescents* (SAS; La Greca & Lopez, 1998), and *Social Interaction Anxiety Scale* (SIAS Heimberg, Mueller, Holt, Hope, & Liebowitz, 1993). fMRI data were collected using a GE MR750 3T using a 1-back, affective face processing task. Data were preprocessed using FSL (Smith et al., 2004); data included here were determined to be useable following preprocessing including motion correction. Amygdala activity was examined using contrasts of faces vs. houses and single-group average was conducted using FSL. Amygdala ROI data were identified with the Harvard-Oxford Subcortical Atlas (https://identifiers.org/neurovault.collection:262) and a binarized mask. Average amygdala values were extracted using z-stat maps.

Results: Pearson's correlations were conducted. Although the right and left amygdala were significantly related to one another, and there were significant links among several anxiety measures, no significant associations between anxiety symptoms and amygdala activity emerged (see Table 1). One link, between the right amygdala and SAS parent-report of fear of negative evaluation showed a trending positive correlation ($r = 0.311$, $p = 0.061$).

Conclusions: Contrary to our hypotheses, no significant links between anxiety symptoms and amygdala activity were found. One trending correlation showed a possible link between parent-report of fear of negative evaluation on the SAS and activity in the right amygdala. Because parsing by specific anxiety disorder diagnosis was not possible in the current sample, it is unknown whether a more fine-grained approach would reveal associations. Lastly, neural activity may be tied to a more proximal measure of symptoms, such as state anxiety measures (e.g., the State Trait Anxiety Inventory; Spielberger, Gorsuch, & Lushene, 1970), as more distal questionnaires such as the CBCL might not reliably capture the true latent construct of anxiety in autism.

435.032 *(Poster)* GABA and Glx Levels in Adults with High Functioning Autism Versus Major Depressive Disorder

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Background: Adults with high functioning autism (HFA) often experience social anhedonia (SA) and depression (Gadow, 2012; Gadow, *et al.*, 2012). Furthermore, SA is a core feature of HFA and major depressive disorder (MDD; Kanner, 1943; Gadow & Garman, 2018; Blanchard *et al*., 2001). Abnormalities in gamma-aminobutyric acid (GABA) and glutamate+glutamine (Glx) are found in major depressive disorder (MDD) and autism, and although findings are mixed, research suggests decreased levels in both populations (Shur *et al.,* 2016; Yuksel & Ongur, 2010; Horder *et al.,* 2013). Nevertheless, little is known about how they compare to one another.

Objectives: To examine similarities and differences in adults with HFA and MDD in behavioral phenotypes, and brain GABA and Glx levels.

Methods: Participants comprised adults with HFA (*n*=30; age=18-45 years) with IQs ≥ 80 and adults with MDD (*n*=21; age=18-45 years), with prior MDD diagnosis and score of 22+ on the Montgomery- Åsberg Depression Rating Scale. Adults with HFA (*n*=16) and MDD (*n*=18) were scanned using (1) Single voxel J-editing H-MRS was acquired on Siemens Biograph 3T scanner for the metabolites GABA and Glx, which was performed with one voxel (30×30×20 mm 3) in the anterior cingulate cortex using a TR/TE of 2000/68 ms with a spectral bandwidth of 2 kHz, 384 spectral average and 16 water reference. Measures included the self-administered Social Responsiveness Scale Second Edition (SRS-2) and the Revised Social Anhedonia Scale (RSAS) and the Hamilton Depression Rating Scale (HAM-D).

Results: The MDD group was significantly more depressed than the HFA group per the Ham-D (*p*<.001; Cohen's d=1.84), Groups did not differ in overall autism severity (SRS-2 total score; *p*=.267) or in SRS-2 Awareness, Communication, and Motivation (*p*s>.05) subscales, but there were significant group differences for Mannerisms and Cognition (*p*s<.02) subscales. Groups did not differ in social anhedonia (RSAS, *p*=.445). HFA had higher levels of Glx than MDD (*p*=.002; Cohen's d=1.17), which remained significant after controlling for severity of depression (HAM-D; *p*=.004; Cohen's d=1.24). Group differences in GABA levels were not statistically significant (*p*=.104).

Conclusions: Adults with HFA and MDD each exhibited comparable levels of social anhedonia and overall autism severity but nevertheless differed with regard to reciprocal social interaction and repetitive behaviors. Collectively, our findings support both transdiagnostic and disorder-specific phenotypic features in these clinic populations. Adults with HFA had significantly higher brain levels of Glx than MDD, which supports the notion that the biologic substrates of the two disorders differ. However, brain GABA levels were comparable. Additional research that includes typically developing adults may help us better understand the biological basis of autism with comorbid depression, which could have important implications for treatment.

435.033 *(Poster)* Identifying Brain Areas Correlated with Autism Diagnostic Observation Schedule

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Background: Altered functional connectivity patterns are believed to play an important role in explaining autism spectrum disorder related impairments. In order to examine such connectivity, resting state functional MRI is the most commonly used technique. To the moment, the majority of effort in this area tends to examine the whole time series of brain activation as a signal generated by a stationary process. In this study, we are providing a more detailed insight of how functional connectivity fluctuates over time, by quantifying the instances where over-connectivity and under-connectivity happens. We are using a novel approach that utilizes non-parametric surrogates test to examine the stationary nature of the activation time series. This study identifies the areas where under-connectivity or over-connectivity are correlated with the autism diagnosis observation schedule.

Objectives: To correlate the most significant areas and neural circuits with subject behaviors.

Methods: In this study, 166 subjects having ADOS module 3 data and 72 subjects having ADOS module 4 data are used. The ADOS reports used are the total, communication, social and behavior reports. We developed an algorithm to quantify the moment of over-connectivity and under-connectivity between the time courses of different brain regions (shown in Fig.1). The extracted feature represent the number of moments falling within top 5% and 10% and bottom 5% and 10% of proposed connectivity null distribution. These features are then used in correlation analysis with the 4 reports of the 2 ADOS modules.

Results: In this study, two main experiments were conducted: (i) to study the correlation between the extracted percentiles features and ADOS module 4, and (ii) to study the correlation between the extracted percentiles features and ADOS module 3. To check if the correlation is significant, FDR is used with adjusted p-value significance level set to 0.1. For ADOS module 3, only two pairs of areas were found to be significant, and these two pairs were correlated only with the behavioral domain: right cerebellar lobules IV–V and right pars opercularis ($r = 0.4$, $p = 0.03$), right caudate and right medial orbitofrontal cortex ($r = 0.39$, $p = 0.033$). They were correlated with over-connectivity moments, 90–95%, 95–100%, respectively. For ADOS module 4. For the communication domain, the most significant pair is right temporal pole and left middle occipital gyrus. The most significant pair in the behavioral domain is right cerebellar lobule III and left thalamus ($r = 0.59$). Correlation of $r = 0.5$ was observed in the paired inferior occipital and superior frontal gyri in the left hemisphere. Finally for the ADOS total severity score, the most significant correlation was seen with left inferior occipital gyrus and right precentral gyrus. This pair is known to be implicated in autism.

Conclusions: This methodology better estimates regional functional connectivity (under-connectivity or over-connectivity) with observed behaviors on the AODS than a stationary process. This work is believed to be an important next step towards personalized autism diagnosis and treatment, where each subject impairments are better understood and addressed.

435.034 *(Poster)* Implementation of a System to Reduce in-Scanner Head Motion in Pediatric Participants with Autism Spectrum Disorder Undergoing a 60-Minute fMRI Protocol

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Background: Performing fMRI scans of children with autism spectrum disorder (ASD) can be a difficult task, as participants tend to move in the scanner. Head motion represents a confound in functional connectivity analyses (e.g. Power et al., 2012), and methods are needed to limit the impact of movement. One approach has been to use shorter fMRI protocols, though this potentially sacrifices reliability of results.

Objectives: We describe steps we have taken to limit head motion in children undergoing a 60-minute MRI scan. We assess if the protocol limits movement, if the system is generalizable, and if it is efficacious in children with ASD.

Methods: We leverage data from an ongoing study. The experimental group (n=12) underwent a formal mock scan, used a weighted blanket, and earned prizes during the scan for limiting head movement; the control group (n=7) did not undergo these steps. No subjects in either group had ASD. To test generalizability, we used a validation group (n=16; 5 with ASD): these subjects underwent the same steps to limit motion as the experimental group, except a separate team of researchers conducted the mock scan and fMRI protocol.

We conducted two-sample *t*-tests to compare demographic factors and a two-tailed Fisher Exact Probability test to compare the number of females. For each participant, we calculated the mean frame-to-frame displacement (FFD) in mm for each functional run. To determine if the mean FFD values differed due to scan condition (movie, attention task ('gradCPT'), and rest), we calculated Hedge's *g* to determine effect sizes. To determine statistical significance, we performed two-sample *t*-tests on the average mean FFD value for a condition and across all scans per participant. Significance was assessed at a *P*-value < 0.05 after correcting for multiple comparisons using the Benjamini-Hochberg procedure. We also classified scans as either low or high motion after applying movement thresholds and used a Chi-square test of association to determine if there was a significant difference among the groups.

Results: All three groups were similar demographically, except there were more females in the validation group relative to the control group (Table 1); we found no significant correlations among IQ and mean FFD values. When we compared mean FFD values, we found the experimental and validation groups tended to have significantly lower mean FFD values compared to controls ($P < 0.05$ in 6/8 comparisons) and effect sizes tended to be large (Hedge's $g > 0.08$ in 18/20 comparisons). When we classified scans as either high or low motion, we found the experimental and validation groups had more scans classified as low motion (all $P < 0.05$; see Figure 1 for a comparison of the control and experimental groups).

Conclusions: Compared to the control group, our steps to reducing motion in both the experimental and the validation group did indeed lead to less head motion. With appropriate measures, these data suggest it is possible to obtain low motion data in participants with ASD undergoing a long scan protocol.

435.035 *(Poster)* Intrinsic Functional Connectivity Versus Fluid Reasoning Abilities in Autistic Children

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Background: Strengths in fluid reasoning have been documented in autistic children, such as greater performance at Raven's Progressives Matrices (RPM) than predicted by Wechsler IQ (Dawson et al., 2007). In typical adults, intrinsic functional connectivity during rest has been associated with individual differences in reasoning abilities (Yuan et al., 2012). Knowing that differences in intrinsic functional connectivity have been reported in autism (Assaf et al., 2010; Monk et al., 2009), do different patterns of intrinsic functional connectivity support reasoning abilities in autistic children?

Objectives: The current study aims to investigate the associations between the pattern of intrinsic functional connectivity in autistic children and individual differences in fluid reasoning, by 1) Exploring patterns of functional connectivity at rest in autistic versus typical children and 2) Examining the links between functional connectivity during rest and fluid reasoning performance.

Methods: 27 (2F) autistic and 26 (7F) typical children equivalent in age (*M*=11.60, *SD*=2.73), RPM percentile scores (M=59.69, SD=29.71) and laterality were scanned in a 3T MRI scanner. Each participant completed a resting state sequence (6min) fixating a white dot on a black background. CONN toolbox was used for preprocessing and seed-to-voxels analyses (few corrected *p*=.05). The posterior cingulate cortex (PCC) was taken as seed for the analyses, as it is a central component of the default mode network (DMN), active during rest (Monk et al., 2009; Fox et al, 2005).

Results: The pattern of functional connectivity involving PCC was similar in both groups, with significant connectivity with precuneus, angular gyrus (bilateral), insular cortex (bilateral), medial prefrontal cortex, superior frontal gyrus (bilateral), lateral parietal cortices (bilateral), temporal lobe (bilateral), lateral occipital complex, parahippocampal gyrus (bilateral) and paracingular gyrus (bilateral). There was no significant between-group difference of functional connectivity among these DMN regions. In all participants, RPM scores were positively associated with functional connectivity between PCC and parahippocampal gyrus (r = .321, *p*<.05). In autistic children, RPM scores were negatively associated with functional connectivity between PCC and left middle temporal gyrus (r = -.383, *p*<.05), left and right angular gyrus (r respectively -.429 and -.415, p<.05). In typical children, RPM scores were positively correlated with functional connectivity between PCC and left middle temporal gyrus (r = .412, *p*<.05) and right superior frontal gyrus (r = .401, *p*<.05).

Conclusions: In line with previous findings, we found that the same network of regions were interconnected with PCC in autistic and typical children (Monk et al., 2009). Previous studies found between-group differences in the level of connectivity, typical participants showing over-connectivity between PCC and superior frontal gyrus, and autistics showing stronger connectivity between PCC and temporal lobe (Monk et al., 2009). Going further, we found that functional connectivity in these regions was associated with fluid reasoning abilities in each group: connectivity between PCC and superior frontal gyrus predicted reasoning abilities in typical children only, while connectivity between PCC and middle temporal gyrus predicted reasoning abilities in both groups but in different directions. Different intrinsic functional connectivity patterns seem to support fluid reasoning in autistic versus typical children.

435.036 *(Poster)* Investigation of Cortical Development in ASD Using Motion-Corrected R1 Relaxometry

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Background: Recent neuroimaging and pathology studies suggest that cortical development is affected in autism spectrum disorders (ASD). In particular, most ASD structural neuroimaging studies have focused on measures of cortical thickness, surface area and gyrification from T1-weighted (T1w) images. The boundary contrast between gray matter (GM) and white matter (WM) on T1w images has also been reported to be reduced in ASD. we utilized a novel whole-brain, high resolution quantitative R1 mapping method to investigate the developmental changes of quantitative R1 (=1/T1) relaxometry in the cerebral cortex, which should provide more direct indicator of both structural and microstructural changes.

Objectives: The primary objective was to investigate the developmental age-related changes of quantitative R1 relaxometry in the cerebral cortex.

Methods: High functioning (IQ >70) participants included 46 with ASD [mean age: 16 years, age range: 5-42 years] and 66 typically developing (TD) [mean age: 16.4 years, age range: 5.75-31 years]. Neuroimaging with 3T MRI included whole-brain MPnRAGE [Kecskemeti et al. 2016], which generated multiple inversion recovery contrasts used to fit quantitative R1 maps with 1mm isotropic spatial resolution. Total imaging time was approximately 8.5 minutes. Retrospective motion correction was used to generate images with consistent high contrast between GM and WM and minimal motion blurring [Kecskemeti et al. 2018]. Cortical parcellation was performed using Freesurfer on the MPnRAGE T1w images, which are inherently coregistered to the quantitative R1 maps. Individual R1 measurements were mapped to the cortical surface, assessed at the half-thickness of the cortex, and resampled onto a standardized cortical template within Freesurfer. Statistical testing was performed at each surface vertex using a general linear model in Freesurfer. First, R1 versus age regression was performed independently for each group. A follow-up model analysis was performed to evaluate R1 versus age, group and age x group effects. Statistically significant effects were assessed following False Discovery Rate multiple comparisons correction at $p<0.05$.

Results: For the TD cohort, there was a significant positive relationship between R1 and age over the majority of the medial and lateral cortical surfaces. Conversely, R1 versus age relationships in the ASD cohort were weaker, with many ventral frontal, temporal, and occipital regions not exhibiting a significant age relationship. In the second model, significant age x group interactions for cortical R1 were observed in bilateral temporal pole, bilateral fusiform gyrus, and right primary auditory cortex.

Conclusions: To our knowledge, this is the first study to investigate quantitative R1 relaxometry in the cerebral cortex in ASD. We observed significant group differences in age-related R1 trajectories, particularly in ventral frontal and temporal regions. The differences in age-trajectories may help to explain the diminished T1w cortical GM versus WM contrast reported in ASD [Andrews et al. 2017]. One potential mechanism for cortical R1 changes is myelination [Glasser et al. 2011]. However, other potential mechanisms include inflammation, iron accumulation, and the distributions of macromolecules in the tissue. In summary, R1 mapping with MPnRAGE is a promising tool for investigation of cortical microstructure in ASD across the lifespan.

435.037 *(Poster)* Lateralization of Precision Motor Behavior and Physiology in ASD

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Background: Individuals with ASD show atypical patterns of motor lateralization characterized by higher rates of mixed handedness. Systematic comparisons of precision sensorimotor behaviors across right and left hands are needed to characterize the extent to which atypical lateralization affects different motor abilities. Task-based functional MRI studies right and left hand motor behavior are needed to clarify neurodevelopmental processes associated with atypical lateralization of motor function in ASD.

Objectives: To (1) characterize precision motor behavior across right and left hands in ASD, and (2) define functional brain networks associated with right and left hand precision sensorimotor control in ASD.

Methods: Twenty-three individuals with ASD, including three left-handed individuals, and 20 typically developing controls, including three left-handed individuals, matched on age (range: 10-34 years), sex, and nonverbal IQ completed a visually guided precision gripping task during fMRI. During the task, participants gripped a force transducer while viewing two horizontal bars. Their task was to press on the transducer to move the lower bar upwards to the height of the static target bar. The target bar was set at 45% of their maximum voluntary contraction (MVC). Participants completed three 26-s blocks of gripping each separated by 26-s of rest. They completed one run of the task with each hand. Grip strength, mean force, force regularity (approximate entropy, or ApEn), and force variability (SD) were examined separately for each hand. Percent BOLD signal change during gripping vs. rest was examined. These preliminary analyses use a voxel-wise threshold of $p < .05$ with a cluster threshold of 20 voxels. Data collection is ongoing, and data of additional subjects will be presented.

Results: Relative to controls, individuals with ASD showed reduced grip strength and mean force with their left hand and reduced ApEn with their right hand. Individuals with ASD also showed increased force variability across both hands. When using their left hand, individuals with ASD showed reduced BOLD activation relative to controls in multiple sensorimotor regions, including bilateral M1, contralateral S1, anterior cingulate cortex, left V1, and pons. When using their right hand, individuals with ASD showed greater activation in left precuneus, left angular gyrus, and right superior temporal gyrus.

Conclusions: Lateralized reductions in grip strength and mean force in ASD suggest atypical development of motor cortical circuits. Reduced force complexity (ApEn) in right but not left hand implicates left-lateralized difficulties with the online integration of sensory feedback. When using their left hand, individuals with ASD also showed reduced activation in contralateral M1 and S1 implicating atypical hemispheric specialization as a critical neurophysiological feature of ASD. Reductions in contralateral precuneus and angular gyrus during right hand control indicates lateralization of cortical motor alterations and suggests abnormal sensory feedback processing contributes to atypical sensorimotor behavior in ASD.

435.038 *(Poster)* MEG Predictors of Cognitive and Language Impairment

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Background: Autism Spectrum Disorder (ASD) is a heterogenous neurodevelopmental disorder presenting with a range of cognitive and language deficits. Prior studies have identified associations between magnetoencephalography (MEG) measures of auditory cortex activity and both general cognitive ability (IQ) and domain-specific language ability. Specifically, measures of auditory encoding processes (e.g., M50 latency) are more sensitive to measures of nonverbal IQ, while post-stimulus event related desynchronization (ERD) of auditory cortex has higher sensitivity to language function. However, with the growing use of imaging (including MEG) in high risk infant cohorts to *'predict'* functional outcome, it becomes important to investigate the ability of MEG measures to explain variance of behavioral functional outcome measures such as IQ or language.

Objectives: In order to better understand the potential utility of MEG to predict functional outcome measures we used general linear models (GLMs) to investigate the ability of a brief battery (<30 minutes) of MEG tasks to explain variance in nonverbal IQ and parent reports of language ability. Participants had a wide range of intellectual and language abilities but for descriptive purposes can be described of coming from 4 cohorts: 1) Minimally-Verbal/Nonverbal children with ASD, 2) lower Intelligence Quotient (IQ) Intellectual Disability/Developmental Disability (ID/DD, non-ASD), 3) Verbal children with ASD, and 4) Verbal typically developing children.

Methods: Fifty six participants (aged 7-13yrs) were included in the final analysis (MVNV children with ASD, n=24, 10.1±1.4yrs; lower IQ ID/DD (non-ASD) children, n=10, 10.0±1.4yrs; Verbal children with ASD, n=10, 9.5±1.4yrs; typically developing children, n=13, 9.5±0.9yrs). The MEG battery consisted of two tasks. Auditory Pure Tone Exam: 500 Hz tones presented with a random ISI between 600ms-2000ms. The latency of middle auditory evoked response (**M50**) was determined bilaterally. Language Task: Stimuli consisted of monosyllabic words and pronounceable nonwords. Bilateral auditory **ERD** was measured between 5-20Hz and 200-1650ms. Cognitive ability was operationalized as the Nonverbal IQ (NVIQ) of the Leiter-3 or Perceptual Reasoning Index of the WISC-IV. Language ability was assessed using the communication domain of the Vineland-3 (Vineland-Comm). GLMs were used to separately investigate the relationship of NVIQ and vineland-comm using fixed effects of M50, ERD and hemisphere.

Results: MEG measures were able to explain significant amounts of variance for both NVIQ (R^2=0.23; $p<0.01$) and Vineland-Comm (R^2=0.36; $p<0.001$). For the NVIQ model, effects of both M50 ($p=0.016$) and ERD ($p=0.001$) were significant and their interaction was marginally significant ($p=0.088$). Effects of hemisphere and its interactions were not significant. Similarly, both M50 ($p=0.009$) and ERD ($p<0.0001$) were significant in explaining Vineland-comm, with a potential trend ($p=0.1$) observed for their interaction. Effects of hemisphere and its interactions were all not significant.

Conclusions: These findings demonstrate a significant association between measures of IQ and language ability with MEG measures derived from a brief battery of passive MEG tasks. While the observed associations were between measures obtained at a single timepoint and in school aged children, these positive results over a large range of functional abilities, are encouraging for future applications to infant subjects and for predicting future measures of cognitive and language ability.

435.039 *(Poster)* Magnetic Resonance Imaging Findings in a Sample of Uruguayan Adolescents with Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) refers to a neurodevelopmental disorder characterized by impairment in social communication and restricted repetitive behaviors and interests. In children and adolescents diagnosed with ASD, multiple structural and functional variations have been identified in sMRI as well as in fMRI, compared to neurotypically developed population. Nevertheless, the growing neuroimaging literature in ASD has not yet identified neuroanatomical or functional markers that specifically and consistently accompany an ASD diagnosis. The limitations to advance in this field are multiple, making international efforts and collaboration between scientists fundamental to achieve better results; in this context is that we initiate our project.

Objectives: Our purpose is to contribute to define more consistently the neuroanatomical features of ASD in adolescents, and considering that the amount of evidence that comes from South American population is scarce, we aim to establish to what extent the variations in sMRI and fMRI described in the international literature are also identified in our patients. Therefore, we aspire to show new data obtained from a sample of patients that participate in our project.

Methods: Participants included are adolescents between 14 and 17 years old, with an ASD diagnosis done by doctoral-level clinicians based in DSM-5 criteria. None of them have medical, neurologic or genetic illness; if this was the case, the participant was excluded. To every participant the Autism Diagnostic Observation Schedule (ADOS), the Autism Diagnostic Interview-Revised (ADI-R) and the Wechsler Intelligence Scale for Children (WISC-IV) or the Wechsler Adult Intelligence Scale (WAIS-IV) were administered. All images were acquired using a 3.0-Tesla MRI (General Electric Discovery 750W). Morphological and functional sequences were done (3D T1,3D Flair, DTI and Resting State fMRI); magnetic resonance imaging was performed without sedation in all cases.

Results: The Resting State fMRI showed normal functional connectivity. The morphological sequence and DTI showed an asymmetry between right and left subcortical white matter, with the identification of multiple white matter tract distortions. In regards to the clinical evaluation, impairments in language, executive functions, as well as in facial and emotional processing were identified.

Conclusions: Encephalic volumetric asymmetry and diverse nervous tracts distortions are described in ASD and our first sample of participants show results that support this fact. The latter could also explain the impairments in language, executive functions, as well as in facial and emotional processing. To advance in the knowledge of these possible associations, research with a bigger number of patients is required, as well as the introduction of neurotypically developed participants to our project.

435.040 *(Poster)* Mapping Neural Correlates to Language and Biological Motion in School-Aged Children with Autism Using High Density Diffuse Optical Tomography

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by marked impairments in social communication and heightened restrictive and repetitive patterns of behavior. Understanding the disruption to neural systems underlying ASD will be crucial in early diagnosis and for developing novel targeted interventions. However, traditional neuroimaging modalities like functional magnetic resonance imaging (fMRI) require participants to remain still in a loud, enclosed environment that can be challenging for children, especially those with ASD. To overcome these challenges while acquiring fMRI comparable images, we have developed high-density diffuse optical tomography (HD-DOT), a silent, wearable, and minimally constraining neuroimaging modality that can map brain function in an open, naturalistic environment more amenable to studies on children with ASD.

Objectives: In the current study, we aim to establish the use of HD-DOT in school-aged children with ASD using a hierarchical paradigm of language processing and also a biological motion processing paradigm previously shown with fMRI to exhibit ASD-associated differences in brain areas known for socially-relevant processing.

Methods: We imaged 30 children with ASD age 9-17 years old and 40 typically developing (TD) age-matched children. Each participant was imaged using HD-DOT while completing three stimulus paradigms. First, participants listened passively to nouns presented over speakers in a block design. Second, participants generated an associated verb in response to nouns presented visually in a block design on a monitor. Third, participants watched alternating 24-seconds of scrambled and coherent point-like animations of biological motion. This paradigm is well-validated in fMRI and eye-tracking studies to evaluate altered patterns of social perception and processing in those with ASD.

Data was processed using the NeuroDOT pipeline (Eggebrecht et al., 2014) in MATLAB, with HD-DOT data (ΔHbO contrast) registered to the MNI atlas for group analyses. Standard GLM analyses were used with an HD-DOT-derived adult hemodynamic response function (Hassanpour et al., 2013) and contrast maps were assessed within and across groups.

Results: Both cohorts exhibit bilateral activations over auditory cortex in response to hearing words presented via room speakers at a volume of normal conversation. In response to the cognitive task of generating words, the groups show two interesting differences. The TD exhibit strong activations in right- and left-lateralized dorso-lateral prefrontal cortex (rdlPFC & ldlPFC), while the ASD cohort exhibits diminished activations in visual cortex and heightened activity in rdlPFC. Results of the biological motion task replicate previous studies in healthy adults as well as in TD and ASD adolescents, demonstrating stronger contrasts of biological-vs-scrambled motion in TD than ASD in right-lateralized temporal-parietal junction (r-TPJ), right posterior superior temporal sulcus (r-STS), and rdlPFC, key nodes of the social brain.

Conclusions: This study shows school-aged children with and without ASD can be successfully imaged with HD-DOT to map brain function with high fidelity in a silent and naturalistic environment. These results show HD-DOT is sensitive to differential responses to biological motion in children with ASD as compared to TD. Future analyses will relate the variation in these contrast maps across participants to variation in assessments of social responsiveness.

435.041 *(Poster)* Measuring Motor Networks in Children with Autism Spectrum Disorder: A Systematic Review of EEG Techniques and Research Designs.

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Background: Motor deficits (e.g odd gait, clumsiness, rigidity) and delays in fine and gross motor skills have been observed in children diagnosed with Autism Spectrum Disorder (ASD). Impairments in the motor domain have been documented as impacting the diagnostic features of ASD, such as language acquisition. As the use of electroencephalography (EEG) in research with this population increases, to better understand behavioral and neural correlates of the motor network, so does the need for research guidelines that: 1) are specialized for the complex symptomatology in this population and; 2) inform methodological approaches of future studies. There are currently no formal guidelines for examining neural correlates of the motor network that account for the special considerations needed in this population. A lack of homogeneity in behavioral measures, EEG techniques and overall study design leads to difficulty replicating findings and identifying factors essential for determining appropriate analytical approaches.

Objectives: To describe and compare EEG techniques and research methods implemented; and describe and compare reported brain activity associated with the motor network in children diagnosed with ASD.

Methods: Systematic review were conducted via PubMed, PsychInfo, and Web of Science, for the terms *electroencephalography OR eeg*; *autis* OR ASD*; *motor*; and *child OR childhood OR children*. Inclusion criteria: English-language articles, use of EEG technique, indirect or direct discussion of the motor network; and participant age 5-12 years old diagnosed with ASD.

Results: A total of 154 articles were reviewed. 13 articles were included in the full text analysis. 18 domains were identified as pertinent factors to consider when determining relevant study designs for examining the motor network in children diagnosed with ASD: (1) Clinical Sample characteristic; (2) Control sample characteristic; (3) Diagnostic measure; (4) Assessment measures; (5) Medication; (6) Behavioral paradigm detail; (7) Experiment setup; (8) Experiment task; (9) EEG system; (10) EEG electrode; (11) EEG recording-online; (12) EEG recording-offline; (13) EEG Analysis: (14) EEG component(s); (15) Temporal characteristics; (16) Quantified EEG; (17) EEG activity; (18) EEG activity function. The domains are displayed in tables. Using the domains, we observed that related articles focused neural activity of: *Movement Related Potential (MRP); Event Related Potentials (ERP); Mu / Mu wave Suppression; Event-related Spectral perturbations (ERSP); Intrinsic Connectivity Network (ICN); Event-related Desynchronization (ERD); and alpha hemispheric activation*. EEG activity was characterized concerning: *Amplitude, Slope and Latency; Amplitude, Slope and ERP; Frequency band rhythm/oscillation; Time frequency oscillation; Functional connectivity;* and *Hemispheric activation*. Behavioral paradigms included: *internally / externally cued movement tasks; modified Posner Cued spatial attention task; Praxis imitation task; motor imitation task; motor observation and execution tasks; and passive resting tasks*.

Conclusions: Although there were commonalities in study designs among articles that used the same analytical approach to characterize the motor network EEG activity, future studies would benefit from study development that accounts for information captured in the 18 domains. Further literature reviews should be conducted to refine the domains and determine its generalizability to other imaging techniques.

435.042 *(Poster)* Motion Matters: An Analysis of Motion Bias Correction in Diffusion MRI

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Background: Diffusion MRI (dMRI) is commonly applied to examining white matter (WM) microstructure and integrity and is often used to examine WM abnormalities in Autism Spectrum Disorder (ASD). DMRI is particularly susceptible to motion-induced artifact, common to children with ASD and those with related disorders, particularly Attention-Deficit Hyperactivity Disorder (ADHD). Prior work suggests that motion systematically alters commonly-reported diffusion metrics in anisotropic (WM) regions, with resulting reductions in fractional anisotropy (FA) and increases in mean diffusivity (MD). Several techniques to control for these biases are commonly employed, but there is little work investigating relative efficacies.

Objectives: To evaluate the performance of motion-bias control methods commonly used in dMRI analyses, comparing impacts on FA and MD in 7 regions of interest (ROIs) in children with ASD, with ADHD and typically-developing (TD) peers.

Methods: This study included 559 children (99 ASD, 187 ADHD, 273 TD) aged 8-12 years. Diffusion scans were corrected for scanner and motion artifacts using FSL, and FA and MD were extracted for 7 WM ROIs, collapsed across hemisphere. Scans were visually inspected for signal loss and assigned the following quality ratings: “Excellent” = 0 volumes with signal loss, “Good” = 1-15 volumes, and “Poor” = >14 volumes. Average frame-wise displacement (FWD) was also calculated for each scan. FA and MD for each hemisphere were estimated after applying 3 different methods for controlling motion-induced bias: 1) “removing poor-quality” (RPQ) data, 2) co-varying for FWD, and 3) matching diagnostic groups on FWD; these findings were compared to each other and to those using “no motion-control” (NMC).

Results: Repeated-Measures ANOVA revealed that RPQ consistently outperformed the two other methods. For left and right hemisphere, when comparing RPQ and NMC, FA and MD significantly differed for TD children (*ps<0.001)*, those with ASD (*ps<0.01)* and those with ADHD (*ps<0.001)*, such that FA increased and MD decreased in both hemispheres. In contrast to RPQ, for children with ASD, FWD co-varying and FWD matching produced no significant changes in FA or MD; for TD and ADHD cohorts, while there were some significant effects observed, these were inconsistent and less robust than changes with RPQ. Given our findings suggesting the superior efficacy of RPQ compared to other methods, we then examined effects of diagnosis on FA and MD for each ROI after applying RPQ. Findings revealed a significant effect of diagnosis on FA in left Supramarginal Gyrus, such that children with ASD showed lower FA compared to TD (*p=0.036*) and a significant effect of diagnosis on MD such that children with ASD showed significantly higher MD than children with ADHD, but not TD, in the left (*p=0.029*) and right (*p=0.013*) Anterior Corona Radiata.

Conclusions: Our findings suggest that RPQ is the most effective method for reducing bias induced by head motion in dMRI. Further, the two other commonly used methods do not produce findings that reliably differ from baseline, and may result in spurious findings. Applying RPQ should help to increase the reliability and validity of dMRI findings in ASD, ADHD and other motion-susceptible populations.

435.043 *(Poster)* Neural Correlates of Autism Spectrum Disorder with Psychotic-like Symptoms in the Adolescent Brain Cognitive Development (ABCD) Cohort

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Background: The neural correlates of autism spectrum disorder (ASD) and the psychotic disorder schizophrenia are divergent. However, the disorders are clinically associated, with ASD individuals at 3 to 4 times greater risk of developing schizophrenia than members of the general population. It is unknown whether ASD with co-occurring psychosis has a distinct neural signature, dissociable from those of ASD and schizophrenia alone. Identifying such a signature may help identify which youth with ASD are at risk of schizophrenia, allowing for individualized treatment and determination of prognosis.

Objectives: Using data collected from the Adolescent Brain Cognitive Development (ABCD) study (n = 11,875; 47.84% female; age mean = 9.91 years, SD = 0.62 years), we compared resting-state functional connectivity measures among three groups: 1) youth with ASD without psychotic-like symptoms, 2) youth with ASD and psychotic-like symptoms, and 3) youth with psychotic-like symptoms but not ASD. We hypothesized that each group would show a distinct pattern of connectivity among large-scale cortical networks.

Methods: To eliminate inter-scanner variability, we restricted the ABCD sample to participants with neuroimaging data collected by a Siemens scanner. We defined ASD by parent report during the screening interview, and defined psychotic-like symptoms by a Prodromal Questionnaire – Brief Child Version score ≥ 6, a cutoff based on previous literature. We then estimated random forest models to predict group status. The feature space for each model comprised 100 measures of resting-state connectivity strength between 10 large-scale cortical networks (auditory, visual, dorsal attention, ventral attention, default mode, salience, cinguloparietal, cingulo-opercular, frontoparietal, and retrosplenial-temporal). We addressed class imbalance using synthetic minority over-sampling and assessed performance using out-of-bag error scores. We calculated global feature importance using the Gini method, and compared top features across models, verifying model predictions by training local surrogate models to explain select predictions.

Results: 5,374 ABCD paricipants met our scanner criterion. 53 had ASD without psychotic-like symptoms, 16 had ASD with psychotic-like symptoms, and 737 had psychotic-like symptoms without ASD. All models predicted group status with low out-of-bag error rates (ASD without psychotic-like symptoms: 0.36%; ASD with psychotic-like symptoms: 0.21%; psychotic-like symptoms without ASD: 7.60%). ASD without psychotic-like symptoms was most strongly predicted by retrosplenial-temporal - salience, retrosplenial-temporal - fronto-parietal, and within-network retrosplenial-temporal connectivity. ASD with psychotic-like symptoms was predicted by dorsal attention network - cinguloparietal, salience - cinguloparietal, and cingulo-opercular - visual connectivity. Psychotic-like symptoms without ASD was predicted by within-network cingulo-opercular, cingulo-opercular - visual, and cingulo-opercular - auditory connectivity.

Conclusions: Within the ABCD cohort, ASD with psychotic-like symptoms, ASD without psychotic-like symptoms, and psychotic-like symptoms without ASD were characterized by distinct patterns of functional connectivity. Our finding that retrosplenial-temporal connectivity predicted ASD without psychotic-like symptoms is consistent with reports that retrosplenial-temporal connectivity is involved in social cognition and is altered in ASD. Our finding that dorsal attention and salience network connectivity predict ASD with psychotic-like symptoms is consistent with potentially altered interpretation of sensory cues in this sub-group. These results suggest that ASD with psychotic-like symptoms may be a sub-type of ASD with distinct neural correlates.

435.044 *(Poster)* Neural Substrates of Sensory Perception in Autism: An ALE Meta-Analysis

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Background: Sensory sensitivities occur in up to 90% of autistic individuals. It has been hypothesized that on the one hand this may contribute to talent in areas such as attention to detail and systemizing, but it is also recognized that it may contribute to high levels of anxiety or feeling overwhelmed with information (for a review, see Robertson & Baron-Cohen, 2017). Sensory sensitivities is one of the DSM-5 core diagnostic criteria for autism, acknowledging its central role in autism. There is therefore a need to have a clearer understanding of its neurobiological correlates.

Objectives: To examine the existing functional neuroimaging evidence of sensory processing in autism compared to neurotypical individuals, via an activation likelihood estimation (ALE) meta-analysis.

Methods: Using ALE, we synthesized information from task-based functional MRI (fMRI) studies of non-social sensory perception in autism published before October 2019. Details were recorded in accordance with PRISMA guidelines. Following systematic literature review, 20 whole-brain task fMRI studies met our inclusion criteria for testing differences in neural activity between autistic (n=379) and neurotypical (n=381) participants during sensory processing. The ALE map was thresholded at $p<0.001$ uncorrected, with a minimum cluster size of $100mm^3$.

Results: Compared to neurotypical participants, autistic individuals showed enhanced activity in parietal (x=-54, y=-22, z=-52), somatosensory (x=48, y=-20, z= 38) , and occipital cortices (x=-16, y=-82, z=26) and in regions including the caudate nucleus (x=16, y=18, z=18), thalamus (x=-18, y=-28, z=4), and primary visual cortex (x=-22, y=-91, z=19) *(Fig. 1A)*. Meanwhile, neurotypical participants showed more activation in the frontal (x=36, y=46, z=28) and temporal (x=64, y= -40, z= 6) cortices *(Fig. 1B).* Coordinates are reported in MNI space.

Conclusions: These results suggest that autistic individuals, compared to the neurotypical population, on average show distinct engagement of sensory-related neural circuits during sensory perception. This meta-analysis may help guide future research to focus on relevant brain networks, regions and neurobiological mechanisms to better understand the causes of sensory sensitivity in autism.

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Robertson, C. E., & Baron-Cohen, S. (2017). Sensory perception in autism. *Nature Reviews Neuroscience*, *18*(11), 671–684. https://doi.org/10.1038/nrn.2017.112

435.045 *(Poster)* Neuroanatomical Trajectories across Age and Association with Clinical Outcome in Autism Spectrum Disorder (ASD)

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Background: Autism spectrum disorder (ASD) and associated behavioural difficulties, such as impaired adaptive functioning, incur a high cost to affected individuals. Nonetheless, the neurobiological underpinnings of these symptoms remain poorly understood. A wealth of studies has associated ASD with differences in neuroanatomy assessed via a variety of structural features such as cortical thickness (CT), surface area (SA), and cortical volume (CV). These features and their differences in ASD are likely to vary across the lifespan and may contribute to clinical outcome.

Objectives: However, no study has examined yet how neuroanatomical differences in ASD across the human lifespan relate to a meaningful change in clinical outcome, such as change in adaptive behaviour. This was the aim of the present study.

Methods: Here we conducted a study in one of the largest longitudinal ASD samples available (n = 639, ASD n = 360, TD n = 279). We examined age-related between-group differences in CT, SA, and CV. Moreover, in the ASD group, we investigated the association between brain structure at timepoint 1 (T1) and change in adaptive behaviour between T1 and timepoint 2 (T2, 12-24 months later). First, we tested if age-related between-group differences predict change in adaptive functioning. Secondly, we grouped individuals into 'Improvers' and 'Worseners' based on the change in their adaptive behaviour (using recently published Minimal Clinically Important Difference [MCID] measures) and compared their brain structure at T1.

Results: In our sample, we established significant between-group differences in the developmental trajectories of CT, SA, and CV in cortical and subcortical areas, including frontal, temporal, parietal and central regions. Among these, CV in frontal and temporal-parietal regions significantly predicted outcome in adaptive functioning scores from T1 to T2 with an accuracy of up to 75%. Moreover, 'Improvers' and 'Worseners' differed significantly in CT, SA, and CV at T1, predominantly in frontal, temporal, parietal, central, and occipital regions.

Conclusions: Our findings of atypical neurodevelopment in ASD based on a variety of morphometric features are largely consistent with previous reports. Moreover, our observation that specific brain structural anomalies in ASD precede and predict subsequent behavioural change has important implications for future studies aimed at utilizing neuroanatomy to predict outcome in ASD.

435.046 *(Poster)* Patterns of Functional Hypo- and Hyperconnectivity in an Autism Subtype with High Social-Communicative but Low Restricted Repetitive Behavior Symptom Severity

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Background: Heterogeneity is one of the biggest challenges for better understanding autism. Amongst the most important priorities are to better understand how phenotypic variability maps onto intrinsic functional neural circuit organization.

Objectives: Use unsupervised data-driven stratification methods to subtype autism by ADI-R social-communication (SC) and restricted repetitive behavior (RRB) scores and then identify replicable subtype-specific differences in functional connectivity measured with resting state fMRI (rsfMRI).

Methods: ADI-R data was identified for n=3,380 autistic individuals across 72 independent datasets in the National Database for Autism Research (NDAR). Each of the 72 datasets were randomly split in half to generate independent Discovery and Replication datasets (n=1,690). Unsupervised hierarchical clustering was used to stratify autism by the DSM-5 symptom dyad SC and RRB algorithm scores. Identical clustering methods were applied to the EU-AIMS LEAP dataset. The LEAP dataset was split into independent Discovery and Replication sets, while preserving proportion of individuals across different scanning sites in each set. Subtypes in EU-AIMS LEAP were then examined for replicable rsfMRI connectivity differences (autism n=274; typically developing (TD) n=243). Functional connectivity was estimated as partial correlations between ICA components from FSL group-ICA and dual regression. Linear mixed effect models were used to identify differences between autism subtypes and TD. These models included sex, age, and mean framewise displacement as other fixed effect covariates and site as a random effect modeled with random intercepts. Replicable differences were required to show significant effects ($p<0.05$) across both Discovery and Replication sets and to have a replication Bayes Factor statistic (repBF) greater than 10.

Results: Six autism subtypes were replicably identified in NDAR Discovery and Replication datasets. Five of these 6 subtypes are also identified in EU-AIMS LEAP data. Replicable functional connectivity differences were isolated for 4 component pairs for a specific autism subtype with very high levels of SC severity and correspondingly low levels of RRB severity (e.g., autism SC>RRB). A fronto-temporal network centered on the bilateral posterior superior temporal sulcus was functionally hypoconnected in this autism SC>RRB subtype with a right-lateralized somatomotor network (Discovery d= -0.58, Replication d= -0.45, *repBF*= 11) and a network centered on visual association cortex that spans midline occipital and temporal cortical areas (Discovery d= -0.43, Replication d= -0.50, *repBF*= 184). This autism SC>RRB subtype also showed functional hyperconnectivty between the default mode network and right-lateralized executive control network (Discovery d= 0.34, Replication d= 0.50, *repBF*= 66) as well as the salience network and a left-lateralized somatomotor network (Discovery d= 0.34, Replication d= 0.38, *repBF*= 11). No other subtypes showed similar replicable functional connectivity differences.

Conclusions: Unsupervised data-driven subtyping by phenotypic patterns reveals consistent subtype population stratification in autism. An autism subtype with high SC but low RRB severity on the ADI-R showed replicable functional connectivity differences that are a mixture of hypo- and hyperconnectivity patterns. These differences in connectivity may help to explain phenotypic and cognitive differences that may be apparent in this particular SC>RRB autism subtype.

435.047 *(Poster)* Scmri Confirms Brain Network Abnormalities in Children with ASD

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Background: Background: Autism is a complex neurological condition characterized by childhood onset of dysfunction in multiple cognitive domains including socio-emotional function, speech and language, and processing of internally- versus externally-directed stimuli. Accumulating evidence suggests that autism is a network-based disease, and that abnormalities in brain network structure underlie the abnormal brain function at the core of the disorder. However, large-scale brain network structure has yet to be fully characterized in autism.

Objectives: Using an emerging technique known as structural covariance MRI (1), this study sought to confirm whether specific abnormalities in large-scale brain network organization are associated with autism, and whether previously reported network-level abnormalities in brain architecture (2) can be reliably detected and replicated with standard clinical MRI in an independent sample.

Methods: We used scMRI to interrogate network-level differences in gray matter structure within eight canonical large-scale 'intrinsic connectivity networks' (ICNs) strongly implicated in autism, in 116 high-functioning autistic subjects and age-, gender-, and IQ-matched controls (mean age 9.67 yrs, range 3-12 yrs, all male). T1-weighted 3.0 Tesla anatomical MRI scans were realigned, segmented, normalized to a customized template, modulated, and smoothed. To study network structural covariance, we derived 4-mm radius spherical seed regions-of-interest (ROIs) within core hubs of canonical ICNs. Extracted mean ROI gray matter intensities provided covariates-of-interest for whole brain condition (diagnosis)-by-covariate analyses based on the General Linear Model. Resulting seed covariance maps for each age group were thresholded at $p < 0.05$, corrected for family-wise error. Direct between-group comparisons were performed using ROI, diagnosis group, and neuropsychiatric test scores as covariates of interest.

Results: Seed-based scMRI confirmed specific perturbations in brain network architecture within distinct ICNs, consistent with phenotypic manifestations of autism. Structural covariance maps in controls were consistent with canonical ICN topologies. Extent and topology of the salience network, involved in social- emotional regulation of environmental stimuli, is markedly underdeveloped in autism. In contrast, the default mode network (DMN) is larger in autism, but demonstrates 'posteriorization'. Moreover, discrete nodes outside of canonical DMN boundaries are present in the autism group, including many regions commonly associated with autism. Other networks demonstrate concurrent over- and under-development, regional decoupling, or remain unaffected.

Conclusions: Specific abnormalities in large-scale brain network structure underlie autism. Our findings are consistent with a network-based 'selective vulnerability' model of autism, provide a plausible substrate for phenotypic features of the disorder, and suggest a unifying interpretation of previous work. Structural brain network abnormalities in autism are quantifiable using standard clinical MRI, and abnormalities are both reliable and replicable.

435.048 *(Poster)* Sex-Related Heterogeneity of Intrinsic Neural Temporal Signal Complexity in Autism

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Background: Evoked responses to sensory stimuli are more unreliable in autism, suggesting an enhancement of neural noise. Enhanced neural noise could be a consequence of intrinsic excitation-inhibition (E:I) imbalance. Given that sex-related mechanisms can affect E:I-relevant biology, we examined how neural noise may modulated by sex-related heterogeneity in autism. To examine intrinsic neural noise, we used resting state fMRI data (rsfMRI) and estimated multiscale entropy (MSE).

Objectives: Examine how MSE differs in autism and typically developing (TD) individuals and identify which cortical areas express sex-related heterogeneity.

Methods: Age-matched adult males and females with and without autism (male autism n = 23, age = 27.13 years; female autism n = 25, age = 27.35 years; male TD n = 29, age = 28 years; female TD n = 33, age = 26.99 years) were scanned at 3T for over 13 minutes (TR = 1302 ms; 620 volumes) with an eyes-closed resting state acquisition. Preprocessing was conducted in AFNI, with motion parameters and their derivatives plus CSF signal regressed out and wavelet denoising was used to further remove residual artefact signals. Mean time-series for 180 regions from the HCP-MMP parcellation were computed and MSE was estimated across 4 scales (m = 2) and with an r parameter estimated for each scale. Hypothesis tests were implemented with a linear mixed effect model that also included mean framewise displacement and full-scale IQ as other fixed effects of no interest. MSE scale was included as a random effect in the model. FDR $q < 0.05$ was used to correct for multiple comparisons.

Results: All MSE estimates were within the range typically observed for pink to red noise. Sex-by-diagnosis interactions were identified in frontal (e.g., ventromedial prefrontal cortex (vMPFC), primary motor cortex (M1)), temporal (e.g., superior temporal sulcus), and occipital cortices. These effects were complex and dependent upon brain region. For example, vMPFC and M1 were characterized by a large TD sex difference (Females>Males), but an absence of this sex effect in autism. Diagnosis effects were widespread across all lobes and generally manifested as higher sample entropy across scales in TD compared to autism. Sex effects were also particularly widespread and manifested as higher sample entropy in females compared to males.

Conclusions: Sex-related heterogeneity in intrinsic MSE is restricted to specific cortical areas and can be described as attenuation or absence of normative sex differences in autism. Other diagnosis differences not affected by sex-related heterogeneity are characterized by decreased complexity and enhanced regularity in autism. These effects may be linked to E:I imbalance and future work should investigate MSE modulations during experimental manipulations to E or I in-vivo.

435.049 *(Poster)* Shared or Distinct? - Neuroanatomical Underpinnings of ASD in Carriers and Non-Carriers of the 22q11.2 Microdeletion

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Background:

There is increasing interest in using human genetic models to better understand the mechanistic underpinnings of autism spectrum disorder (ASD).A crucial step in this process, however, is to demonstrate that the biological underpinnings of ASD in genetic high-risk conditions are similar to those in idiopathic illness. 22q11.2 deletion syndrome (22q11.2DS) is a genetic condition with complex clinical phenotypes that include ASD. Evidence from *in vivo* neuroimaging studies (Antshel et al.,2007; Jalbrzikowski et al.,2017; Gudbrandsen et al.,2019) suggests that 22q11.2DS individuals with ASD symptomatology are neuroanatomically distinct from those without, and may represent a distinct neurobiological subgroup. None of these previous studies, however, included individuals with idiopathic ASD. It therefore remains unknown how closely the neurobiological phenotype of ASD in 22q11.2DS resembles the ASD phenotype in those without the microdeletion.

Objectives: To establish whether ASD symptomatology in 22q11.2 deletion carriers is underpinned by the same – or distinct – neural systems that mediate these symptoms in non-carriers.

Methods: We examined vertex-wise estimates of regional cortical volume, surface area, and cortical thickness (CT) across 131 individuals (6-25 years). We included (1) 50 22q11.2 deletion carriers (n=25 ASD, n=25 without ASD), and (2) 81 non-carriers (n=40 ASD, n=41 healthy controls). In accordance with previously published studies (Jalbrzikowski et al.,2017; Gudbrandsen et al.,2019), all individuals with ASD met diagnostic cut-offs in the reciprocal social interaction and communication domain of the ADI-R (Lord et al.,1994), but were allowed to fall below threshold in the repetitive behaviors domain. We employed a multivariate dimensional approach using canonical correlation analysis (CCA). This allowed us to; 1) treat ASD as a continuous clinical construct spanned by multiple symptom domains assessed via the five subscales of the Social Responsiveness Scale (SRS; Bölte & Poustka,2008; Constantino & Gruber,2012), and 2) to examine the multivariate association between inter-individual clinical profiles and neuroanatomical variability in 22q11.2 deletion carriers and non-carriers.

Results:

Initially, CCA was performed across individuals without the microdeletion (see **Fig.1**) where clinical variability across the five subdomains of the SRS could be reduced to a single latent trait variable that was (1) highly predictive of group membership (i.e. ASD vs. controls), and (2) significantly associated with neuroanatomical variability across multiple morphometric features. In contrast, in 22q11.2 deletion carriers (see **Fig.2**) the multivariate association between ASD symptoms and neuroanatomical variability was very significantly decreased relative to non-carriers (RV_{coef}=0.06, p<0.7 vs. RV_{coef}=0.196, p<0.0001), even though clinical variability was represented by a similar latent factor structure. Moreover, the spatially distributed patterns of neuroanatomical variability associated with this factor significantly differed between groups particularly for measures of CT in the right lateral and medial orbitofrontal cortex, the right rostral middle frontal cortex, and the left precuneus and superior parietal cortex.

Conclusions: ASD symptomatology is mediated by distinct neuroanatomical substrates in individuals with and without the 22q11.2 microdeletion, even when taking inter-individual variability in SRS subdomains of ASD into account. Brain mechanisms underlying ASD associated with specific genetic etiology may thus diverge from those in idiopathic illness.

435.050 *(Poster)* Shifted Phase of EEG Cross-Frequency Coupling in Individuals with Phelan-Mcdermid Syndrome

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Background: Phelan-McDermid Syndrome (PMS) is one of the most well-characterized genetic subtypes of Autism Spectrum Disorder (ASD). PMS is a rare disorder caused by deletion or mutation of the *SHANK3* gene. *SHANK3* encodes an important structural component of excitatory synapses, thus disrupting the balance between neural excitation and inhibition in both thalamic and cortical neurons,[1,2] potentially altering processing of feedforward (“bottom-up”) versus feedback (“top-down”) neural activity. Feedforward:feedback imbalances may contribute to phenotypes frequently seen in PMS, including ASD, seizures, and other neurodevelopmental concerns.

In this context, we hypothesize that individuals with PMS may exhibit abnormalities in an electroencephalography (EEG) based measure termed "phase bias." Phase bias reflects the cross-frequency coupling between neural oscillations, and a more positive phase bias reflects the degree to which the amplitude of the faster oscillation increases at the peak (versus the trough) of the slower oscillation[3]. Feedforward and feedback activity can increase at different points in the slower oscillation; phase bias thus may reflect the overall balance between feedforward and feedback neural network activity.

Objectives: We examine whether individuals with PMS display differences in resting EEG phase bias, compared to age-matched typically developing controls.

Methods: Resting EEG data were collected at multiple sites (n = 16 controls, n = 35 PMS). Among EEG electrodes in a standard 10-20 configuration, we examined cross-frequency coupling between alpha (8-12 Hz) and gamma (20-60 Hz). Positive phase bias was calculated as the proportion of amplitude of the high frequency (gamma) signal occurring in the positive phases of the low frequency (alpha) signal, - .5. Therefore, a positive phase bias >0 or <0 indicates gamma amplitude increasing at the peak or trough, respectively, of the alpha waveform. Among all possible channel and frequency combinations, statistically significant clusters were identified using a permutation based clustering algorithm.

Results: Positive phase bias in individuals with PMS (mean = .0005, SD = 0.0010) is increased relative to controls (mean -.0005, SD = 9.3e-05; p = .00004). This reflects a tendency for gamma amplitude to increase at the trough of the alpha oscillation in the control group, but at the peak of the alpha oscillation in PMS group. Clusters demonstrating increased positive phase bias are primarily located at posterior channel locations.

Conclusions: We find individuals with PMS demonstrate increased positive phase bias, possibly reflecting an altered ratio of feedforward:feedback activity in this population. Future work aims to determine whether abnormal phase bias may portend ASD (or other specific behavioral phenotypes) more broadly, assess for similar findings in other genetic populations at high risk for ASD, and better understand the biological underpinnings of this EEG-based finding.

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435.051 *(Poster)* Somatosensory-Evoked Potentials in Young Children with Autism Spectrum Disorder

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Background: More than 90% of children with autism spectrum disorder (ASD) show atypical responses to sensory stimuli (e.g. hyper- or hypo-sensitivity) that affect their everyday functioning. Impaired tactile processing has been proposed to exacerbate deficits in communication and social skills. Sensory tactile abnormalities in ASD are often measured with parent questionnaires. While clinically relevant, these do not inform the underlying neurophysiological mechanisms. Electroencephalography (EEG) provides insight to cortical excitation and inhibition with excellent temporal resolution and is an ideal tool for paediatric populations (e.g. easy-to-apply, no loud noises, less sensitive to movement compared to MRI). Increasing evidence suggests that an excitation-inhibition imbalance results in atypical sensory processing in ASD. While evidence of inhibitory dysfunction in older children with ASD exists, little is known about tactile processing in young children under the age of 8, despite early emergence of sensory symptoms (<age 3).

Objectives: Using EEG, we are investigating tactile processing in young children aged 3-6 years with ASD compared to typically developing (TD) children and the relationship with parent-reported sensory, behavioral and social symptom severity.

Methods: Twenty-four children with ASD of varying cognitive and verbal abilities and forty TD children aged 3-6 years participated in the study (Table). All participants with ASD had a clinical diagnosis. During EEG recording, children received tactile fingertip stimulation at different rates (1050ms and 150ms interstimulus interval (ISI) in blocked presentations) while watching a movie. Latency and amplitude measures for somatosensory-evoked potentials (SEPs) elicited with the 1050ms ISI were derived and the difference between SEP amplitudes elicited by 1050ms and 150ms ISIs was used as a measure of adaptation.

To assess intellectual functioning, the Wechsler Non-Verbal Scale of Ability (non-verbal IQ) was utilized, and parents completed standardized questionnaires that assessed sensory (SP, Sensory Profile 2), behavioral (BASC-3, Behavior Assessment System for Children 3) and social (SRS-2, Social Responsiveness Scale 2) symptoms.

Properties of SEPs and adaptation were compared between ASD and TD groups using ANCOVA models controlling for age, biological sex, and non-verbal IQ, and Pearson correlations were used to determine associations with sensory, behavioral and social symptom severity.

Results: Preliminary results show that ASD and TD groups were comparable in terms of age and sex, but children with ASD had lower IQ, and showed significant sensory, behavioral and social difficulties. The latency and amplitude of the early prominent SEP, ~50ms post-stimulus (P50), did not differ between groups (p>0.4). Similarly, there was no significant group difference in P50 adaptation (p>0.4); however, the amount of adaptation was significantly different from zero only in the TD group (p=0.004). Specific to the ASD group, greater P50 amplitude was associated with stronger sensory seeking behavior (r=0.48, p=0.019, Figure).

Conclusions: We have >80% success rate of collecting EEG in children with ASD at this challenging age range, including those with low cognitive and/or verbal abilities. This represents a highly novel dataset to better understand tactile processing in early childhood ASD, which is important for informing future therapies for sensitivities. Our investigations will continue with a larger sample by 2020.

435.052 *(Poster)* Thalamic Resting-State Connectivity Mediates the Relationship between Thalamic GABA and Sensory Over-Responsivity in ASD

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Background: Sensory Over-Responsivity (SOR) is a highly prevalent and impairing feature of ASD. 50-75% of children with ASD experience SOR, ranging from discomfort to distress in response to stimuli (e.g., clothing tags, loud sounds), and these symptoms are among the most disruptive in their everyday life (Ben-Sasson et al., 2007). A better understanding of the physiological mechanisms and underlying neurochemistry of SOR may translate to psychopharmacological and psychotherapeutic interventions for individuals with ASD and SOR, thereby dramatically improving their lives. Genetic studies of GABA receptor function, biochemical analyses of GABA synthesis and degradation, as well as computational models have suggested that core features of ASD are driven by an excitatory-inhibitory imbalance of neuronal activity (Rosenberg et al., 2015). Work from our laboratory shows reduced modulation of thalamocortical connectivity in autism in response to mildly aversive sensory stimulation, suggesting altered thalamic sensory gating that could be related to neurochemical imbalance.
Objectives: Examine how GABA in the thalamus 1) differs between youth with and without ASD; 2) correlates with behavioral measures of SOR; and, 3) relates to intrinsic brain connectivity.
Methods: Subjects were 29 youth with ASD (21 males; mean age 15.0±2.6 years) and 26 typically developing youth (15 males; mean age 13.4±3.1 years). Single-voxel edited 1H-MR spectra were acquired from the bilateral thalamus (8.75ml voxel) using a Siemens prototype MEGA-PRESS sequence (TE/TR 68/2000ms; 256 averages) and post-processing in MATLAB (Guo et al., 2018) to yield high accuracy GABA ([GABA] = GABA/Cr) concentrations. For resting-state fMRI, the bilateral thalamus was the seed in a bottom-up whole-brain connectivity analysis with [GABA] entered as a regressor to determine how metabolite concentrations predicted intrinsic connectivity (thresholded at $Z>2.3$ and corrected for multiple comparisons at $p<0.05$). The Sensory Over-Responsivity (SenSOR) Inventory (Schoen et al., 2008) – a child sensory responsivity questionnaire – was completed by parents.
Results: [GABA] was not statistically different between groups (Student's t-test). In the ASD group, a negative correlation was found between [GABA] and SOR scores (SenSOR Total $r=-0.47$, $p=0.01$). Thalamic [GABA] predicted lower thalamic-somatosensory (SMS) connectivity in ASD as opposed to greater thalamic-SMS connectivity in TD (Fig 1). Thalamic [GABA] was correlated with greater thalamic-insula connectivity only in the ASD group (Fig 2). Furthermore, thalamic-insula connectivity mediated the effect of Thalamic [GABA] on SOR in youth with ASD.
Conclusions: These results demonstrate a relationship between lower thalamic [GABA] and greater severity of SOR symptoms in youth with autism that is mediated by intrinsic connectivity between the thalamus and insula. This suggests that in ASD youth, higher GABA may reduce the risk of SOR through increased thalamic connectivity with the insula, a Salience Network hub. Importantly, these variations in GABA and associated network connectivity in the ASD group highlight the potential role of GABA as a mechanism underlying SOR, a major source of phenotypic heterogeneity in ASD. For ASD youth, abnormalities of the thalamic neurochemical balance could interfere with the thalamic role in integrating, relaying, and inhibiting attention to sensory information. Results have implications for GABA-modulating pharmacologic interventions.

435.053 *(Poster)* The Imaging Validity Questionnaire: Development of a Novel Methodology

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Background: Social validity of neuroimaging findings is a largely under-utilized tool in studying autism, as it is a critical link between imaging and real-world experiences. Although the neuroimaging literature makes generalized claims about autistic experiences, rarely does this research ask autistic people if findings fit their own experiences. The superiority of autistic individuals' self-reports vs. parent-reports in evaluating multiple psychological domains suggests that the validity of imaging findings may be compromised by failing to consider the autistic perspective (Benetto et al., 2018).
Objectives: To bring together autistic self-advocates, clinical researchers, and neuroimagers to create a novel measure for autistic individuals to report their own experience of traits identified in previous neuroimaging studies of autism. This measure can be used to validate participants' resting state data, thus framing findings within the autistic perspective and providing context for interpreting future neuroimaging studies.
Methods: Resting state fMRI imaging data from a multi-site NIMH Autism Center of Excellence (ACE) Network study (n=112) was used to identify cortical nodes showing the greatest differences in connectivity between autistic males and females and corresponding control groups. These nodes' accompanying coordinates were entered into Neurosynth.org, an application for large-scale fMRI data synthesis, from which we extracted lists of associated concepts, along with values indicating strength of association. Neurosynth identified neuroimaging studies related to autism and combined reported activation in brain areas with terms that appear alongside in the texts to generate these lists. Self-advocates led the development of a questionnaire, translating functional constructs into accessible language. Once items were finalized, a brief cognitive interviewing process with autistic adolescents was conducted to ensure comprehensibility. To further prepare for use in the ACE study, test-retest data was collected online from adults within the US; participants were recruited via targeted Facebook postings and self-reported their diagnostic status.
Results: A 20-item measure was generated from the constructs identified by Neurosynth. Its overall Flesch Kincaid reading level was grade 4.7. Test-retest data, completed by autistic (ASD), non-autistic mixed-clinical (MC), and control (C) participants (n=58; nASD=14; nMC=24; nC=20, ages 18-27) showed adequate reliability for both absolute and relative stability. Relative stability of the measure was high (r=0.68) and absolute stability of the measure was moderate (ICC=0.67).

Conclusions: This imaging validity questionnaire provides early promise of a new methodology that integrates the expertise of autistic self-advocates, neuroimagers, and clinical researchers through a novel interdisciplinary partnership. This questionnaire will be used to contextualize claims for future, related neuroimaging studies. The novel approach used to develop this measure is original in that specific questions were generated based on neuroimaging findings; this process can be used with related imaging studies to validate results. This process is also innovative in that self-advocates directly collaborated with psychologists and neuroimagers to produce the resulting measure. Future research can use this collaboration as a model to continue including the input of autistic participants in brain-imaging studies to both reflect on their own experiences and provide social validity for imaging results.

435.054 *(Poster)* Title: Examination of Regional Cerebellar Volumes and Associations with Core ASD Traits

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Background: One of the most consistent neuroanatomical findings reported in ASD has been alterations in cerebellar structure, as described in neuroimaging, animal model, and post-mortem dissection studies. Further, regional differences in cerebellar structure have been linked to core features which characterize the disorder. Prior studies examining cerebellar structure have primarily relied on gross cerebellar boundary definitions and from neuroanatomical atlases not validated against the high accuracy manual delineation approach. As such, the ability to examine detailed cerebellar morphology using validated methods is essential to advance our comprehension of ASD etiology.

Objectives: To examine the relationship between functionally-distinct cerebellar regions and associations with core ASD deficits, specifically social communication deficits and repetitive and restrictive behaviors.

Methods: Participants included 50 male children aged 8-13 (25 ASD & 25 TD) balanced on age, scan quality, and scanner head coil. Autism-associated traits were assessed using the Social Responsiveness Scale-2 (SRS-2), the Autism Diagnostic Observation Scale-2 (ADOS-2) and the Repetitive Behavior Scale-Revised (RBS-R). Lobular volumes were generated using a cerebellar atlas developed at the Center for Neurodevelopmental and Imaging Research. The cerebellar atlas (Figure 1.) is based on a highly reliable manual parcellation with interclass correlation coefficients ranging from .86-.99 across eleven anatomically defined subdivisions including: the Corpus Medullare, Hemisphere Lobules I-V, VI, Crus I, Crus II/VIIB, VIII, IX, and X, and Vermis Lobules I-V, VI-VII, and VIII-X. We applied our parcellation schema to a high-resolution human cerebellar template, the Spatially Unbiased Infratentorial (SUIT) template allowing for automation with a high level of spatial correspondence to the manual “gold-standard” technique. The SUIT toolbox was used to align each subject to the SUIT-template space using nonlinear normalization. The cerebellar atlas was back-projected into native-space for regional calculation. Tissue segmentation interrogated gray and white matter within each cerebellar label. Multivariate linear models were used to examine the diagnosis effect on cerebellar volume and associations with autistic traits. Total cerebral volume was included as a covariate in all models.

Results: Pairwise comparisons revealed a significant diagnosis effect in regional GM volumes, with decreased volumes in ASD for: left lobule VI ($p=0.021$), right lobule VI ($p=0.023$) and left crus I ($p=0.047$). Further, correlation analyses revealed a significant correlation between the ADOS Communication total score and right lobule X GM ($r= -0.539$, $p=0.008$,) such that decreased volume was associated with greater communication impairment. In contrast, the ADOS social interaction total score correlated with both the left crus II/VIIB ($r= 0.539$, $p=0.049$) and the left lobule VIII ($r= 0.415$, $p=0.008$) such that increased volume was associated with greater social impairment. Analysis of the RBS-R and SRS-2 with regional cerebellar volumes revealed no significant effects.

Conclusions: Consistent with prior findings we observed structural alterations in regional cerebellar volumes involved in sensorimotor integration and higher-order functions including language and gestural communication. Further, we observed associations with measures of social and communicative function in children with ASD. Future studies, with larger samples sizes, could examine additional behavioral ASD components in order to develop a greater understanding the role of cerebellar structure in ASD etiology.

435.055 *(Poster)* Transdiagnostic Data-Driven Patterns of Emotion Regulation in Functional Resting State Connectivity

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Background: The ability to modulate the intensity of one’s emotional responses to adaptively fit the context or achieve one’s goals is known as emotion regulation (ER; Mazefsky et al., 2013). ER difficulties are associated with various mental health outcomes in adolescence (Weinberg and Klonsky, 2009). Examining resting state brain connectivity transdiagnostically in adolescents at various risk for ER difficulties may reveal ER-specific neural signatures. Recent work by Burrows and colleagues (2017) hypothesized that the salience network (SN), which relates to attention allocation, and default mode network (DMN), which underlies self-referential cognitions and inflexible thinking, may be linked to ER difficulties, i.e., repetitive negative thinking.

Objectives: Thus, we aimed to determine whether transdiagnostic data-driven SN-DMN connectivity subgroups relate to common and distinct patterns of ER difficulties in a sample of adolescents with autism, social anxiety, and controls.

Methods: Participants completed the Difficulties in ER Scale (DERS) and a resting state brain scan. The DERS has six subscales (i.e., Nonacceptance, Goals, Impulsivity, Awareness, ER Strategies, Clarity) with higher scores indicating greater ER difficulties. Functional and structural Magnetic Resonance Imaging (MRI) were collected on a Siemens 3T scanner. Preprocessing was conducted using the Configurable Pipeline Analysis of Connectomes (C-PAC; https://fcp-indi.github.io/). The dataset consisted of 55 adolescents. Participant characteristics are detailed in Table 1.

Four DMN and three SN nodes were chosen using Neurosynth (http://neurosynth.org/). Thus, a total of seven 5mm spherical regions were extracted for each participant. Group Iterative Multiple Model Estimation (GIMME), a graph theory approach (Gates and Molenaar, 2012), was applied on time series data in order to identify individual connectivity patterns. Subsequently, a community detection algorithm was used on individual patterns to identify subgroups characterized by distinctive SN-DMN connectivity patterns.

Results: All participants were characterized by within-SN and within-DMN connections (Figure 1). Two data-driven subgroups were identified: Subgroup A (n=30) was characterized by one additional path, while Subgroup B (n=18) had four additional paths. Data-driven subgroups did not differ in IQ or age (*p*s>.16). When examining the subgroups transdiagnostically, a MANOVA revealed no differences in ER (all *p*s >.19). When examining ER patterns by subgroup within diagnostic group, analyses revealed that controls in Subgroup B demonstrated greater difficulties in ER Clarity than those in Subgroup A ($p<.001$). Additionally, in ASD, a trend ($p<.10$) emerged for difficulties in Goal-directed behavior, such that adolescents with ASD in Subgroup B had greater difficulties than those in Subgroup A. No subgroup differences existed within the social anxiety group (*p*s>.20).

Conclusions: These results suggest that the hyperconnectivity of SN-DMN processes may subserve group-specific patterns in ER dysfunction during typical vs. atypical adolescence. More specifically, adolescent controls with SN-DMN hyperconnectivity had difficulties in clearly identifying their emotions, while adolescents with ASD with hyperconnectivity had a trend toward greater difficulties in goal-directed behavior. This work highlights the importance of understanding ASD-specific and trandiagnostic patterns. This information may aid in identifying neural markers for tailoring ASD-specific ER-targeted treatments (e.g., mindfulness, biofeedback).

435.056 *(Poster)* Variability Quenching in Adults with Autism

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Background: Previous research has demonstrated that children and adults with autism exhibit excessive cortical response variability across trials when examined with either electroencephalogram (EEG) or functional magnetic resonance imaging (fMRI) recordings. A universal characteristic of cortical neural activity is that trial-by-trial variability is reduced (i.e., "quenched") by stimulus presentation. For example, EEG variability across trials is reduced by ~30% after presentation of visual stimuli. Previous studies have not examined whether neural variability quenching may differ in autism.

Objectives: The goal of the current study was to quantify trial-by-trial EEG variability before and after stimulus presentation and identify potential differences across autism and control groups.

Methods: 43 adults, ages 18-45, 23 with ASD and 20 controls, participated in this study. EEG was recorded using a 64 channel Biosemi II system while subjects performed a contrast discrimination task with a two-interval forced-choice (2IFC) design. Each trial contained two checkerboard stimuli that were presented one after the other. One stimulus always had 100% contrast while the contrast of the other stimulus was 50% on the first trial and then adjusted according to the subject's abilities using a 2-down-1-up staircase procedure. All subjects completed six blocks of 80 trials each, yielding 480 trials with 100% contrast. Trials with eye-blinks, saccades, and other artifacts were removed. The remaining trials were used to estimate trial-by-trial variability in the pre-stimulus (-200ms to 0) and post-stimulus (150ms to 400ms) periods. The ratio between the two, normalized into units of percent change, was used to estimate variability quenching. In addition, all subjects completed the Autism Quotient to assess social-communication difficulties and the Raven test to assess performance IQ.

Results: There was a trend for larger absolute trial-by-trial variability in the ASD group in comparison to the control group in both pre-stimulus ($t(41)=1.27$, $p=0.21$) and post-stimulus ($t(41)=1.57$, $p=0.12$) periods. The mean magnitude of variability quenching was similar in both groups (ASD = -18.8%, control = -17.2%) and did not differ significantly ($t=-0.325$, $p=0.746$). Nevertheless, individual magnitudes of variability quenching were correlated with the severity of ASD symptoms as estimated by the ADOS ($r(23)=0.45$, $p=0.03$).

Conclusions: These findings demonstrate a trend for larger neural variability across trials in adults with ASD along with similar magnitudes of variability quenching across groups. Intact quenching suggests that basic cortical mechanisms that act to suppress neural variability following stimulus presentation are acting in a similar manner in adults with ASD as in controls.

435.057 *(Poster)* White Matter Compromise in Children and Adolescents with ASD Detected By Tracula

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Background: Both functional and structural connectivity findings from MRI suggest that symptoms of Autism Spectrum Disorders (ASDs) are linked to disruptions in distributed brain networks. Aggregate findings from diffusion weighted imaging (DWI) have suggested that children younger than 4-5 years have higher fractional anisotropy (FA) and lower mean diffusivity (MD) in white matter throughout the brain, compared to typically developing (TD) controls, whereas older children and adolescents show predominantly lower FA and higher MD, considered indices of reduced white matter integrity. However, findings in this later period have been mixed, particularly with regard to localization, possibly due to insufficient motion-matching and methodological differences.

Objectives: To broadly test across several major white matter tracts for differences in white matter microstructure between samples of children and adolescents with ASDs and TD peers tightly matched for in-scanner motion.

Methods: We collected diffusion MRI data from participants aged 7-19 years: 60 with ASDs (mean age=13.1±2.9; 13 female, 6 left-handed) and 56 TD controls (mean age=13.2±2.9; 15 female, 7 left-handed). Groups were matched for age, non-verbal IQ (ps>.51), and head motion (ps>.83). ASD diagnoses were confirmed using the Autism Diagnostic Observation Schedule (ADOS-2). Automated tractography was performed using TRActs Constrained by UnderLying Anatomy (TRACULA), which estimates probable locations for 18 white matter tracts in individual subject space. Data from each participant were carefully inspected to ensure each tract reconstructed properly. To test for group and age effects, general linear models were run for each diffusion measure (FA and MD) of each tract, fitted with age, diagnostic group, average rotation, and average translation as model terms. Follow-up tests on axial and radial diffusivity (AD, RD) were performed for tracts with significant group effects. To investigate potential brain-behavior relationships, partial correlations were performed between diffusion measures and autism symptom severity (Social Responsiveness Scale 2), adjusting for age and motion. All reported effects were FDR-corrected (at $q < .10$).

Results: Compared to the TD group, the ASD group had lower FA in bilateral uncinate fasciculus (UF), left parietal superior longitudinal fasciculus (SLFp), and right cingulum angular bundle (CAB), and higher MD in bilateral UF, right CAB, right inferior longitudinal fasciculus (ILF), as well as both of the right parietal and temporal superior longitudinal fasciculi (SLFp and SLFt respectively).
Follow-up tests for RD and AD revealed that differences in all reported tracts were driven by larger RD in the ASD group. No significant correlations were found between diffusion measures and autism symptom severity.
Conclusions: In a sample of children and adolescents, we found evidence of reduced tract integrity in several association tracts in ASD. Many of the tracts implicated are associated with functions such as socio-affective processing (UF), language functioning (both branches of the SLF), and working memory (CAB). – domains known to be affected in individuals with ASDs. These analyses were performed on samples that were well matched for subject motion and support the presence of altered tract microstructure in white matter tracts pertinent to autism symptomatology.

435.058 *(Poster)* Who Can Participate in Neuroimaging Research? Considering Temperament As a Factor for Maximizing Scan Success

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Background: Clinical and behavioral protocols to support neuroimaging scan experiences for children who have autism spectrum disorder (ASD) (Gabrielsen et al., 2018; Nordahl et al., 2016; Kuschner et al., 2019) have advanced the field and expanded participation in neuroimaging studies. Children who have limited language and cognitive ability have often been excluded from neuroimaging studies due to assumptions of difficulties remaining still, tolerating novel sensory experiences, inhibiting repetitive behaviors, and understanding/following the directions associated with the exam. Current clinical and behavioral protocols have supported children with limited language and cognitive ability to complete neuroimaging scans, with scan success rates from 75-100%.
Objectives: To consider temperament as a child trait that will help optimize protocols and, ultimately, predict likelihood of scan success.
Methods: Participants included 42 children 8 to 12 years (mean age=10.3 years, SD=1.4; Nonverbal IQ mean=54.5, SD=15.8). Children were minimally verbal/nonverbal with ASD or had a neurodevelopmental disorder/genetic syndrome and intellectual disability. With the support of the *MEG Protocol for Low-Language/Cognitive Ability Neuroimaging* (MEG-PLAN; Kuschner et al., 2019), magnetoencephalography (MEG) data were obtained using a 275-channel CTF MEG system. We report on a pure tone paradigm. Sinusoidal tones (300 ms duration; 10 ms ramps) with a pseudo-randomized 600-2000ms inter-trial interval were presented using a freefield loudspeaker (and thus binaurally). Parents completed the Carey Temperament Scales (Carey & McDevitt, 1995) to report their child's behavioral style across nine categories of temperament. Questionnaire version was chosen based on nonverbal mental age, with 35 parents completing the Behavioral Style Questionnaire (for 3-7 years) and 7 parents completing the Toddler Temperament Scale (for 1-35 months). Participants were groups into "Successfully" and "Unsuccessfully" scanned participants, with success operationalized as reaching a point where MEG data were *acquirable* (i.e., MEG machine was turned on and an exam administered). Dependent variables were Carey temperament category scores, including Activity level, Adaptability, Approach to novelty, Distractibility, Emotional intensity, Persistence, Quality of mood, Rhythmicity, and Sensory sensitivity. Temperament ratings between groups were compared with independent samples t-tests.
Results: Using MEG-PLAN, a 76% success rate was achieved. Temperament scores were examined between the 32 children who scanned "successfully" (n=32) versus those with "unsuccessful" scans (n=10). Children with unsuccessful scans were more likely to have elevated scores on the Distractibility scale (i.e., external stimuli alter their ongoing behavior; p=.03, Cohen's d=.8) and the Emotional Intensity scale (i.e., show greater energy level in response to their environment; p=.03, d=.7), and to be rated by their parent as more globally difficult to manage (p=.03, d=.7). There were no other group differences.
Conclusions: Temperament features related to distractibility, intensity of emotional responses, and general manageability were associated with difficulty completing neuroimaging protocols. As the field seeks to expand participation in neuroimaging research, executive control and regulation weaknesses will limit successful scanning. Clinical and behavioral protocols to target these skills are needed.

435.059 *(Poster)* Whole-Brain Resting State Lag Structure Is Similar in Adolescents with and without Autism Spectrum Disorders

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Background: Atypical functional connectivity (FC) has been widely reported in autism spectrum disorders (ASDs). Conventional functional connectivity MRI (fcMRI) methods typically assume that activity within shared brain networks is synchronous. However, recent research suggests that lagged blood oxygen level-dependent (BOLD) correlations may better characterize functional brain networks by accounting for neural propagation or differences in hemodynamic latency. In typical development, reliably 'early' and 'late' regions have been identified within some functional networks; e.g., posterior cingulate and ventromedial prefrontal cortices are early and late, respectively, within the default mode network (Mitra et al., 2014). A few studies have reported atypical resting-state BOLD lag structure in high-functioning adults with ASDs (King et al., 2018; Mitra et al., 2017). However, it remains unclear whether or how BOLD latency structure differs at rest in adolescents with ASDs.
Objectives: We aimed to (i) establish the relationship between FC and BOLD latency in adolescents with and without ASDs; (ii) characterize regional BOLD latency structure in each group, and (iii) compare regional BOLD latency between groups.
Methods: Low-motion, multi-echo, multi-slice resting-state functional MRI data (TR = 1.1 or 1.25s) from 22 ASD and 20 typically developing (TD) participants was included, group-matched for age, sex, handedness, and cognitive ability. A functional cortical atlas (Schaefer et al., 2018) and the Harvard-Oxford subcortical atlas were combined to yield 114 regions of interest (ROIs) covering the whole brain. FC was calculated for each ROI pairing at zero-lag. Cross-covariance was then used to examine synchronicity at different latencies ranging from -2 to 2 TRs. The optimal lag corresponding to the maximum absolute covariance between each ROI pairing was determined using parabolic interpolation. For each ROI, average latency with respect to all other ROIs was computed to identify putative sources and sinks of neural activity. Zero-lag FC, ROI-ROI lag matrices, and average ROI latencies were compared across groups.

Results: A one-sample t-test showed predominant overconnectivity across all ROI pairings in ASDs ($t(6440) = 70.7$, $p < .001$) at zero-lag, largely driven by increased positive correlations between default-mode and other networks. No significant differences were found with respect to average whole-brain latency for any of the 114 ROIs. The average ROI-ROI lag matrices for the ASD and TD groups were highly similar ($r = .70$, $p < .001$). Among the ten 'earliest' ROIs for both groups were occipital cortex, posterior parietal cortex, and precuneus. Among the ten latest ROIs for both groups were higher-order regions, such as frontal eye fields and prefrontal cortex.

Conclusions: Zero-lag FC was overall increased in ASDs, particularly between default-mode and other networks. On average, ASD and TD participants showed highly similar regional 'early' and 'late' patterns of BOLD latency across the brain, suggesting absence of dramatic differences in neural propagation or regional hemodynamic latency during the resting-state in high-functioning adolescents with ASDs.

Neurology

POSTER SESSION — **NEUROLOGY**
436 - Neurology Posters

436.001 *(Poster)* Self-Reported Parkinsonism Symptoms in Older Autistic Adults: A Descriptive Study

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Background: Parkinson disease (PD) is thought to be prevalent in the autistic population[1,2], but recognizing PD related parkinsonism in autistic populations is a challenge. It is unknown what characterizes the autistic adults who do show this Parkinsonian complex of motor symptoms (i.e., parkinsonism). For example the high observed prevalence in previous studies might be large driven by the prevalent intelectual disabilities in the autistic samples included, and might not be related to autism perse. We will, therefore, focus on parkinsonism in autistic adults without an intelectual disability.

Objectives: In this study we explore: (a) the prevalence of self-reported motor symptoms associated with parkinsonism in autistic adults with a late adulthood diagnosis of ASD; (b) the age of onset of symptoms; and (c) whether there are differences between those who screen positive or negative for parkinsonism.

Methods: A total of 296 autistic adults aged 50 to 81 years of age (M 58.4, SD 5.9; 183 males; 113 females) filled out a new, six-item, parkinsonism screening questionnaire (PSQ)[3]. Information was collected, through self-report, regarding mental health problems, physical health problems, and use of psychotropic medication. We also measured subjective cognitive functioning with the *cognitive failures questionnaire.*

Results: Of the older autistic adults, 64.5% gave an affirmative answer to at least one of the questions of the PSQ with a mean age of onset ranging from 35.9 to 50.4. A subgroup (16.9%; N=50) scored above the cut-off of the PSQ screening score. The estimated percentage of true positives is between 15.9 to 16.2%. People screening positive encountered more physical and mental health problems, but less cognitive failures, then people who screened negative. As especially the use of anti-psychotics is associated with parkinsonism symptoms, we explored whether the use of anti-psychotics differed between those who screened positive and those who screened negative, but no significant differences emerged.

Conclusions: We conclude that (a) self-reported parkinsonism is prevalent in middle and older autistic adults with a late adulthood diagnosis; (b) self-reported motor symptoms are not likely to be an intrinsic part of autism; and (c) are not likely to be due to psychotropic drug use. It needs to be determined whether adults who screen positive for parkinsonism need to receive a follow up neurological examination. Put differently, while we can conclude that subjective parkinsonism is prevalent in older autistic adults without an intelectual disability, it needs to be determined, by means of longitudinal studies including neurological examinations, if self-reported parkinsonism is a red flag for neurologically validated parkinsonism and idiopathic Parkinson disease.

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Neurophysiology/Electrophysiology

POSTER SESSION — **NEUROPHYSIOLOGY/ELECTROPHYSIOLOGY**
437 - Neurophysiology/electrophysiology Posters

437.001 *(Poster)* "I Bet There Comes a Beat". an ERP Study of the Effects of Positively and Negatively Violated Expectations in an Auditory Oddball Task in Young Adults with ASD.

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Background: The study of the neural correlates of predictive coding in individuals with autism spectrum disorder (ASD) has given interesting insights into the cognitive processes from which some of the distinctive behavioural features of people with ASD may originate.
Previous studies have used different paradigms to investigate predictive coding in ASD, including adapted versions of the oddball paradigm. Such studies generally involve the use of standard, frequent deviant and infrequent deviant stimuli. However, they often do not differentiate between the effect of unexpected stimuli when specific expectations are present (negatively violated expectations) or absent (positively violated expectations). Moreover, the differential processing of infrequent deviant stimuli may be caused by different sensitivity to physical stimulus properties.
Objectives: We designed an auditory oddball paradigm to disentangle the effects of negatively violated expectations from those of positively violated expectations, and the effects of expectedness from those of acoustic stimulus features.
Methods: Participants with ASD (n = 16, 6 women, mean age 20.5 ± 3.3, mean non-verbal IQ 112 ± 7) and typically developing (TD) controls (n = 16, 6 women, mean age 21 ± 3.5, mean non-verbal IQ 113 ± 7) heard 210 series of four pure tones (duration: 190 ms, silence between tones: 500 ms, silence between series: 2500 ms). In 70% of cases, the series consisted of 3 low tones (500 Hz sinusoidal) and one high tone (800 Hz sinusoidal) occurring in position 3. In 15% of cases, the high tone occurred in position 2 (positively violated expectation: an unexpected deviant tone plays when a standard one normally occurs and participants do not formulate specific expectations). In the remaining 15% of cases the series consisted of 4 identical low tones (negatively violated expectation: listeners specifically expect a deviant tone in position 3, but a standard one plays). EEG activity was recorded using a 32 electrode 10-20 montage.
Results: For negatively violated expectations, we found a group difference in the effect of expectedness over the amplitude of the N1 peak to low tones (Expectedness x Group: $F(1,30) = 4.680$, $p = .039$). The effect of Expectedness was only significant in the ASD group ($F(1,15) = 12.092$, $p = .003$). Exploratory analysis showed good sensitivity (87.50%) but lower specificity (68.75%) of this effect to discriminate between ASD and TD participants.
The response to positively violated expectations did not differ between the two groups, who showed an N2 and P3 effects.
Conclusions: Our results suggest that existing expectations and top-down mechanisms can have a stronger impact over sensory processing in individuals with ASD than in their TD peers. For negatively violated expectations, participants with ASD showed an effect of expectedness over the processing of acoustically identical stimuli at an early stage (100-200 ms time-window), when effects are generally due to physical stimulus properties and bottom-up processes. However, participants in both groups processed positively violated expectations in a similar way. Overall, this might signify that it is particularly problematic for individuals with ASD to cope with non-fulfilled expectations rather than with unexpected events.

437.002 *(Poster)* Altered Error-Related Negativity (ERN) in ASD May Result from between- Rather Than within-Subject Variability of the Timing and Magnitude of Neural Response.

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Background: The error-related negativity (ERN), an index of threat monitoring measured via electroencephalogram (EEG), is generated from theta-band oscillations from the anterior cingulate cortex (Cohen, 2011). The ERN is different, but not consistently so, in autism spectrum disorder (ASD) compared to non-ASD youth (Groen et al., 2008; Rosen & Lerner, 2018; South, et al., 2010; Vlamings et al., 2008). One plausible explanation for these mixed findings is that individuals with ASD may have greater within-subject variability in the ERN (Milne et al 2011). However, no study to date has examined whether within-subject variability of the timing or magnitude of theta oscillations of the ERN account for observed differences in the ERN in ASD. Inter-trial phase coherence (ITPC) can isolate within-subject variability in the *timing* of trial-level theta oscillations during the ERN. Time-frequency analyses can be used to calculate within-subject variability of the *magnitude* of trial-level theta oscillations during the ERN. Thus, they represent ideal tools for determining whether mixed ERN findings in ASD can be explained by greater within-subject variability of the timing and magnitude of neural response.
Objectives: We examined whether group differences in the ERN are due to within- or between-subject variability in the timing and magnitude of theta oscillations during the ERN.
Methods: Forty-four youth (M_{age}=11.61, SD_{age}=2.92; 32male) with ADOS-2-confirmed ASD diagnosis and seventy-two typically-developing (TD) youth (M_{age}=12.39, SD_{age}=1.89; 34male) completed the Flanker Task (Eriksen & Eriksen, 1974). 15 artifact-free trials were randomly selected per participant. The ERN was calculated using the difference between the mean amplitude of Error-Correct responses between -25-to-75ms post-response. Morlet-wavelet transformation (.5Hz resolution; m=4) were conducted on single trials in the theta-band (4-7Hz) to calculate within-subject variability of magnitude. Then, ITPC were extracted (Trujillo & Allen, 2007). A one-way ANOVA examined group differences in the ERN, ITPC, and magnitude of theta oscillations. A repeated-measure ANOVA examined differences in within-subject variability of the magnitude of theta oscillations between groups.
Results: The ERN differed between groups ($F(1,109)=4.86$, $p=.03$), such that the ERN was less negative in ASD compared to TD. Groups did not differ on theta-band ITPC ($F(1,108)=1.55$, $p=.22$), yet the ASD group exhibited a bi-modal distribution (Fig1). Groups differed in the magnitude of theta oscillations ($F(1,115)=11.22$, $p=.001$), such that the magnitude of theta oscillations was smaller in ASD compared to TD (Fig2). There were no group differences in within-subject variability of the magnitude of theta oscillations ($F(1,109)=.85$, $p=.36$).
Conclusions: The ERN was less negative in ASD relative to TD youth, replicating previous literature (Rosen & Lerner, 2018; Vlamings et al., 2008). In contrast to current theories suggesting that greater within-subject variability contribute to inconsistent ERN findings (Milne et al., 2011), our results suggest ASD and non-ASD youth have similar levels of variability in the timing and magnitude of theta oscillations during the ERN. Rather, the ASD group overall had less theta activation during the ERN. Additionally, the bi-modal distribution ITPC of the ERN suggests there may be greater between-subject variability in in timing of neural response in ASD relative to non-ASD youth.

437.003 *(Poster)* An EEG Study of Music and Speech Processing in Children with Autism Spectrum Disorder

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Background: *"My child has autism; he doesn't speak, but he can sing."*

Strong musical abilities are commonly reported in verbal and nonverbal children with autism spectrum disorder (ASD), such as perfect pitch or rhythmicity. Furthermore, most intervention programs include music-based sessions to enhance social responsiveness and emotion regulation. Yet, few neurophysiological studies have investigated the neurobiological mechanisms involved in music processing in the context of speech anomalies in ASD children. Neuroimaging studies report an overlap among brain regions involved in music and speech and higher fronto-temporal connectivity in adolescents/adults with ASD compared to their typically developing (TD) peers during singing than speaking, suggesting alternate mechanisms for music processing in ASD. However, neural findings on young children with ASD are critically missing, as imaging techniques are often burdensome and challenging to implement on younger participants. Thus, this study focuses on the neurophysiological underpinnings of musicality in young children with ASD.

Objectives: The goal of this study was to use EEG, a convenient, non-intrusive method, to examine neuronal response such as differential patterns of electrocortical activation, to musical and matched spoken stimuli in young children with ASD.

Methods: Participants included two groups of children with ASD (n=15) and TD children (n=6) matched on sex and age (4 to 6 years). All children were evaluated for diagnostic (ADOS) and intellectual functioning, followed by testing with EEG. In the same testing room, children were asked to sit in their parents' laps in front of a low-impact visual stimulus and fitted with a 128-electrode cap connected to the Net Station EEG acquisition system (Electrical Geodesics, Inc., Eugene, OR) for approximately 6 minutes. After 1 minute of silent baseline, two counterbalanced, randomized blocks of sung and spoken forms of four popular nursery rhymes (i.e. "Twinkle, Twinkle, Little Star", "Row Your Boat", "Clean Up", and "ABC") were presented using a stimuli presentation software. Physiological artifacts were removed, and data were filtered and average referenced. *T*-statistics were used to analyze differences in EEG spectral power across groups (unpaired tests) and stimuli (paired tests).

Results: All children except three with ASD were able to complete the experiment (ASD: n=12; TD: n=6). Widespread significant differences in music minus speech EEG spectral power ($|t| > 2.4$, $p < .05$) between children with ASD and TD children were found, with a high degree of spatiotemporal clustering in response to music at 10, 31, and 52 Hz in children with ASD. Overall, our results reveal a less scattered, more spatially localized pattern of spectral power differences between ASD and TD while listening to music.

Conclusions: Our findings confirm significant differences in patterns of neural activation in response to music and speech between ASD and TD children. These results suggest differential brain patterns that may contribute to high musicality frequently reported in ASD. This study provides preliminary neurophysiological evidence for music and speech processing pointing to a potential, novel electro-cortical signature of ASD. These biologically based findings may help in the development of targeted music-based therapy and the search for electrophysiological biomarkers in ASD.

437.004 *(Poster)* Attentional Allocation to Auditory and Visual Stimuli in Autism Spectrum Disorder

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Background: Autism Spectrum Disorder (ASD) is commonly characterized by sensory abnormalities; many individuals with ASD display hyper- or hyposensitivity to sensory stimuli in both auditory and visual domains. It remains unclear, however, whether individuals with ASD attend to sensory stimuli differently than typically developing (TD) individuals, and whether attentional allocation in ASD is related to sensory symptoms. We utilized oddball paradigms during continuous electroencephalograph (EEG) recording to measure attention to task-relevant "target" and task-irrelevant "novel" sensory input.

Objectives: Our aim was to quantify differences in neural markers of attention to visual and auditory stimuli between ASD and TD.

Methods: EEG was recorded during visual and auditory oddball tasks (VOD and AOD). Each task consisted of three blocks of 150 trials in pseudorandom order; 80% of trials presented a "standard" stimulus (VOD: small blue circle; AOD: 500Hz tone), 10% presented a "target" stimulus (VOD: large blue circle; AOD: 1000Hz tone), and 10% presented a "novel" stimulus (VOD: fractal image; AOD: animal noises, bells). Participants responded with a button press to target stimuli only. Amplitudes of P3a (novel) and P3b (target) event-related potentials (ERPs) were assessed. EEG was recorded from participants with ASD (VOD: n=11 (27.3% female), mean age=22.97 years; AOD: n=11 (36.4% female), mean age=21.80 years) and TD (VOD: n=15 (60.0% female), mean age=22.32 years; AOD: n=17 (52.9% female), mean age=22.56 years). Participants with ASD also completed the Adolescent/Adult Sensory Profile to measure self-reported sensory symptoms.

Amplitudes of P3a (novel) and P3b (target) event-related potentials were compared between groups using independent samples t-tests. Correlations between ERP amplitude and sensory symptoms were calculated for ERP variables that showed significant differences between groups.

Results: During the VOD task, ASD (9.53μV) and TD (8.96μV) groups displayed similar P3a amplitude to novel stimuli (p=0.75), but P3b response to target stimuli was significantly enhanced in ASD (ASD: 11.42μV; TD: 8.12μV; p=0.04). During the AOD task, ASD and TD individuals did not differ significantly in either P3a amplitude to novel stimuli (ASD: 9.25μV; TD: 7.16μV; p=0.19) or P3b amplitude to target stimuli (ASD: 9.29μV; TD: 6.91μV; p=0.13). Behavioral performance of target detection accuracy did not differ between groups in either task.

Within the ASD group, P3b amplitude in response to VOD target stimuli had a significant negative correlation with self-reported measures of visual sensory symptoms (r=-.76, p=.01), as well as sensory sensitivity across modalities (r=-.64, p=.05).

Conclusions: Our findings identify a significant group difference only in visual P3b, suggesting individuals with ASD attend more strongly to visual target stimuli than TD individuals. This result indicates a difference in how ASD individuals allocate attentional resources in response to visual but not auditory, and target but not novel, stimuli. It is consistent with enhanced perceptual functioning in ASD in the visual domain.
We further identify an inverse relationship between attentional allocation to visual target stimuli and sensory symptoms within the ASD group. This suggests that individuals with ASD who allocate more attention to behaviorally-relevant visual stimuli may be less likely to have clinically-impairing sensory symptoms.

437.005 *(Poster)* Children with ASD Show Abnormally Delayed Left-Hemispheric Sustained Field Neuromagnetic Response to 40 Hz Click Trains.

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Background: ASD is often associated with delayed or abnormal language development. The neural mechanisms of language deficits in ASD are poorly understood, but may involve degraded capacity for processing of low-level properties of sounds in the left hemisphere. The acoustic features such as periodicity and spectrum are encoded by two types of neuronal populations in the auditory cortex – one fires in synchrony with individual acoustic events, and the other increases firing non-synchronously with the individual events within a periodic sound (Wang et al, Neuroscience, 2008,154:294). Periodic 40Hz clicks engage both these neural populations and induce two concurrent responses in magnetoencephalogram (MEG): the auditory steady state response (ASSR) time-locked to each click and the sustained field (SF) – a deflection of the magnetic field that follows the transient response and is sustained during the whole interval of the stimulation. ASSR and SF originate from different cortical sources and may respectively reflect activity of the 'synchronized' and 'non-synchronized' neural populations. While previous ASSR studies in ASD were generally inconclusive, the SF has never been studied in ASD.
Objectives: We aim to investigate in children with ASD and neuro-typical (NT) children both ASSR and SF responses to periodic 40 Hz click trains using MEG and individual MRI-derived brain models.
Methods: Participants were 35 NT and 37 ASD children aged 7-12 years. Their IQs (KABC-II) range was 45-128 in ASD and 94-145 in NT. Autism severity was assessed using parental questionnaires (SCQ, SRS, Child-AQ) and the 1st PCA component was used as an autism severity score. The 500 ms trains of 40 Hz clicks were presented monaurally with 1000 ms intervals. The brain sources of the evoked auditory responses (ASSR and SF) contralateral to the presented sound were localized using S-Loretta.
Results: The ASSR originated from the Hershel gyrus, with higher prominence in the right hemisphere. In accordance with the previous report (Edgar et al, Dev Neurosci, 2016), the 40 Hz ASSR inter-trial phase coherence (ITPC) increased with age in both NT and ASD participants (NT: left R=0.41,p=0.012, right R=0.43,p=0.008; ASD: left R=0.28,p=0.09; right R=0.39,p=0.02), while between-group differences in the ITPC or its developmental courses were absent.
The cortical source of the SF in the Hershel gyrus was positioned rostral to that of the ASSR. The SF started at approximately 150 ms after stimulus onset, and then, after initial rise, sustained over time until 100 ms post-stimulus. Age did not affect the SF amplitude and timecourses in either group (all p's>0.1). The rmANOVA with factors Group, Hemisphere and Time revealed significant 3-way interaction (p=0.0005) due to an abnormally slow rise of the SF in ASD in the left hemisphere. The degree of the SF delay correlated with higher severity of autism (R= 0.41, p<=0.026), but not with IQ (p=0.8).
Conclusions: The delayed SF response in the left primary auditory cortex in children with ASD may reflect abnormal processing of periodic sounds in the 'language-dominant' hemisphere. Further studies are needed to investigate the consequences of this neuro-functional deficit for speech processing in ASD.

437.006 *(Poster)* Detection of an Autism EEG Signature from ONLY Two EEG Channels through Advanced Machine Learning

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Background: In previous studies we have shown the ability of a novel method of machine learning system named MS-ROM/IFAST to extract interesting features in digital EEG with standard 19 electrodes montage that allow very good distinction of ASD children from those who are developing typically and from those affected by other neuro-psychiatric disorders. If this signature is already present already at birth, then a screening program could be afforded in general hospitals registering EEG signals in the newborn. Since the equipment routinely available in neonatology units employ often few channels (2-8 electrodes), we were curious to check if features extracted from just two channels were enough to allow a good diagnostic performance in the same cases of the above-mentioned studies.
Objectives: The aim of this study is to evaluate the information load present in just two EEG channels to distinguish autistic subjects from typically developing ones and from those affected by other neuro-psychiatric disorders.
Methods: C3 and C4 time-series were isolated from EEG data sets used in two previous studies, the first carried out in Italy on 25 subjects (15 ASD and 10 typicals) and the second carried out in US on 40 subjects (20 ASD and 20 with other neuropsychiatric disorders)A continuous segment of artifact-free EEG data lasting 10 minutes in ASCCI format was used to compute multi-scale entropy values and for subsequent analyses. A Multi-scale ranked organizing map (MS-ROM), based on the self-organizing map (SOM) neural network, coupled with the TWIST system (an evolutionary system able to select predictive features) created an invariant features vector input of EEG on which supervised machine learning systems acted as blind classifiers.
Results: After MS-ROM/I-FAST preprocessing, ninety features were extracted from C3-C4 timeseries of study 1 and of study 2 representing the EEG signature. Acting on these features the overall predictive capability of different machine learning systems in deciphering autistic cases from typicals (study 1) and from other NP disorders (study 2) ranged between 93% and 94. % (study 1) and from 80 and 88% (study 2) These results were obtained at different times in separate experiments performed on the same training and testing subsets.

Conclusions: The results of this study suggest that also a minor part of EEG contain a precious information useful to detect autism if treated with advanced computational algorithms. This could allow in the future to use standard EEG from newborn to check if ASD signature is already present at birth.

437.007 *(Poster)* Different Eye Tracking Patterns in Autism Spectrum Disorder in Toddler and Preschool Children

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Background: Although the aforementioned studies have demonstrated the potentials of eye tracking, few studies have investigated the eye tracking differences in ASD children of different ages. Elucidating these differences will significantly enhance our understanding of the development of ASD. Recently, machine learning techniques have been successfully applied to identify biomarkers for ASD. As a subset of artificial intelligence in the field of computer science, machine learning is a procedure that trains the computer algorithm to analyze a set of observed data and statistically learn the latent patterns without being explicitly programmed. Different markers such as behavior, brain structure, activity and connectivity, and eye tracking has been used to distinguish individuals with ASD and TD and has achieved encouraging results.

Objectives: We applied a paradigm consisting of several pictures and short videos to 1) systematically investigate the eye tracking patterns of children with ASD across different ages and their association with clinical symptoms and 2) apply a machine learning method to explore the features distinguishing ASD from TD across different ages.

Methods: In this study, we recruited two cohorts of children with ASD (1-3 years old toddlers and 4-6 years old preschoolers) and two cohorts of age- and gender-matched typically developing (TD) children to investigate eye tracking changes across different ages using video and picture paradigms.

Results: We found that compared with TD children, fixation times of children with ASD on non-biological motion (moving helicopter and duck), electronic fan picture and eye area of a woman sitting still and mouthing the alphabet is normal in toddler years, but significant lower in preschool years compared with age matched TD. Support vector machine analysis showed that the classifier could discriminate ASD from TD in toddlers with an accuracy of 80%, a sensitivity of 80.0%, and a specificity of 81.8%; and could discriminate ASD from TD in preschoolers with an accuracy of 75.7%. a sensitivity of 89.2%, and a specificity of 62.2%.

Conclusions: Our results suggest that toddler years may be an important developmental period for ASD, and our findings may shed light on the development of new screening methods for the early detection of ASD.

437.008 *(Poster)* EEG Correlates of Excitatory/Inhibitory Balance during Visual Perception in Autism and Schizophrenia Spectrum Disorders

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Background: Excitatory/Inhibitory (E/I) imbalance theory purports to explain dysfunction in both autism spectrum disorder (ASD) and schizophrenia (SZ). E/I neurotransmitter balance facilitates center-surround interactions within receptive fields of neurons in the visual cortex. Surround suppression reflects the effect whereby neural responses to a central stimulus are suppressed by input from the surrounding visual field. This study assesses integrity of surround suppression effects across ASD and SZ by comparing neural responses to central vertical gratings in parallel and perpendicular surround conditions.

Objectives: This study aimed to use EEG to (1) assess event related potential (ERP) indices of surround suppression in adults who met diagnostic critera for ASD, SZ, or were typically developing (TD) and (2) evaluate associations between neural response and diagnostic features across disorders.

Methods: Participants included 17 ASD (15 males; age: M=25.94±6.05 years; IQ: M=106.71±17.17), 14 SZ (12 males; age: M=23.96±4.22 years; IQ: M=92.64±16.05), and 39 TD adults (21 males; age: M=26.46±5.99 years; IQ: M=112.24±15.89). EEG data were recorded using a 128-channel net. Participants observed vertical sinusoidal grating filling a central annulus, either alone, surrounded by perpendicular gratings, or surrounded by parallel gratings (Fig. 1). With intact surround suppression, attenuated ERP amplitudes are expected in parallel vs perpendicular surround. We focused on N1 and P2 components over occipital scalp. Participants were administered the Autism Diagnostic Observation Schedule (ADOS) and the Positive and Negative Syndrome Scale (PANSS) to assess current ASD and psychosis symptoms, respectively. Between-group differences were examined with repeated measures ANOVAs. Associations between neural activity and clinical variables were explored with bivariate correlations.

Results: For the N1 response, there was a main effect of condition ($F(1,67)=46.58$, $p<.001$) with N1 amplitude suppressed during the parallel condition across groups. There was also a groupXcondition trend ($F(2,67)=2.69$, $p=.075$), wherein ASD adults showed enhanced N1 suppression during parallel vs perpendicular surround, particularly relative to TD ($p=.030$). For P2, we saw the opposite effect, wherein P2 amplitude was greater in the parallel versus perpendicular condition across groups ($F(1,67)=11.54$, $p=.001$). A main effect of group was also observed ($F(2.67)=3.61$, $p=.032$) where P2 amplitude was larger in ASD vs both SZ ($p=.028$) and TD ($p=.016$) across conditions. With regard to clinical variables, greater N1 suppression correlated with fewer positive psychosis symptoms transdiagnostically ($r=.36$, $p=.05$). Weaker suppression of the P2 response correlated with greater ASD symptoms ($r=.39$, $p=.032$).

Conclusions: Results reveal evidence for surround suppression effects in the N1 ERP response during visual perception across ASD, SZ, and TD. We did not find clear evidence for global suppression deficits in either ASD or SZ. Rather, relative strength of N1 suppression was related to degree of positive psychosis symptoms across groups. This finding suggests that, rather than corresponding directly to diagnostic categories, E/I imbalance may represent a state-specific property of neural function that corresponds to period of increased delusions, conceptual disorganization, and hallucinations transdiagnostically. Further work to understand the amplification of P2 response during parallel surround conditions, and its association with ASD traits, is warranted.

437.009 *(Poster)* Early Neural Difference in Auditory Processing of Speech in Children with ASD: Is It Habituation or Discrimination?

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Background: Key diagnostic criteria of autism spectrum disorder (ASD) include social impairment, and one important aspect of social functioning is the ability to encode, perceive, and attend to relevant speech cues. Research suggests that the auditory processing pathway is disrupted in ASD, particularly to speech. However, the nature of this difference is less well interrogated. On the one hand, individuals with an ASD may show differences in their habituation to speech sounds, with some evidence suggesting that speech and non-speech are treated similarly in ASD but not in TD. On the other hand, individuals with autism demonstrate consistent enhanced discrimination abilities, and as such may attend to different aspects of speech cues than TD children. Here we attempt to tease apart these two perspectives by examining differences in early auditory evoked responses to speech in ASD, focused on the P1 ERP component. Working to determine the nature of early auditory processing differences between TD and ASD children in discrimination of and habituation to speech will enhance our understanding of auditory processing in ASD.

Objectives: The current study seeks to examine auditory habituation and discrimination by looking at P1 ERP responses to speech sounds presented in an auditory oddball paradigm among TD and ASD children.

Methods: Participants currently include 9 children with Autism Spectrum Disorder (ASD) and 17 Typically Developing (TD) children, ages 7-16, and data collection is ongoing. ASD diagnosis was confirmed by administering the Autism Diagnostic Observation Schedule 2nd Edition (ADOS-2) and Autism Diagnostic Interview-Revised (ADI-R), and TD participants had no psychological diagnoses. Participants were excluded if their hearing thresholds were elevated, their IQ was below 80, or if they had a history of epilepsy, neurological, genetic, psychiatric, or learning disorders. The P1 was evoked by speech stimuli “ba” and “da” and recorded via an electrode net. There were 1000 trials, 80% standard and 20% deviant, presented in random order. Participants were seated in a sound-insulated room and stimuli were presented via two speakers at an intensity of 60 dB sound-pressure level, while a visual distraction task engaged the participants’ attention. The P1 was measured as the mean amplitude of the most positive peak at about 100ms at the FCz cite, discrimination was measured by the difference between standard and deviant waveforms, and habituation measured by the difference of the response to standard auditory stimuli over repetitions.

Results: Preliminary data suggest that ASD children have a significantly larger P1 response to standard minus deviant stimuli than TD children and did not differ from TD children in their response to repetitions of standards.

Conclusions: Our results suggest that TD children may encode speech within a broader category, such that similar speech sounds are not discriminated at the early neural level. In contrast, discrimination was evident for very similar speech sounds for the ASD participants. Habituation was similar for both groups in response to the repetition of the speech sounds. Results suggest that it is discrimination, not habituation that is driving the ASD-related differences.

437.010 *(Poster)* Exploring Physiological Profiles Associated with Challenging Behavior in Adolescents with ASD

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Background: Those with autism spectrum disorder (ASD) can display challenging behaviors that interfere with skill development and negatively impact quality of life. Electrodermal activity (EDA) refers to changes in the electrical conductivity of the skin in response to sweat secretion and is associated with activation of the sympathetic nervous system. When looking at the alignment of EDA responses with challenging behaviors in those with ASD, findings have been inconsistent. Some researchers have found that physiological arousal can be used to predict aggressive behavior in individuals with ASD (Goodwin et al., 2018) and in individuals without ASD who display aggression (Looff et al., 2018), while others have found that a significant build-up of physiological arousal is not always present prior to a behavior in those with ASD (Ferguson et al., 2019). Better understanding the timing of physiological responding around behavior onset and offset can help guide intervention efforts.

Objectives: This exploratory study aims to further examine the alignment of behaviors and EDA responses within and across individuals with ASD who display high-impact behaviors such as elopement, disruption, self-injury and aggression.

Methods: The participants include four minimally-verbal adolescents with ASD and moderate-to-severe intellectual disability who live and attend school in a residential setting. EDA data were collected in a temperature controlled classroom during normally planned lessons using the Q-Sensor by Affectiva or the E-4 by Empatica. Behavior data were retrieved from video and coded by research assistants. After visual inspection of the EDA, we used the web-based tool EDA Explorer (Taylor et al., 2015) to classify the data into peaks (skin conductance responses) and artifacts. The threshold for the amplitude of the peaks was set at 0.05 μS. We set the maximum number of artifacts to 25%. Data not meeting this criterion were discarded. We calculated the total number of peaks, peaks per minute (PPM), mean EDA, standard deviation and EDA mean difference for 30 minutes preceding and following the behavior of interest. In order to determine whether there was an immediate anticipatory physiological response, we calculated peaks per minute for the 5 minutes preceding the problem behavior.

Results: Data collection is finished for all four students. At the time of this proposal, data analysis is complete for 21 sessions across two behaviors for one student. For Student 1, the average total number of peaks was greater in the 30 minutes *afte*r the behavior compared to the 30 minutes *prior* to behavior onset. Only 38% of sessions had more than 1 PPM in the 5 minutes prior to behavior onset, meaning that an immediate anticipatory physiological response was not significant for most behaviors.

Conclusions: Our initial analysis is consistent with findings from our previous research. Significant physiological arousal is not always present before behavior onset in people with severe forms of ASD. Furthermore, the amount of arousal that remains following behavior offset is concerning and has implications for treatment. Patterns of physiological responding around behaviors may not be dependent on behavior topography.

437.011 *(Poster)* Face Processing Hemispheric Specialization Differences between ASD, ASD + ADHD, and Typically-Developing School-Age Children: The Autism Biomarkers Consortium for Clinical Trials

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Background:
While ASD and ADHD are considered separate disorders, between 40 to 70% of children with ASD also have a co-occurring diagnosis of ADHD (e.g., Antshel & Russo, 2019). It is suggested that ERP responses may be informative in understanding the neural similarities and distinctions in the two disorders (Lau-Zhu et al., 2019).
The N170 Event Related Potential (ERP) component is associated with early-stage face processing. In typically-developing (TD) populations, the N170 is right lateralized. The response is less consistently lateralized in individuals with ASD (Kang et al., 2018). For example, Tye et al. (2013) found that the N170 in participants with ASD-only and ASD+ADHD was not lateralized, while it was right biased in an ADHD-only or TD group. The Autism Biomarker Consortium for Clinical Trial (ABC-CT) study poses a unique opportunity to study the distribution of N170 laterality responses in children with ASD: (1) as the N170 to upright faces is a primary outcome variable; (2) the ABC-CT has 280 participants with ASD and 119 with TD; and (3) the EEG battery is collected at three time periods.
Objectives:
(Aim 1) To examine patterns of N170 lateralization to upright faces in a large sample of children aged 6 to 11 years of age with ASDonly, ASD+ADHD, and TD. (Aim 2) To examine possible subcategorization based on subgrouping of symptoms or stimulant medication usage.
Methods:
Participants, ages 6-11yrs, completed a high-density EEG battery that included watching pictures of upright and inverted faces and upright houses. Parents completed the Aberrant Behavior checklist with the Hyperactivity/Noncompliance domain and the Child and Adolescent Symptom Inventory Inattentive and Hyperactivity sub-scales. Analyses used a difference score for the N170 latency to upright faces Temporal Parietal (TP) right minus TP left. A negative difference reflects a faster right region response.
Results:
Analyses focus on our interim sample of 84 children with ASDonly (20 female), 38 with ASD+ADHD (5 female), and 62 with TD group (22 female). ANOVA analysis yielded significant main effect between the groups for Face Upright Right TP N170 Latency $F(2,181)=7.3$ $p<0.05$. The ASDonly (M=215.00 SD=27.90 [141-298]) did not differ from either the ASD+ADHD (M=202.50 SD=37.46 [131-308]) or the TD (M=195.97 SD=28.69 [140-276]) group.
As seen from the mean values and the reported range, the response in the ASDonly group was suggestive of no hemisphere bias. The ASD+ADHD group also demonstrated a response that was similar.
Conclusions:
Kang et al. (2018) found that 8 studies demonstrated a right lateralized group (mean) response in ASD, while 12 did not. We found response ASD children during perception of upright faces to be similar to TD children as well as ASD+ADHD and does not support the findings of Tye et al. (2013). Our sample was significantly larger than these studies and focuses on elementary school age children, which may account for the differences in findings. Additional analyses will extend these group differences to ADHD subtypes and include the P100, a perceptual-attention response that precedes the N170. Further analyses will control for medication, specifically stimulant use.

437.012 *(Poster)* Implicit Processing of Happy and Fearful Expressions in Individuals with High and Low Autistic Traits: An EEG Fast-Periodic Visual Stimulation Study

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Background: Individuals with autism spectrum conditions (ASC) often have difficulties with processing visual information from faces such as recognizing emotional expressions. These deficits have been related to altered sensory perception, implying an interdependent relationship between social functioning and sensory processing. With the help of a fast-periodic visual stimulation (FPVS) paradigm, our study investigated the link between autistic traits and the ability to detect brief changes in emotional expressions.
Objectives: We aimed to quantify the sensory differences in the processing of happy and fearful facial expressions as a function of autistic traits.
Methods: Twenty-eight neurotypical participants (15 females, age M = 31.68, SD = 10.02) completed the Autism-Spectrum Quotient (AQ). During electroencephalogram (EEG) recordings, we showed two variations of a FPVS paradigm. In the first variant, participants were presented with neutral faces at a rate of 6.00 Hz (base frequency) for a period of 40 s; while every fifth face (deviant, presented at a rate of 1.2 Hz) was either a happy or fearful face (maximum emotion intensity). In the second variant, happy or fearful faces were presented with parametrically increasing emotion intensity (every 20 s in 20% steps until 100 %). The resulting 1.2 Hz EEG response and its harmonics were used for quantifying the detection of facial expression change. Based on FFT-transformed, baseline-corrected amplitudes, we calculated linear mixed models with emotion, emotion intensity and AQ as fixed factors and participant and electrode as random factors. Analyses focused on occipital-temporal sites.
Results: In the maximum emotion intensity variant of the paradigm, no effects of emotion or a significant interaction with AQ were found. In the variant with gradual increase in emotion intensity for deviants, we detected a significant effect for emotion. Happy deviants elicited larger amplitudes compared to fearful deviants ($p < 0.01$). We also detected a significant interaction of emotion and AQ ($p < 0.05$). Increased AQ values led to a decrease in amplitude for both emotions. There was, however, no significant difference between the different emotion intensities.

Conclusions: We found partial evidence for sensory differences modulated by autistic traits. Individuals with higher autistic traits may be less susceptible to brief changes in emotion expressions as indicated by lower EEG amplitudes, which is in line with former studies employing an emotional face FPVS paradigm with individuals with autism.

437.013 *(Poster)* Intraindividual Variability in Spectral Power Slope and Spectral Band Power Demonstrates Concordance with Sensory Processing Deficits in Adults with Autism Spectrum Disorder

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Background: Autism Spectrum Disorder (ASD) is characterized, in part, by reports of atypical sensory experiences. However, the expression of atypical sensory symptoms is heterogenous among the ASD population, and their mechanisms remain unknown. Currently, symptomology is captured by clinical interviews or questionnaires, yet no objective biological markers of these symptoms exist. Recent research indicates that the balance of excitation and inhibition (E/I) across the cortex, which can be indexed by the slope of the electroencephalographic (EEG) power spectrum, may associate with individual differences in sensory processing. Here we explore, for the first time, how within-individual variability in E/I balance, which indexes more global shifts in brain activity, may associate with sensory sensitivity.

Objectives: Characterize the relationship between within-person neural variability and atypical sensory processing in adults with ASD.

Methods: Resting EEG was collected from 38 adults with ASD (7 female, mean age of 25). EEG was cleaned of artifact and power spectral density was calculated over 2-second epochs. The slope of power spectra was computed as a linear fit on logarithmically transformed data between 2 and 55hz. The slope of the loglog power spectrum was calculated in a given 2s epoch for each channel in a scalp region of interest and then an average slope per epoch was created by taking the mean of all the slopes across channels in the region. Intraindividual slope variability was calculated as the standard deviation of slopes across all epochs. Power band variability was calculated by taking power from each canonical frequency band (delta, theta, alpha, beta, gamma) per channel, averaging across channels in the scalp region of interest, and calculating the standard deviation across all epochs for each frequency band.

Results: Intraindividual variability in EEG slope significantly correlated with the "tactile hyposensitivity" subscale of the *Glasgow Sensory Questionnaire* (GSQ) in the left occipital ($p < .01$, $r = .44$) and right occipital ($p < .01$, $r = .49$) regions, indicating that more variable E/I balance at rest may be associated with sensory hyposensitivity. Intraindividual variability of EEG power also correlated with tactile hyposensitivity, including gamma power variability in occipital left ($p < .01$, $r = .44$) and right ($p < .01$, $r = .43$) as well as alpha power variability in frontal right ($p < .01$, $r = .44$). Additionally, the "gustatory hypersensitivity" subscale of the GSQ displayed a significant negative correlation with theta band variability in the parietal left region ($p < .01$, $r = -0.47$). These changes in specific band power may be what is captured, in part, as the EEG slope changes over time.

Conclusions: Our results demonstrate that intraindividual variability in EEG activity is a useful metric, unto itself, for capturing meaningful variability in symptomology. Furthermore, differential relationships across the scalp suggest a level of regional specificity for these effects. Through analyzing variability in EEG measures by lateralized region, spatio-temporal patterns of sensory processing may thus be further mapped.

437.014 *(Poster)* Microstate Analysis of Resting-State Electroencephalography in Autism Spectrum Disorder

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Background: Variability in the electroencephalogram (EEG) across the scalp can be parsed into a small set of canonical topographies, or "microstates," that shift every 80-120ms. These topographies (labeled A, B, C, and D) are evident across studies and clinical populations and reflect activity in different brain networks. Combined EEG and functional magnetic resonance (fMRI) studies have shown microstate A to index signal in the auditory resting-state network; B in the visual network; C in the default mode network; and D in the dorsal attention network. However, temporal parameters of microstates have not been well characterized in adults with autism spectrum disorder (ASD) and hold potential to provide useful information about activation of functional networks.

Objectives: 1) Identify the four canonical microstates and compare their temporal parameters between groups of individuals with ASD and typical development (TD). 2) Assess the relationship between microstate parameters and clinical characteristics within the ASD group.

Methods: Participants were 22 adults with ASD and 37 TD controls aged 18 to 39 years. Demographic and clinical characteristics are presented in Table 1. Microstate analysis of eyes-closed resting-state EEG was performed using the *Microstate EEGlab Toolbox* and identified the four canonical microstates (Figure 1). Each microstate was characterized by three temporal parameters: 1) The duration a given microstate remained stable before switching to a different microstate; 2) The frequency of occurrence of each microstate; and 3) The fraction of time for which a given microstate was dominant (i.e., coverage).

Results: Between-group independent-samples *t*-tests demonstrated that the occurrence of microstate B was significantly greater in ASD (M=3.79) compared to TD (M=3.55), $t(57)$=-2.222, p=.030, and had significantly greater coverage in ASD (M=.30) compared to TD (M=.27), $t(57)$=-2.084, p=.042. The opposite pattern was found for microstate C, for which the occurrence was significantly greater in TD (M=2.69) compared to ASD (M=2.27), $t(57)$=2.64, p=.011, and had significantly greater coverage in TD (M=.18) compared to ASD (M=.15), $t(57)$=2.167, p=.034. Within-group linear regression analyses revealed that lower microstate C duration significantly predicted greater ADOS CSS scores in ASD, R^2=.188, p=.044. Also, greater microstate B duration [R^2=.201, p=.042], occurrence [R^2=.279, p=.014], and coverage [R^2=.235, p=.026] significantly predicted higher GSQ visual hypersensitivity scores in ASD.

Conclusions: Greater occurrence and coverage of microstate B in ASD may reflect increased visual processing load. This is corroborated by our finding that greater microstate B duration, occurrence, and coverage predicted greater self-reported hypersensitivity to visual stimuli in ASD. Less occurrence and coverage of microstate C in ASD may reflect suppressed brain activity in the default mode network, which is consistent with previous research. Lower duration of microstate C predicted greater ASD symptomatology in ASD, suggesting that time spent in microstate C rather than its occurrence and coverage is a significant predictor of default mode network activity in ASD. Together, these results suggest that microstates may serve as markers for abnormal visual and default mode networks in ASD. Future directions include using different EEG preprocessing strategies as well as different microstate clustering algorithms to further explore these relationships.

437.015 *(Poster)* Neural Correlates of Own Name and Own Face Processing in Neurotypical Adults Scoring Low Versus High on Symptomatology of ASD.

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Background: It has been argued that self-referential processes are altered in ASD. On the neural level, people with ASD show a reduced enhancement of the P3 in response to self-related stimuli such as their own name or face. A limitation of current work is that different types of self-related stimuli are mainly studied in isolation, while they might differ in crucial aspects. There is only one study that looked at own name and face processing in the same sample. They found visual name and face processing to be altered in ASD. However, this study presented the name stimuli visually, stripping the stimuli from its ostensive feature; for spoken names are mostly used to grab someone's attention to engage in social interaction. Moreover, they did not investigate whether the (absent) self-referential effect present for both stimuli can be ascribed to overlapping or distinct underlying mechanism.

Objectives: To overcome previous limitations, we directly compared the neural response to hearing the own name and seeing the own face in the same sample. We presented the names auditory, which allows us to compare two self-related stimuli of which one is also an ostensive cue. In order to test whether the underlying mechanisms are similar for different self-related stimuli we correlated the neural response to both types of stimuli.

Methods: 60 neurotypical adults scoring low versus high on ASD symptomatology (n_{low} = 30, n_{high} = 30) completed an auditory oddball task with own name stimuli and a visual oddball task with own face stimuli. Close-other names and faces and unknown names and faces were used as control stimuli. Brain activity was recorded with EEG.

Results: P3 amplitudes were larger for own names and faces (than close-other names and faces) indicating a self-referential effect for both types of self-related stimuli. However these effects were present irrespective of group. We found no relationship (correlation near 0) between self-referential processing of own names and faces

Conclusions: The absent relationship between self-referential processing of the own name and face suggest that two distinct mechanisms may underlie the self-referential effects seen for own names and faces. Interestingly, we did not find the self-referential effect to be diminished in individuals that score high on ASD symptomatology. This would imply that an absent self-referential effect for own names and own faces is specific for ASD and not a dimensional feature of ASD symptomatology. This finding warrants further investigation applying a dimensional approach (i.e. sample that includes low, and high scoring individuals as well as individuals with ASD) before firm conclusions can be made.

437.016 *(Poster)* Pathways of Perceptual Primacy: ERP Evidence for Relationships between Autism Traits and Enhanced Perceptual Functioning

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Background: Individuals with autism spectrum disorder (ASD) show enhanced perceptual functioning on a range of behavioral tasks. Neurophysiological evidence from fMRI investigations also corroborates the conclusion that persons with ASD utilize perceptual processes in reasoning and problem solving to a greater extent than neurotypical (NT) comparisons; despite robust behavioral and neuropsychological evidence for enhanced perceptual functioning among individuals with ASD, the cognitive and behavioral consequences of such early perceptual processing differences remain unclear.

Objectives: The first goal of the present study was to explicitly examine the relationship between the size of participants' early perceptual (P1 component) and late cognitive (N400 effect) event related potentials (ERPs). In order to associate ERP indicators of processing to levels of ASD traits, the second goal was to assess whether the size of participants' P1 and N400 effects were related to participants' self-reported levels of Attention to Detail as measured by the Autism Spectrum Quotient (AQ) using path analyses.

Methods: 62 NT adults (28 female) between the ages of 18 and 23 years participated in the study. Participants watched a computer screen while pictures of animals were presented simultaneously with an animal sound. Congruent trials consisted of trials in which the animal picture and audio were the same (i.e., a dog picture presented with a bark and a frog picture presented with a ribbit). Incongruent trials consisted of trials in which the animal picture and audio were mismatched (i.e., a dog picture presented with a ribbit and a frog picture presented with a bark). Participants' ERPs were recorded during the task. Following the ERP portion of the experiment, participants were administered the AQ. Causal relationships between ERP components and self-reported levels of Attention to Detail on the AQ were examined using path analysis models.

Results: The size of participants' perceptual ERPs (P1 effects) were positively correlated with the size of their late cognitive ERPs (N400 effects) and self-reported levels of Attention to Detail on the AQ. Path model comparisons indicated that variation in levels of Attention to Detail predicted meaningful variation in participants' ERP waveforms. Specifically, the relationship between Attention to Detail scores and the size of the N400 effect was significantly mediated by the size of the P1 effect.

Conclusions: Findings indicate that individuals with higher levels of Attention to Detail show larger perceptual ERP differences, which correspond to larger cognitive ERP effects. Results support the Enhanced Perceptual Functioning model of autism, suggesting that perceptual processing differences cascade forward and result in modifications of cognitive mechanisms. The positive relationship between P1 and N400 effect sizes suggests a strong feed-forward flow of information from perception to higher-order levels of processing in NT individuals. Future research should explore whether the strength of such processes is moderated by ASD status.

437.017 *(Poster)* Reduced Frontal Spectral Power in Infants at High Familial Risk for ASD

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Background: Infant siblings of children diagnosed with ASD demonstrate increased risk of developing ASD compared to the general population (Ozonoff et al., 2011). Using electroencephalography (EEG) to measure neural synchrony through spectral power, neurophysiological differences can be detected in high risk infants prior to onset of atypical development (Tierney et al., 2012). As early as age 3 months, familial risk infants demonstrate reduced frontal power across multiple frequency bands compared to low risk controls, particularly in the gamma (30-50 Hz) range (Levin et al., 2017). This early difference in gamma power has been linked to cognitive and language skills in early childhood (Benasich et al., 2008).

Objectives: (1) To examine frontal spectral power in the gamma frequency band (30-50 Hz), acquired during spontaneous resting state EEG from 3 month old infants at familial risk for ASD compared to low risk controls. (2) To examine correlations between gamma power at 3 months and later cognitive function in familial risk infants.

Methods: As part of a longitudinal study of neurodevelopment in high risk infants, resting spontaneous EEG was acquired in a sound attenuated, dimly lit room using a 128-channel Hydrocel net (Electrical Geodesic Net Inc.) for 3 to 5 minutes, while infants sat in a caregiver's lap and a hidden experimenter blew bubbles. Usable data were obtained at 3 months from 29 low risk controls and 36 familial risk infants. Data were processed using EEGLAB (Delorme and Makeig, 2003) and cleaned using Artifact Subspace Reconstruction (ASR) (Chang et al., 2018). A Laplacian filter was applied to remove electromyogram artifact that may obscure electrophysiological activity in the gamma band. Independent samples t-tests were used to analyze differences in spectral gamma power according to familial risk status and ADOS-T concern classifications at 18 months. A Pearson correlation test was used to analyze the relationship between spectral gamma power and behavioral Mullen subscores at 18 months.

Results: Relative spectral power was reduced in the gamma frequency band in familial risk infants compared to low risk controls ($t = 2.047$, $p = .045$). Relative spectral gamma power was reduced in infants showing increased ASD symptomatology at 18 months compared to infants with no ASD concern ($t = 2.927$, $p = .005$). Relative spectral gamma power was significantly correlated with the visual reception ($p = .039$), receptive language ($p = .005$), and expressive language ($p = .036$) Mullen subscores.

Conclusions: Results from this study suggest that reduced relative frontal power in the gamma frequency band is an electrophysiological marker of risk for ASD. However, as reduced gamma power was also indicative of concern for ASD at 18 months, it suggests that underlying atypical neurodevelopment due to ASD symptomatology is driving differences in risk groups. Furthermore, relative gamma power is associated with both nonverbal and verbal cognition, suggesting that these early physiological changes may impact early learning and further neurodevelopment. EEG is a scalable tool that can facilitate early prediction of neurodevelopmental disabilities and improve early screening and monitoring of those infants at highest likelihood of atypical development.

437.018 *(Poster)* Resting EEG As a Predictor of Autism Severity in School-Aged Children with below Average Head Circumference: Results from the ABC-CT

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Background: Autism spectrum disorder (ASD) is a developmental disorder with complex, heterogenous etiology involving atypicalities in a variety of neural systems. Historically, electroencephalography (EEG) has been used to understand neurophysiological substrates underlying the disorder. A growing body of research is using EEG to understand the abnormalities of the resting brain in individuals with ASD. For example, research has identified differences in alpha and gamma power between individuals with ASD and typical development (TD). The manner in which atypical head circumference, a common finding in ASD, may influence EEG is poorly understood.

Objectives: (1) Characterize EEG power in the low alpha, high alpha, and gamma bands across head circumferences in school-aged children with ASD and TD. (2) Examine relationships among EEG power, head circumference, and ASD symptomatology.

Methods: Participants were children with ASD (n=133) and TD controls (n=58) aged 6-11 (Table 1). ASD diagnoses were confirmed using the Autism Diagnostic Observation Schedule (ADOS-2) and the Autism Diagnostic Interview (ADI-R). Parents completed the Social Responsiveness Scale (SRS-2), a measure of ASD symptom severity. Head circumference data obtained prior to EEG was grouped into three categories based on a standardized head circumference growth chart: small (<-1SD), average (-1SD to +1SD), and large (>+1SD). Participants viewed a resting paradigm in which non-social, abstract moving images were presented in 30 second blocks (n=6). Power spectra for low alpha (8-10 Hz), high alpha (10-12 Hz), and gamma frequency (30-55 Hz) were obtained.

Results: The age-matched ASD and TD groups showed no significant difference in their average head circumference (p>.05). Within the small head circumference group, ASD participants exhibited significantly greater low alpha power than TD participants (p=.033). This difference did not exist in the average or large head circumference groups (p>.05). Additionally, no significant differences between ASD and TD participants emerged for high alpha or gamma power in any of the three head circumference groups (p>.05). Linear regressions were used to understand the relationship between low alpha power and ASD symptom severity transdiagnostically (Table 2). Within a linear regression model, low alpha power and age explained 40.4% of the variance in SRS T-scores across all participants in the small head circumference group (R^2=.404, $F(2,12)$=4.060, p=.045). When controlling for age, low alpha power independently predicted SRS T-scores (β=.804, p=.016). However, age did not independently predict SRS T-scores (p>.05). The same model did not predict SRS T-scores in participants with average or large head circumferences (p>.05). Additionally, neither high alpha nor gamma power predicted SRS T-scores in any of the head circumference groups (p>.05).

Conclusions: Preliminary results suggest that global low alpha power at rest is distinct in individuals with ASD and TD who have head circumferences more than one standard deviation below average. Across participants in this head circumference group, low alpha power significantly predicted severity of ASD symptomatology when controlling for age. These results suggest that head circumference, specifically small head circumference, must be carefully considered when understanding the relationship between EEG spectral power and symptom severity in school-aged children with ASD and TD.

437.019 *(Poster)* Sensory Features and EEG Connectivity in Young Males with ASD

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Background: 'Sensory features' (SF), manifesting as atypical behavioural responses to sensory stimuli (Dunn, 1999; Schaaf et al., 2014), affects 90-95% of individuals with Autism Spectrum Disorder (Baranek, Little, Parham, Ausderau, & Sabatos-DeVito, 2014). SF also reflects a threshold of internal neurological and self-regulatory processes (Baum, Stevenson, & Wallace, 2015; Schauder & Bennetto, 2016). However, there are limitations upon external observation of these neurological phenomena, which may also restrict clinical and research understanding of SF and its effects. Consequently, some researchers have used psychophysiological recording techniques to study SF in ASD, including electroencephalography (EEG). Although some previous studies have inferred brain connectivity (which typically describes the strength of the communication between two EEG signals obtained from different areas of the brain) to study sensory processing via the detection of event-related potentials (ERPs) (Brandwein et al., 2013; Bruneau, Bonnet-Brilhault, Gomot, Adrien, & Barthelemy, 2003; Cascio, Woynaroski, Baranek, & Wallace, 2016; Kang et al., 2018; Marco et al., 2011; Whitehouse & Bishop, 2008), they have not directly investigated the association between neural connectivity and SF *per se*.

Objectives: To directly investigate the relationship between EEG connectivity and SF features in an *a priori*-justified sample of children and adolescents with ASD, using data obtained from a standardised scale of SF.

Methods: Forty male participants aged between 6 and 17 years, with an IQ of at least 70 and who were diagnosed with Autism Spectrum Disorder (ASD) underwent audiovisual stimulus conditions which consisted of three naturalistic videos varying in intensities of illuminance (visual) and weighted decibels (auditory). EEG responses to the low-, medium-, and high-intensity audiovisual stimulus conditions were analysed via Granger Causality (GC).

Results: At the lateral (averaged connectivity values separated by left and right hemispheres) and non-lateral (total averaged connectivity values) levels, there was a medium-sized negative relationship between the *CSP-2* Quadrants and GC between the Frontal and Temporal regions at medium beta (β2 = 18 to 23.75 Hz) and high beta (β3 = 24 to 30 Hz) frequencies. In addition, there were significant ($p < .05$) main effects between lateral right T→F using GC connectivity and dominant (i.e., participants' highest Quadrant score) Sensory Quadrant *CSP-2* scores. There were also significant ($p < .05$) main effects for non-lateral F→T and non-lateral T→F connectivity and the *CSP-2* dominant Quadrants.

Conclusions: The results above indicated deficits in neural connectivity between Frontal and Temporal brain regions, particularly in the right hemisphere, in response to varying audiovisual stimulus conditions. These findings have the potential to provide more avenues for neurophysiological interventions such as transcranial direct current stimulation (tDCS) or neurofeedback to strengthen neural connections (particularly in relation to Frontal and Temporal brain regions) and reduce the adverse effects associated with sensory features in young people with ASD.

437.020 *(Poster)* Social Perception in High-Functioning Adolescents with ASD: A MEG Study

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Background: Autism spectrum disorders (ASD) are neurodevelopmental conditions characterized partly by core social dysfunction, impaired social motivation and interaction. Recent discoveries highlight the impact that intranasal administration of the neuropeptide Oxytocin (OT) may have on social behavior and perception in ASD. Several brain imaging studies in individuals with ASD show OT's capacity to modulate "the social brain", however, there is a gap in the literature regarding the effect of OT on neural temporal dynamics in ASD as compared to typical developing (TD) individuals.

Objectives: This study explored brain responses to faces in adolescents diagnosed with ASD using magnetoencephalography (MEG) and the impact of OT administration on the time course of brain activity. This is the first ever study to explore OT's neural effects via MEG in children with ASD. As a first stage in our research, following previous studies that examined social perception we focused on the M100, M170 and M250 components which tend to show atypical patterns in ASD. We hypothesized that OT will modulate the amplitudes of the above components so that they resemble those of an aged matched TD group.

Methods: We present data from 28 adolescents with ASD (aged 12-18), who received a single dose of intranasal OT (24IUs) in a double-blind placebo-controlled study. Forty-five minutes following administration, participants were scanned in the MEG. During each scan participants were presented with pictures of emotional eyes or vehicles and asked to identify the picture theme. Twenty-five TD aged-matched individuals served as a comparison group. For ethical reasons, TD participants did not receive OT/placebo.

Results: Whole head analysis revealed significant differences in the M170 component between TD and ASD groups with TD showing higher amplitude in response to the social stimuli. We also found marginal group differences in M100 amplitude, mainly over posterior sensors. In this specific analysis for the mentioned components we did not find effects for OT.

Conclusions: Our study provides evidence for distinct patterns of neural activity in response to social stimuli in ASD individuals. In this preliminary analysis, and contrary to our hypothesis, we did not find major effects of OT on the components tested here. However, since OT effects tend to be subtle, more detailed analyses will follow.

437.021 *(Poster)* Tactile Processing in Children with ASD: A Behavioral and Electrophysiological Study

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Background: Touch plays a key role in facilitating social communication. Individuals with autism spectrum disorder (ASD) show atypical tactile responsivity, which is associated with increased ASD symptomatology. However, the neural mechanisms associated with responsivity to touch in ASD remain unknown. Additionally, it is unclear whether tactile cues may facilitate behavioral responses in individuals with ASD (as is observed with visual and auditory cues). The current study investigates the neural indices of tactile processing in children with ASD and how these relate to behavioral response patterns.

Objectives: (1) To identify neural processes underlying novel tactile stimulation and determine whether tactile cues facilitate behavioral responses in ASD. (2) To examine the relationship between neural and behavioral indices of touch-related processing and socio-communicative impairments in ASD.

Methods: To date, participants include 8, 6-to-12-year-olds with ASD and 14 age- and non-verbal IQ matched typically-developing (TD) children (Projected N= 20 ASD; 20 TD). ASD diagnoses are confirmed using the ADOS-2 and the SCQ. Caregivers also complete the SRS-2. For the neural task, children participate in an ERP oddball paradigm during which they watch a silent video while being presented with auditory and tactile stimuli (i.e., 80% standard speech sound /a/; 10% oddball speech sound /i/; 10% novel vibrotactile stimuli on the fingertip with standard speech sound /a/; Figure 1). Participants also complete a behavioral tactile-cueing task in which they are instructed to respond with a button press to a target speech sound. Tactile cues are presented at 200, 400, and 800ms (25% each) prior to the onset of the target sound. The remaining trials (25%) are presented without tactile cues.

Results: For the ERP task, preliminary analyses suggested that there was a significant main effect of ROI (frontal, central, parietal) (p<.001), and an interaction between Condition (standard, oddball, novel) and ROI (p<.001). N2b amplitudes in response to novel touch were greater in the frontal compared to central and parietal ROIs (p<.001). However, there were no between-group differences (p=.93; Figure 2). In the ASD group, there was a negative correlation between frontal N2b amplitudes to novel touch and SRS-2 scores (p=.02). Results of the behavioral tactile-cueing task showed that there was a main effect of Cue Interval (no cue, 200, 400, 800ms; p<.001), but no main effect of Group (p=.35) or interaction between Cue Interval and Group (p=.84). Last, in the ASD group, behavioral facilitation to tactile-cues was not related to neural indices of tactile processing or ASD symptomatology.

Conclusions: Children in both the ASD and TD groups responded to perceptual novelty as indicated by increased N2b amplitudes in response to novel tactile stimulation. Presentation of tactile-cues facilitated behavioral performance in both groups. In the ASD group, decreased response to perceptual novelty was associated with increased ASD symptomatology. Preliminary results indicate that children with ASD may show similar performance in detecting novel tactile stimuli and in using tactile-stimulation as cues to facilitate behavioral performance compared to TD children. Last, reduced neural response to perceptual novelty may be related to increased socio-communicative impairments in ASD.

437.022 *(Poster)* Testing 1/f As a Proxy Marker of E/I Ratio in EEG Using Arbaclofen: Evidence from Adults with and without Autism Spectrum Condition (ASC)

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Background: Excitatory (E) glutamate signalling and Inhibitory (I) GABA signalling ensure efficient information processing in the brain. E-I regulation is thought to be disrupted in neurodevelopmental conditions such as autism spectrum condition (ASC). However, methods for investigating E-I systems in the living human brain, such as positron emission tomography (PET) and magnetic resonance spectroscopy (MRS), are predominantly invasive and/or expensive, constraining their general application. In contrast, EEG is a cheap and non-invasive method that can reveal subtle alterations in brain oscillating activity. As the frequency of these oscillations increases, their power decreases; this relationship is captured in the 1/f frequency spectrum. Evidence from computational modelling and animal studies suggest that this 1/f exponent is a proxy of E/I ratio. However, we do not know if this translates to typical humans, let alone those with a neurodevelopmental condition, namely ASC.

Objectives: In this Proof-of-Concept study we tested the hypothesis that there would be a correlation between 1/f and MRS measures of E/I ratio in ASC and Typically Developing (TD) individuals. We then examined whether this 1/f measure was sensitive to (i.e. correlated with) a shift in E/I, elicited by the GABAB receptor agonist Arbaclofen, in TD and ASC individuals.

Methods: Participants were 15 ASC males (M_{age}: 29.09 years) and 12 TD males (M_{age}: 33.19 years). Using MRS, we quantified GABA+macromolecules (GABA+), Glutamate+Glutamine (Glx) and E/I ratio (Glx/GABA+) levels in the medial occipital cortex (mOCC). We further conducted EEG recordings during an auditory odd-ball paradigm. Data were collected at baseline (after placebo) and following a single dose of 30mg of Arbaclofen. EEG data were segmented into 4 consecutive standard tones lasting 24 seconds. Power Spectral Density (PSD) slopes were extracted and a regression line was fitted to the PSD slopes to characterize the 1/f slope function. We examined the association between MRS metrics and 1/f at baseline, and after pharmacological challenge across the entire sample, as well as within each group separately.

Results: Across groups, baseline 1/f measures correlated significantly with MRS metrics of E/I (r=-0.470, p=0.013). Similarly, across groups, the drug-induced shifts in 1/f and E/I correlated significantly (r=0.365, p=0.034). Our sample size precluded further analyses of group differences between correlations but an initial post-hoc analysis within each group suggested that the relationship between E/I shift and 1/f change appeared to be driven primarily by the neurotypical control group, (r=0.649, p=0.005), and was not statistically significant in the ASC group (r=0.130, p=0.618).

Conclusions: Here, we provide Proof-of-Concept that 1/f correlates with MRS metrics of E/I at baseline and is sensitive to change. This metric may thus be a non-invasive, candidate proxy marker of E/I. Our observation of a qualitatively stronger relationship between E/I and 1/f shift in TD group compared to the ASC group might indicate a difference in the E/I control of the activity underpinning 1/f in ASC and will be examined during the on-going data collection.

437.023 *(Poster)* The Respiratory Sinus Arrhythmia in Young Children with Developmental Delay and Prominent Features of Autism Spectrum Disorder: A Follow-up Study

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Background: Respiratory sinus arrhythmia (RSA) i.e., heart rate variability in synchrony with respiration has been associated to social engagement and emotion regulation. Earlier research has found lowered RSA in cognitively able adults, adolescents and school-aged children with ASD and it has been suggested as one of the potential biomarkers for ASD. There have, however, been also contradictory findings showing no ASD specific differences in RSA, especially in young children with ASD and intellectually impaired children with ASD. In addition, it is not clear how stable the atypical RSA findings are in development of ASD.

Objectives: The aim of the study was to investigate longitudinally baseline RSA in young children with developmental delay and prominent features of ASD. To ensure that the possible abnormal findings were autism-specific, the RSA were measured also from a developmental-age matched comparison group of children with developmental delay (DD) without ASD and from a normative comparison group of age-matched typically developing children (TD).

Methods: The sample of 47 children (14 children with ASD, 17 TD children and 16 children with DD) participated in the study. Every group included 2 girls and the age ranged from 29 to 81 months. ADOS-2 and ADI-R evidenced prominent features of ASD and IQ estimate ranged between 45 to 88. The follow-up after two years consisted of 43 children (14 ASD, 17 TD & 12 DD children). Heart rate was measured whilst the children looked at a neutral video about a person building with blocks for 3 minutes. Data was carefully offline video analysed in order to reject artefacts. Measurement segments for the analyses varied between 54-169 seconds. There were no significant differences in the length of the segments between the groups. RSA was analysed in 0.24–1.04 Hz using a Matlab-based in-house program.

Results: The findings revealed significant difference in RSA between the groups at the initial (Kruskal-Wallis H = 6.324, $p = .042$) and tendency of difference at the follow-up (Kruskal-Wallis H = 5.355, $p = .069$) measurement. Paired comparison revealed that the children with ASD had significantly lower RSA than TD children and children with DD in both time points. There were no differences in RSA between TD and DD children in either of the time points (Figure 1). There was a tendency of increase in RSA during the two-year follow-up period all the children (Z = -1.652 $p = .099$). There was a strong correlation in RSA between the first and the follow-up measurement (r = .807, $p = .000$).

Conclusions: The findings suggested that lowered RSA is detectable in young children with developmental delay and prominent features of ASD, and seems to show ASD specificity. The findings showed that baseline RSA seemed to be constant measure within an individual. Future studies with larger sample size could examine whether RSA has predictive value of different developmental trajectories.

437.024 *(Poster)* Variation in Early Vocal Emotion ERPs By Age and Autism Symptom Severity

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Background: Evidence suggests that the ability to identify another's emotion from prosodic cues, vocal emotion recognition (VER), is impaired for some individuals with ASD (Fridenson-Hayo et al., 2016; Globerson et al., 2014). However, relatively little is known about the neural underpinnings of this impairment or its emergence across development. Previous work suggests an ensemble of early event-related potentials (ERPs; N100, P200, N300) are implicated in VER, reflecting attention to vocal stimuli, integration of prosodic acoustic cues, and early emotional evaluation, respectively (Paulmann et al., 2009; Paulmann & Kotz 2008). A small literature has examined these in ASD, suggesting the N100 may differ (Korpilathi et al., 2007) and be associated with decreased VER behavioral task performance (Lerner, McPartland & Morris, 2013) in this population. These components have likewise been associated with corresponding ERPs in the facial emotion recognition domain (Lerner et al., 2013), wherein ample research suggests the N170 face-responsive component gets faster with age and is delayed as a function of ASD symptoms (Kang et al., 2018). However, little is known about how these VER-related ERPs may vary by age or ASD symptom severity. Such understanding is crucial for disentangling whether processes underlying VER are modality-specific, or reflect more general underlying differences in processing social-emotional information.

Objectives: To examine whether age and ASD severity are related to N100, P200, N300 ERP responses to a VER task.

Methods: 108 adolescents and adults with and without ASD completed a standardized VER task while electroencephalography (EEG) was recorded (Table 1; Figure 1). A mixed ASD and non-ASD sample was used to maximize variation in ASD symptomology and, thus, consequent relations with the target ERPs. ASD symptom severity was measured by the Autism Diagnostic Observation Schedule-2 (ADOS-2; Lord et al., 2012) comparison score (CS; Gotham, Pickles, & Lord, 2009; Hus & Lord, 2014). Pearson correlations were used to examine variation in ERP (N100, P200, and N300) responses during the VER task by participant age and ASD symptom severity.

Results: Faster N100 latency was associated with lower autism symptom severity (r(108)=.192, p<.05). Larger P200 amplitude was related to younger age (r(108)=-.370, p<.01). No associations with the N300 emerged.

Conclusions: Consistent with prior work (Lerner & McPartland, 2013; Korpilathi et al., 2017), a slower N100 latency was associated with greater ASD symptom severity suggesting possible decreased attention to emotional prosodic cues. Additionally, smaller P200 amplitude was related to older age indicating that the processing of emotional information may require more effort for adolescents than adults (Garrido-Vásquez et al., 2013). Taken together, these findings suggest that initial orientation to vocal emotions may be delayed for individuals with greater ASD symptom severity and that efficient emotional salience detection likely continues to develop through adolescence into adulthood. Furthermore, VER-related ERP responses did not differ by ASD diagnostic status thus reflecting a continuity in processing vocal emotion information across ASD and non-ASD populations.

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438.001 *(Poster)* A Pilot Study on Executive Functioning in Mainland Chinese Autistic Preschoolers

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Background: There is a robust literature on the positive benefits of executive functions (EFs) on academic (Blair & Razza, 2007; Bull, Epsy, & Weibe, 2008; Clark, Pritchard, & Woodward, 2010) and social-emotional development (Carlson & Wang, 2007) in neurotypical preschool- and school-aged children from Western countries. Studies over the last two decades also offer emerging support for higher EF ability in East Asian children compared to same-aged peers in the US (Imada, Carlson, & Itakura, 2013; Lan, Legare, Ponitz, Li, & Morrison, 2011) and UK (Ellefson, Ng, Wang, & Hughes, 2017; Oh & Lewis, 2008). Given the social and academic challenges experienced by autistic individuals, there is great interest in furthering our understanding of EF in this population. However, there is mixed evidence regarding EF dysfunction in autism (Faja & Dawson, 2014; Griffith, Pennington, Wehner, & Rogers, 1999; Pellicano et al., 2014) and very few studies have investigated EF skills in East Asian autistic children. Further research is necessary to understand the EF profile of East Asian autistic children.

Objectives: The purpose of this study was to compare whether preschool-aged, autistic children and neurotypical peers in mainland China differed on iPad-delivered measures of EF, specifically inhibitory control, visuospatial working memory, and cognitive flexibility.

Methods: Forty-nine, 36- to 83-month-old preschoolers in Beijing, China participated in this study. The sample included 21 autistic preschoolers and 28 age- and sex-matched neurotypical preschoolers. Eligibility criteria included a Verbal Comprehension Index (VCI) score above 70 on the Weschler Preschool and Primary Scales of Intelligence – Fourth Edition (WPPSI-IV; Weschler, 2012). All autistic children had a clinical diagnosis of autism spectrum disorder from a child psychiatrist based on DSM-5 criteria and no other comorbid neurodevelopmental disorders. Children were administered an iPad-based EF assessment battery (Go/No-Go, Mr. Ant, and Card Sort tasks) from the Early Years Toolbox (EYT; Howard & Melhuish, 2017) to measure inhibitory control, working memory, and cognitive flexibility. Linear regression analyses were conducted to evaluate the unique associations between autism and inhibitory control, working memory, and cognitive flexibility.

Results: Diagnostic status significantly predicted inhibitory control (B = -0.19, $t(47)$ = -2.96, $p < .001$, working memory (B = -0.88, $t(47)$ = -4.27, $p < .001$), and cognitive flexibility (B = -3.50, $t(47)$ = -3.52, $p < .001$). Specifically, neurotypical children outperformed autistic children on all EF tasks.

Conclusions: This study provides preliminary evidence for EF impairment in Chinese autistic preschoolers compared to neurotypical peers. It is also the first study to utilize iPad-administered tasks to assess for EF in young autistic children. Currently, early intervention for Chinese autistic children focuses largely on core autistic symptoms. However, it is evident that autistic preschoolers may benefit from accommodations and interventions that support their EF challenges. Further research on the efficacy of EF interventions for autistic preschoolers is needed. Cross-cultural studies are also needed to determine the generalizability of these findings to other preschool populations.

438.002 *(Poster)* Behavioral and Neural Profiling of School-Aged Children and Adults with Non- or Minimally Verbal Autism Spectrum Conditions (ASC)

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Background: Up to 30 % of individuals with ASC are estimated to remain non- or minimally verbal throughout their lifetime. Due to difficulties in assessment, little is known about their neuropsychological and neuroanatomical profile.

Objectives: To explore cognitive variability in this population using a series of behavioural - linguistic and non-linguistic - standardised measures and, in a subset, the neural basis of absence of language using a structural and functional MRI-protocol.

Methods: 48 children and adults (chronological age, CA, range=5;11 – 57;1, M=20;3) participated in this study. ASC diagnosis was confirmed with ADOS-2 or ADOS-Adapted and, in the case of 24 participants, the ADI-R as well. Their non- or minimally verbal status was determined on the basis of the vocalisations produced during the ADOS assessment. Depending on the type and number of vocalisations, the participants were classified as either having less than 5 words (N=29) or more than 5 words or simple phrases (N=19). Standardised tests were applied to determine their verbal mental age (VMA) (PPVT-III), nonverbal IQ (Leiter-R), and capacity of forming abstract mental representations of daily objects (ComFor). A structural and functional MRI-protocol was applied to 8 children of the sample under propofol sedation, using a protocol that has previously demonstrated that neural responses to auditory stimuli can still be detected. We targeted the integrity of language-related white matter tracts and neural responses to heard speech and reversed-speech.

Results: The neuropsychological profiling yielded floor-level variation VMA (M=1;11, SD=1;3) and nonverbal IQ (NVIQ; M=50, SD=17). Approximately 92% of the sample had intellectual disability (ID, defined as NVIQ<70). Participants' ComFor scores fell into three levels (a) no attribution of meaning to objects (N=11), attribution of functional meaning (N=15), attribution of generic meaning (N=18). Correlational analyses showed that variability in abstraction levels was significantly related to VMA ($r_s(44)=.660$, p=.01), and to NVIQ ($r_s(44)=.521$, p=.01), while VMA and NVIQ did not correlate ($r_s(48)=.156$), as assessed by Mann-Whitney sign rank tests. When dividing the group by productive language (having less or more than 5 words), differences showed between them in both VMA (U=459,5, d=1,352, p<.005) and ComFor (U=357,5, d=1,226, p<.005), but not CA. All seven participants participating in the MRI study showed anomalous right lateralisation of fractional anisotropy scores in the arcuate fasciculus (t-test: p=0.0312; Wilcoxon signed-rank test: p=0.0156). They also showed neural BOLD responses to speech condition in the canonical language network at p=.01 uncorrected. When activations to reverse speech were subtracted from normal speech, only three children maintained, although diminished, language-network activations.

Conclusions: Near-absence of language development is accompanied by floor level nonverbal IQ and language comprehension, though some variation remains. A residual capacity to form abstractions covaries with both word comprehension and nonverbal IQ, and improves with even minimal language production differences. Differences in white matter language-related connectivity and failure to recognise the difference between forward and reversed speech in most but not all individuals, suggest fundamental differences in language organisation in the brain.

438.003 *(Poster)* Characterizing the Executive Functioning Profile of Females with ASD, ADHD, and Comorbid ASD+ADHD

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Background: Executive functioning (EF) deficits are well established both in individuals with Autism Spectrum Disorder (ASD; O'Hearn et al., 2008) and Attention-Deficit/Hyperactivity Disorder (ADHD; Willcutt et al., 2005). While findings vary depending on methodology, overall, children with ASD tend to present with more difficulties in cognitive flexibility, whereas problems with inhibitory control are typically more pronounced in children with ADHD (Antshel & Russo, 2019). Children with comorbid ASD+ADHD generally present with more significant EF problems with characteristic deficits of both disorders (Craig et al., 2016). However, research characterizing EF in these populations is biased by use of participant samples that are predominantly male. Given research identifying sex differences in ASD symptomatology, it is important to determine whether the extant research characterizing patterns of EF deficits across ASD and ADHD is representative of females with these diagnoses.

Objectives: This study is the first, to our knowledge, that characterizes and compares the specific EF profile of females with ASD, ADHD, and ASD+ADHD. It was hypothesized that females with ASD+ADHD will exhibit more pronounced EF deficits compared to participants with ASD or ADHD only.

Methods: Participants included 200 females (8-18 years) diagnosed with ASD only (n=20), ADHD only (n=150), or comorbid ADHD+ASD (n=30). EF was assessed via parent report on the Behavior Rating Inventory of Executive Function, 2nd Edition (BRIEF-2; 9 subscales), as this measure has been identified as having greater ecological validity than performance based measures of EF, particularly in ASD (Kenworthy et al., 2008).

Results: A MANCOVA with IQ as covariate identified a main effect of group on EF. Follow-up ANCONVAs showed significant differences on Inhibit, Shift, Plan/Organize, and Task-Monitor subscales. Post-hoc multiple pairwise comparisons using adjusted means and Bonferroni correction indicated that on the Inhibit and Shift subscales, ADHD+ASD was more impaired compared to ADHD only. On the Plan/Organize and Task Monitor subscales, ADHD+ASD was more impaired compared to ASD only.

Conclusions: Paralleling prior work with predominantly male samples, we found that females with ASD+ADHD exhibited a more severe EF profile compared to females with ASD or ADHD alone. However, the pattern of specific EF deficits observed across groups differed compared to what would be expected based on research with male participants. Unlike prior research, we found no significant differences when comparing EF profiles of girls with ADHD only and ASD only. This suggests a greater degree of overlap in EF deficits across diagnostic groups in females compared to males. Further, while research with ASD+ADHD males has typically found that this group shares deficits in shifting and flexibility with ASD and inhibition with ADHD, we instead found that ASD+ADHD females shared deficits in shifting and inhibition with ASD and deficits in planning and monitoring with ADHD. This study is the first to identify unique EF profiles in females with ASD, ADHD, and ADHD+ASD, and underscores the importance of explicitly targeting females in research characterizing neurocognitive phenotypes of ASD and ADHD.

438.004 *(Poster)* Characterizing the IQ-Adaptive Functioning Gap in Autistic and Typically-Developing Girls and Boys

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Background: Cognitively-able individuals with autism spectrum disorder (ASD) show a gap between IQ and adaptive functioning, or the skills critical to successful independent living. This gap suggests cognitive skills captured by IQ do not serve to bolster adaptive skills among autistic individuals without an intellectual disability. Further, there is increasing evidence that this gap between intellectual potential and adaptive functioning widens with age, and is associated with markers of poor outcome, including greater autistic symptomatology and elevated rates of co-occurring psychopathology.

Objectives: The IQ-adaptive functioning gap has been documented in predominantly male ASD samples; therefore, it is unknown if such a gap exists among ASD girls, and if so, whether the gap differs from ASD boys. Additionally, it is unknown whether the gap is found in typically developing (TD) individuals. To address these understudied aspects of the IQ-adaptive functioning gap, we leverage a unique, sex-balanced sample of ASD and TD youth.

Methods: We assessed 177 ASD (mean age: 12.5±2.9; 75 female) and 178 TD (mean age: 13.0±2.9; 87 female) youth 8 to 17y with full-scale IQ (FSIQ)>70. Expert clinicians confirmed ASD diagnoses using the Autism Diagnostic Observation Schedule, Second Edition and the Autism Diagnostic Interview-Revised. Parents of participants reported on their children's adaptive skills (Vineland Adaptive Behavior Scales-II [VABS-II]). FSIQ was estimated using participants' General Conceptual Ability Standard Scores on the Differential Abilities Scales-II. Difference scores between estimated FSIQ and the VABS-II Adaptive Behavior Composite score were calculated for each group as a measure of the IQ-adaptive functioning gap.

Results: One-sample *t*-tests showed the IQ-Adaptive functioning gap differed significantly from zero for each group (ASD girls: t=11.3, p<.001; ASD boys: t=15.7, p<.001; TD girls: t=4.4, p<.001; TD boys: t=9.8, p<.001). Groups did not differ in age (F=1.49, p=.22). Collapsing across sexes within each diagnostic group, the IQ-adaptive functioning gap is positively associated with age (ASD: r_s=.21, p<.01; TD: r_s=.25, p<.001); however, considering the sexes separately, this association appears to be driven by ASD boys (r_s=.19, p<.05) and TD girls (r_s=.29, p<.05), with non-significant associations for ASD girls and TD boys. An ANCOVA controlling for age revealed a main effect of group (F=30.6, p<.001), but no main effect of sex (F=0.91, p=.34), and no group by sex interaction (F=1.9, p=.17). Post-hoc follow-up tests indicated both ASD girls (t=-5.5, p<.001) and boys (t=-4.0, p<.001) showed a greater IQ-adaptive functioning gap than their same-sex TD counterparts.

Conclusions: Corroborating the extant literature, ASD youth show a greater IQ-adaptive functioning discrepancy than their same-age TD peers, and this discrepancy widens with age. However, we provide novel evidence for a smaller but significant gap occurring in TD youth as well. Additionally, *both* autistic girls and boys demonstrate a greater discrepancy in IQ-adaptive functioning than their same-sex TD peers. Fully characterizing the discrepancy between IQ and adaptive functioning in ASD girls and boys promises to yield a better understanding of factors that contribute to or are consequent of difficulties in independent living despite high intellectual potential in cognitively-able autistic individuals.

438.005 *(Poster)* Comparing the Cognitive Flexibility of Adolescents with Intellectual Developmental Disorder (IDD) with and without Autism

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Background: Rigidity is one of the core diagnostic features of autism and is related to difficulty with cognitive flexibility (i.e., CF; the ability to move freely between information, concepts or tasks). A review of 122 studies which assessed CF in autism reveals inconsistent findings, contingent on the choice of CF measures and participant characteristics (Lung et al., in prep.). Studies that use performance-based tasks (e.g., Wisconsin Card Sorting Task; WCST) to assess CF were more discordant about the presence of CF difficulty in autism than studies that use questionnaire-based assessments (e.g., Behavioural Rating Inventory of Executive Function; BRIEF). Moreover, most of the studies concluded findings based on comparisons of autistic children and adults against their typically developing peers (111 studies), as well as on autistic participants with average or above intelligence (117 studies), see *Tables 1 and 2*. CF studies that focus on autistic adolescents with comorbid intellectual developmental disorder (ASD-IDD) remain scarce.

Objectives: Given the scarcity of CF studies on autistic adolescents with intellectual developmental disorder identified from the review of 122 related studies, this study aims to examine CF of adolescents diagnosed with ASD-IDD by comparing their CF abilities with adolescents with IDD but no autism.

Methods: Thirty-nine adolescents diagnosed with IDD, M_{age} = 14.65 (1.08), M_{FSIQ} = 53.15 (9.65) were recruited; fourteen of whom also had an autism diagnosis (ASD-IDD). They completed the computerized WCST since it was found to be the most frequently used measure of CF (41 of the 122 studies; or 34% of studies) in the review. Both ASD-IDD and IDD groups were matched for chronological age and Full-Scale IQ measured by Wechsler Abbreviated Intelligence Scale – Second Edition (WASI-II). T-test was used to compare between-group difference in WCST performance and Pearson correlation was used to examine the relationship between WASI-II and WCST performance in each group.

Results: Between-group comparison between the autistic (ASD-IDD) and non-autistic (IDD) groups suggested no CF difference, $t_{perseverative\ errors}$ (36.818) = -.571, p = .571 and $t_{conceptual\ responses}$ (37) = .053, p = .958. Despite the comparable between-group performance on CF, relationship between cognitive abilities and WCST performance differed between groups. Notably, a positive relationship between fluid reasoning abilities (as measured in Matrix Reasoning subtest "MR" of WASI-II) and WCST performance is only found in the ASD-IDD group, $r_{MR\text{-}perseverative\ errors}$ (14) = -.644, p = .013; $r_{MR\text{-}conceptual\ responses}$ (14) = .621. Interestingly, it was the verbal categorical skills (as measured in Similarities subtest "SI" of WASI-II) that was positively associated with higher conceptual responses for in the IDD group, $r_{SI\text{-}conceptual\ responses}$ (25) = .399, p = .048.

Conclusions: Given respective CF difficulty in IDD and ASD, no aggregate CF deficit was found in the ASD-IDD group. This may be explained by the limited detectability of variances in CF in extremity of cognitive functioning, and/or floor effect of standardized tests. Moreover, the ASD-IDD group may be more dependent on nonverbal skills compared to the IDD group while making conceptual responses.

438.006 *(Poster)* Dual Language Learning Does Not Hinder Cognitive Functioning in Youth with Autism Spectrum Disorder

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Background: Dual-language learning has been associated with advantages in cognitive skills and executive functioning (EF) in neurotypical individuals (Barac et al., 2014). Yet, families are routinely told by providers to avoid dual-language exposure in individuals with Autism Spectrum Disorders (ASD), due to concerns about hindering language and cognitive development (Yu, 2013). However, few studies have systematically evaluated the effects of dual-language learning on cognitive development in youth with ASD.

Objectives: To assess the hypothesis that among youth with ASD, dual language learners (DLL) will show no deficits in broad cognitive skills (IQ) and advantages in EF relative to monolinguals

Methods: Participants were drawn from a sample of >2,000 individuals (ages 6-25) seen for neuropsychological testing through clinical and research evaluations at a center specializing in ASD in the Washington, DC metropolitan area. A final sample was identified (n=354) who met Lainhart criteria for ASD and had known language learning history. Participants were designated as monolingual if they had no or very minimal exposure to a second language, and as DLLs if they had substantial exposure ($\geq$30%) to a language other than English. All participants were tested in English only and considered English dominant at the time of testing. Socioeconomic status (SES) was ordinally-defined as highest level of parent education achieved, where lower numbers indicate higher education. Full-scale IQ and verbal and nonverbal reasoning were assessed by a standardized IQ measure (e.g., Wechsler Intelligence Scale for Children). Global EF was assessed via parent report on the Behavior Rating Inventory of Executive Functioning (BRIEF). Verbal working memory was evaluated via the Sentence Memory subtest of the Wide Range Assessment of Memory and Learning-2 (WRAML-2). Independent sample t-tests were used for initial comparisons of DLLs (n = 75) and monolinguals (n = 279), followed by multiple linear regression analyses to control for the effects of gender, age, and SES.

Results: DLLs scored significantly lower on unadjusted comparisons of verbal IQ (t=2.12, p = 0.04) and verbal working memory (t=*2.38,* p = 0.02) and showed trend-level advantages in global EF (t=1.86, p=.07). However, when adjusting for the effects of age, gender, and SES using multiple linear regression, cognitive and EF skills were not predicted by language learning status. SES significantly predicted WRAML Sentence Memory (*β= -.68, t= -2.17, p=.03*) and predicted verbal IQ at the trend level (*β= -5.87, t= -1.76, p=.08*), such that higher SES was associated with better performance. DLL status was associated with reduced EF deficits at the trend level (*β= -5.25, t= -1.84, p=.07*).

Conclusions: Findings show dual-language exposure does not impair cognitive skills in youth with ASD and may show EF advantages. Future studies are needed to explore these findings, using additional performance-based measures of EF and other neuropsychological domains, and to monitor cognitive development of autistic DLLs longitudinally. Preliminary findings suggest that families should not be discouraged from exposing autistic youth to multiple languages.

438.007 *(Poster)* White Matter Structure Relates to Delayed Processing Speed for the Planning Task and in ASD without Intellectual Disability.

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Background: Impaired executive function has been well demonstrated in individuals with autism spectrum disorder (ASD). However, many neuroimaging studies for examining executive function in ASD and neural correlates have not been adequately considered symptoms and diagnosis of Attention-deficit hyperactivity disorder (ADHD), although ADHD has been able to diagnose in individuals with ASD from DSM-5 (2013).

Objectives: The aim of this study is to examine dysfunction and neural basis of executive function in individuals with ASD after controlling ADHD symptoms adequately.

Methods: We used a test battery that is consisted of 8 neuropsychological tests for comprehensibly assessing various executive function domains including planning, set-shifting, flexibility, cognitive control, and divergent thinking. Some of the neuropsychological tests were conducted on a PC tablet using a cloud-based test, namely CANTAB and measured performance speed besides performance results. Additionally, we collected T1 weighted image and diffusion tensor imaging (DTI) with a 3T scanner. Analyses of neuroimaging data were conducted cloud-based system (MRI cloud). These data acquired form 11 individuals with ASD having no intellectual disabilities (ID) (FSIQ $\geq$ 80) and 37 sex-, handedness and intelligence matched neurotypical subjects (NT).

Results: When controlling ADHD symptoms, individuals with ASD did not show a lower performance of any neuropsychological tests. Whereas, it was observed a slower performance speed on the test of One Touch Stockings of Cambridge (OTSC) that measure planning domains of executive function compared to NT ($p < 0.0049$). In the comparison of T1 weighted image data, individuals with ASD showed reduced gray matter volume of the right middle frontal gyrus and right inferior temporal gyrus and increased white matter volume of the right superior frontal gyrus. In the DTI, individuals with ASD exhibited lower fractional anisotropy value in the right precentral gyrus and the temporal part of the right superior longitudinal fasciculus (all $p < 0.005$). Then, partial correlation analyses showed that white a matter volume of the superior frontal gyrus positively correlated a performance speed on the OTSC (partial correlation $r = 0.514$, $p < 0.001$), indicating a larger white matter volume of the superior frontal gyrus associated with a slower performance speed on the planning task. These results suggest that an abnormality of white matter structure in the right superior frontal gyrus closely relates to delayed performance speed of activity that required planning skills.

Conclusions: Individuals with ASD having no ID had difficulties in performance speed in planning but not the performance itself, when controlling ADHD symptoms. In the brain volume, the white matter volume of the superior frontal gyrus was increased in ASD. Additionally, it was observed that the delayed performance in the task which required a planning skill related to an increased white matter volume in the right superior frontal gyrus. These results indicate that delayed planning performance is the true condition of executive dysfunction in ASD, and this dysfunction is related to the abnormality of white matter structure in the frontal lobe.

Neuroscience: Affective, Behavioral, Cognitive

ORAL SESSION — NEUROSCIENCE: AFFECTIVE, BEHAVIORAL, COGNITIVE
323 - Brain-Behaviour Relationships

323.001 *(Oral)* Saccade Velocity Dysmetria during Naturalistic Visual Exploration in Autism Spectrum Disorder

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Background: Visual exploration in Autism Spectrum Disorder (ASD) is characterized by attenuated social attention. However, the underlying oculomotor function that shapes visual exploration is understudied, although laboratory studies during restricted viewing indicated aberrant saccade features in ASD. Specifically, saccade velocity dysmetria was reported that suggested different (oculo-)motor modulation by the ponto-cerebellar motor network.

Objectives: We wanted to characterize oculomotor function during naturalistic visual exploration in a large and heterogenous ASD sample. We expected to replicate saccade velocity dysmetria, which would outline an underlying mechanism of altered visual exploration in ASD (see figure 1): A subcortical network of ponto-cerebellar motor modulation that has been underutilized in previous ASD imaging research.

Methods: Oculomotor function was recorded using infrared remote eye-tracking in 279 ASD participants (age = 16.1/5.7 [6-30][1]; IQ = 99.5/18.1 [46-148]; gender = 194/85 [m/f]) and 156 neurotypical controls (age = 15.8/5.8 [6-30]; IQ = 104.2/16.7 [50-139]; gender = 102/54 [m/f]) during free viewing of naturalistic videos with and without social content. Groups were matched within age subgroups (children: 6-11 y, adolescents: 12-17 y, adults: 18-30 y) by age, IQ, and sex. Oculomotor function was defined as well established saccade, fixation, and pupil-dilation features that were compared between groups in linear mixed models. Combined features were investigated for their potential as ASD classifier in Receiver Operating Characteristic curves.

[1] Mean / SD [Min – Max]

Results: ASD oculomotor function is characterized by increased variation in peak saccade velocity ($d = 0.19$, CI [0.01, 0.37]) and velocity main sequence, which is saccade velocity corrected for saccade amplitude ($d = 0.27$, CI [0.06, 0.48]). These characteristics of saccade velocity dysmetria were independent of social video content. We also found ASD oculomotor function with decreased pupil dilation variation for average IQ ($85 \leq IQ \leq 115$; $d = -0.24$, CI [−0.47, −0.01]), and decreased saccade duration and amplitude for social video content ($d = -0.29$, CI [-0.47, -0.05]; $d = -0.29$, CI [−0.51, −0.07]). Oculomotor function is outlined as a valid ASD classifier across the heterogenous sample (AUC = .689 CI [.638, .740]) with increased power in age- and IQ-stratified subgroups (adolescents: AUC = .765 CI [.691, .839]; IQ < 85: AUC = .840 CI [.711, .969]; IQ > 115: AUC = .822 CI [.734, .909]). Oculomotor function is comparable to “attenuated social attention” as ASD classifier concerning discriminative power.

Conclusions: Saccade velocity dysmetria during visual exploration is confirmed across a heterogenous ASD sample that emphasizes generalizability to the ASD population. Our findings extend previous restricted-viewing findings to naturalistic gaze behavior that provides ecological validity. Thus, saccade velocity dysmetria likely contributes to attenuated social attention in ASD. This is supported by subgroup-specific findings in average IQ and social video content that suggested attenuated visual exploration. Overall, saccade velocity dysmetria indicates altered ponto-cerebellar motor modulation, which provides a promising underlying mechanism of altered visual exploration in ASD.

323.002 *(Oral)* Alterations in Gray Matter Covariations in Autism Spectrum Disorder Compared to Controls. Results from the EU-AIMS Longitudinal European Autism Project

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Background: Voxel-based Morphometry (VBM) provides a voxel-wise characterization of gray matter (GM) densities commonly used to examine brain structural differences in psychiatric disorders. VBM studies in Autism Spectrum Disorder (ASD) have yielded inconsistent results of GM differences, which could partly be attributed to structural abnormalities depending on inter-regional covariations.

Objectives: To detect the GM structural covariation alterations of ASD, we applied Independent Component Analysis (ICA) on VBM data from EU-AIMS (European Autism Interventions) Longitudinal European Autism Project. Further, we were interested in the relationship between the obtained independent components set of GM variations and the categorical diagnostic labels, and continuous measures of the core ASD symptoms.

Methods: The sample comprised 347 individuals with ASD (72.9% male) and 252 typically developing individuals (64.7% male), between 6 and 30 years of age, and a full-scale IQ (FIQ) > 50. Each subject's T1-weighted structural image was used to obtain subject VBM measures. All subjects' VBM data was then decomposed into 100 spatially independent components using ICA. A Generalized Linear Model (GLM) was used to examine case-control differences between subject loadings of each component while correcting for age, sex, FIQ, and sites. A GLM was also utilized to explore the univariate relationships between each component and each symptom profile in the ASD group. Furthermore, Canonical Correlation Analysis (CCA) was performed to separately examine the integrated effects between all brain components and ADI, ADOS (N = 325), and between all brain components and Social Responsiveness Scale (SRS), Repetitive Behaviour Scale-Revised (RBS), and Short Sensory Profile (SSP) (N = 194) in the ASD group. The statistical significance of each canonical variate was determined by permutation testing (number of permutations = 10000).

Results: GLM analyses showed significant case-control differences at two independent components, i.e., component number 10 (IC10, $p = 8.850X10^{-5}$), and component number 14 (IC14, $p = 5.450X10^{-4}$) (FDR corrected, $q = 8.072X10^{-4}$). As shown in Figure 1, IC10 primarily was related to structural variations in bilateral insula, inferior frontal gyrus, orbitofrontal cortex, and caudate nuclei. IC14 mainly involved variations in the bilateral hippocampus, parahippocampal gyrus, and amygdala. No further corrected significant linear association with pathology symptoms was found. Considering the results of the two CCA analyses, in both cases, IC14 was one of the components with the strongest loadings in all components on symptom profiles (Figure 2e, g). On the first CCA analysis (Figure 2a), the ADOS RRB subscale loaded most among the symptom profiles (Figure 2f) in the significant Bonferroni corrected CCA mode (permutation $p = 0.008$, Figure 2c). In the secondary analysis (Figure 2b), the SSP weighted most in this case (Figure 2h) for the again significant Bonferroni corrected CCA mode (permutation $p = 0.002$, Figure 2d).

Conclusions: We demonstrate ASD-driven inter-regional covariation changes of the insula, frontal area and caudate, and highlight a strong effect of the hippocampus, parahippocampal gyrus, and amygdala on ASD symptoms, which indicate the brain morphometry abnormalities could be a part of the consequence of affected brain regions' covariations, and could be linked to the phenotypes of ASD.

323.003 *(Oral)* Brain Activation during Emotion Regulation Predicts Anxiety in Women but Not Men with Autism Spectrum Disorder

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Background: Women with ASD show higher rates of psychiatric co-morbidities, especially depression and anxiety. Emotion regulation difficulties may partially explain the high prevalence of psychiatric co-morbidities in ASD and lead to poorer quality of life and reduced functional independence. Sex differences in emotion regulation and its neurocircuitry have been observed in neurotypical and clinical populations, but have received limited attention in ASD.

Objectives: We provide a preliminary characterization of sex differences in emotion regulation neurocircuitry in adults with ASD and associations with anxiety and depression.

Methods: Participants included men and women (18-72 years, mean: 32.5[13.9]) of average intellectual ability (mean IQ: 102.9[16.9]) with ASD (female ASD: *n*=21; male ASD: *n*=38) participating in a larger intervention study. Behavioral dependent measures included self-reported Beck Depression Inventory-II and State/Trait Anxiety Inventory and the informant-reported Strength and Difficulties Questionnaire emotional difficulties subscale. Participants completed a cognitive reappraisal emotion regulation fMRI task (Richey et al., 2015). Statistical parametric mapping was used for whole-brain, family-wise error corrected (p=0.01) activation group-level and sex differences analyses. Task-modulated connectivity using generalized psychophysiological interaction was used for seed regions showing significance in the activation analysis. Mean activation and connectivity values from significant regions were extracted and correlated with anxiety and depression scores. Age and IQ were used as a covariates in all brain and behavioral analyses.

***Results**:* Women with ASD had greater depression ($F_{1,53}$=6.417;p=.014) and emotional difficulties ($F_{1,46}$=7.207;p=.010) than men with ASD, and greater trait anxiety approached significant ($F_{1,53}$=2.882;p=.095). During cognitive reappraisal, significant activation across all participants with ASD was observed in bilateral insula/orbitofrontal cortex (OFC), anterior-mid cingulate (aMCC), dorsomedial prefrontal cortex (dmPFC), caudate, and cuneus; left dorsolateral prefrontal cortex (dlPFC), inferior parietal lobe (IPL)/temporoparietal junction (TPJ), pre/post-central gyrus; and right middle temporal gyrus. No sex differences in activation were observed at the whole brain level. Women but not men showed associations between state anxiety and task activation in the IPL/TPJ (r_{17}=.543;p=.016), left dlPFC (r_{17}=.483;p=.036), pre/post-central gyrus (r_{17}=.591;p=.008), bilateral insula/OFC (left: r_{17}=.591;p=.008, right: r_{17}=.458;p=.048), right caudate (r_{17}=.466;p=.045), and dmPFC (r_{17}=.477;p=.039). Across all subjects, increased task-modulated connectivity was observed for 1) aMCC with the left superior parietal lobe, and 2) right insula/OFC with right posterolateral temporal cortex, which correlated with reduced emotional difficulties (r_{46}=-.281;p=.05; r_{46}=-.384;p=.007, respectively). Men but not women with ASD showed greater task-modulated connectivity with multiple seed regions, including dmPFC, aMCC, left insula/OFC, and left IPL/TPJ. Increased task-modulated connectivity between the left insula and right cerebellum in men but not women predicted reduced state (r_{32}=-.362;p=.035) and trait (r_{32}=-.409;p=.016) anxiety and depression (r_{32}=-.418;p=.013).

***Conclusions**:* Brain activation during emotion regulation predicts anxiety in women but not men with ASD. While profiles of brain activity are similar across sexes, men show increased task-modulated connectivity compared to women. Interestingly, connectivity between the left insula and right cerebellum during cognitive reappraisal may be protective against anxiety/depression in men with ASD, compared to women with ASD. These findings highlight the importance of characterizing sex differences in ASD neurocircuitry to inform sex-tailored interventions.

323.004 *(Oral)* The Maturation of Functional Emotional Neural Networks in Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is characterized by social impairments, which may be related to deficits in processing emotional faces. Altered functional connections among brain regions critically involved in affective processing have been reported using magnetoencephalography (MEG) in different developmental cohorts. However, few studies have examined the maturation of functional networks underlying emotion processing in ASD, and differences between ASD and typical development.

Objectives: Using MEG, we investigated changes from childhood to mid-adulthood in functional connectivity of eight ROIs (bilateral insulae, fusiform gyri, amygdalae and anterior cingulate cortex; ACC) during the implicit presentation of emotional faces in 190 children, adolescents and adults: 83 with ASD (*M* age=19.5±9.17 yrs, range=7.02-39, 59 males) and 107 age-and sex-matched controls (*M* age=19.92±8.83yrs, range=6.6–39, 74 males).

Methods: Happy or angry faces and a scrambled pattern (target) were presented simultaneously for 80ms on either side of a central fixation cross while MEG was recorded. The location of the target (left or right) was indicated as rapidly as possible by a button press. MEG data were epoched by emotion. Time-series were derived from 90 cortical and subcortical sources of the AAL atlas using the LCMV beamformer. The phase difference derivative was used to assess phase synchronization of ongoing neural oscillations among sources.

Results: In ASD, increased functional connectivity to happy faces across age 0-400ms was found in the theta band (F=7.7, 36 edges, 35 nodes, p_{corr} <0.008). The network included interregional connections anchored in the left insula and left amygdala and spanned primary visual, parietal, and temporal brain regions. Increased theta band connectivity across age was also found to angry faces in ASD (F=9.5, 37 edges, 33 nodes, p_{corr} <0.008). The majority of connections were anchored in the right hemisphere, particularly in the right fusiform gyrus and right ACC.
Likewise, in the control group, we found a positive correlation between functional connectivity and age in the theta band, 0-400ms to happy faces (F=6.6, 35 edges, 31 nodes, p_{corr} = 0.04). The most important nodes were the right ACC and left fusiform. To angry faces in controls, we also found a positive correlation between connectivity and age in theta (F=7.7, 35 edges, 30 nodes, p_{corr} <0.008), with the majority of connections anchored in the left amygdala and left fusiform. Decreased functional connectivity with age to happy faces in beta (F=7.6, 35 edges, 32 nodes, p_{corr} <0.008) was also found in controls; anchored in the right ACC, left insula and fusiform. No significant interactions were found between age and group, or significant between-group differences either to happy or angry faces.

Conclusions: We found age-related changes in functional connectivity of brain regions important for emotion processing in typical controls and in ASD. Both those with and without ASD showed increased connectivity with age in the theta band to happy and angry faces. Findings of increased theta band connectivity across age may reflect greater communication and recruitment of these networks across development, while decreasing recruitment of a happy face-specific beta band network in controls suggests automaticity in processing.

Novel Therapeutic Approaches (gene, protein or RNA targeted therapies)

POSTER SESSION — NOVEL THERAPEUTIC APPROACHES (GENE, PROTEIN OR RNA TARGETED THERAPIES)
439 - Novel therapeutic approaches (gene, protein or RNA targeted therapies) Posters

439.001 *(Poster)* Explore the Effect of Multi-Session Intermittent Theta Burst Stimulation over Bilateral Posterior Superior Temporal Sulci in Adults with Autism Spectrum Disorder

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Background: Although the therapeutic potential of repetitive transcranial magnetic stimulation (rTMS) for individuals with autism spectrum disorder (ASD) has been proposed for years, the results are quite limited. Theta burst stimulation (TBS) is a modified rTMS method with shorter simulation duration and lower stimulus intensity than conventional rTMS. TBS may be more suitable than conventional rTMS for individuals with ASD. However, the therapeutic benefits of TBS on ASD remain unclear.

Objectives: Our study aimed to explore the impacts of intermittent TBS (iTBS) over the bilateral posterior superior temporal sulcus (pSTS) for 5 consecutive days in adults with ASD. The outcomes included the clinical symptoms and executive functions.

Methods: In our randomized, single-blinded, sham-controlled crossover trial, 13 adults with ASD received iTBS for 5 consecutive days over the bilateral pSTS and inion (as a sham control) in a 4-month interval and in a randomly assigned order. The executive function was measured with the Wisconsin Card Sorting Test (WCST) for cognitive flexibility. The clinical outcomes were measured with the Autism Spectrum Quotient (AQ) by participants themselves and their parents before and after 5-day iTBS interventions.

Results: Our results did not find significant direct effects of multiple-sessions iTBS over the bilateral pSTS on clinical symptoms and neuropsychological performances in adults with ASD. However, our further analysis revealed several moderators might modify the effects of iTBS on the clinical symptoms and cognitive flexibility in adults with ASD. Specifically, the immediate impacts of iTBS were moderated by the concurrent medication use and baseline severity of restricted and repetitive behaviors (RRB) on the total errors in the WCST. In addition, the immediate effects of iTBS on the self-reported AQ scores were moderated by the baseline intelligence, baseline severity of RRB and concurrent medication use. Moreover, the effects of iTBS on the parents-reported AQ scores were moderated by the baseline intelligence and baseline severity of language.

Conclusions: Although modulating pSTS activities may be a potential therapeutic target in treating ASD, we did not find definite impacts of multiple-sessions iTBS over the pSTS in adults with ASD. However, several important factors, which should be noticed in the future study, might moderate the effects of iTBS over the pSTS on adults with ASD.

Patients, Families, and Clinical Services

ORAL SESSION — PATIENTS, FAMILIES, AND CLINICAL SERVICES
324 - Autism at the Point of Care: Informing Services for Patients and Families

324.001 *(Oral)* Utilization of a Best Practice Alert (BPA) at Point-of-Care for Recruitment into a US-Based Autism Research Study

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Background: Recruitment for research studies is challenging and can thus limit the rate of scientific progress. A survey of research participants indicated that provider referral is one of the most influential reasons a family enrolls in a study. To ease referral burden on providers and researchers, we developed a Best Practice Alert (BPA) that fires during a clinical visit if the patient meets basic eligibility criteria for the study.

Objectives: To determine the efficacy of using a BPA for in-clinic recruitment of individuals with Autism Spectrum Disorder (ASD) for the SPARK (Simons Foundation Powering Autism Research for Knowledge) study.

Methods: The BPA was developed with the Epic Team at Texas Children's Hospital (TCH) to include a brief description of the SPARK study and multiple response options (*interested, decline, enrolled, dismiss*). The BPA was activated in four pediatric sections at TCH (Neurology, Developmental Pediatrics, Psychiatry, and Psychology). Once a provider recorded a response, an Epic inbox message was sent to the research team with the response and patient's information. This information was transferred to a spreadsheet where follow-up information was recorded. "Interested" patients received an email invitation within 72 hours of the response, followed by up to two phone calls and three reminder emails. For referrals received from 9/12/18-9/12/19, referral information, such as visit date, pediatric section, all contact attempts, patient response, and enrollment status, were tracked from 9/12/18-10/12/19.

Results: During the assessment period, 111 providers recorded 1879 BPA responses, including 1203 (64.0%) "Interested," with a weekly average of 23 "Interested" responses. Of these, 233 (19.4%) enrolled in SPARK. The largest number of enrollments (88) came after the email invitation (37.8%) and the first phone call (21.5%); 12.0% of new enrollments from the BPA occurred without any contact from the study team. Referral numbers differed widely across departments (from 1020 in Neurology to 64 in Psychology). Although providers from the Neurology department had the lowest "Interested" rate (56.8%), they had the highest rate of enrollment (21.4% of "Interested" patients). The Psychology Department, which had the highest "Interested" rate (90.6%), had the lowest rate of enrollment (14.0%).Throughout the assessment period, we received 861 additional enrollments from participants who did not receive the BPA, and 258 (30.0%) of these returned the saliva kit for the individual with ASD. However, 56.0% of participants recruited through the BPA returned the saliva kit for the individual with ASD, which was a significantly higher proportion (p <.0001, Fischer's exact).

Conclusions: A best practice alert (BPA) can be highly effective in identifying patients with ASD and recruiting them into a research study during a clinic visit. Participants recruited through the BPA were more likely to complete the study by sending back the saliva kit for the individual with ASD, indicating that families who hear about a study at the doctor's office may be more engaged and likely to complete study involvement. By improving recruitment and engagement processes for participants with ASD, we can more quickly execute research to speed up our understanding of ASD and improve patient outcomes.

324.002 *(Oral)* Inclusion, Acceptance, Shame and Isolation: Attitudes to Autism in Aboriginal and Torres Strait Islander Communities in Australia

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Background: This research investigates attitudes towards autism in Aboriginal and Torres Strait Islander communities in Australia. Overall, Aboriginal and Torres Strait Islander peoples, who constitute 3.3% of the total Australian population, experience widespread socioeconomic disadvantage and health inequality, including being 1.8 times more likely to be living with disabilities than other Australians. Such disparity is especially evident in rates of childhood disability. The qualitative research presented contributes to the growing literature on cross-cultural and pluralistic understandings of autism and family experience.

Objectives: This is the first research to explicate attitudes towards autism in Aboriginal and Torres Strait Islander communities in Australia. Understanding the complexity of these attitudes is crucial because they influence recognition of autism as well as support and management. We cannot simply assume that Western biomedical conceptualisations of autism are accepted in these diverse communities or that current diagnostic practices and services will meet their needs. The overall research objective was to provide a detailed understanding of family experiences of supporting children diagnosed with autism in Aboriginal and Torres Strait Islander communities. This understanding can contribute to the design of services that are culturally safe and relevant to these communities.

Methods: Families with Aboriginal and/or Torres Strait Islander children on the autism spectrum were recruited through the networks of our partner organizations, Positive Partnerships and First Peoples Disability Network. Twelve families from diverse parts of Australia – including eleven mothers and one grandmother – agreed to participate in a semi-structured interview. These women talked about their experiences of supporting 16 children diagnosed with autism, who ranged in age from 2 to 22 years. The research team was comprised of two non-Aboriginal and one Aboriginal researchers, whose disciplinary backgrounds span psychology, anthropology and Indigenous policy and health. Interview transcripts were thematically analyzed using the six-step process outlined by Braun and Clarke (2006). Here we report on a group of themes related to attitudes towards autism in Aboriginal and Torres Strait Islander communities that emerged as a distinct data set within the overall data corpus.

Results: We identified four themes relating to Aboriginal and Torres Strait Islander attitudes towards autism: inclusion, acceptance, shame and isolation. Overall, there was a marked tension in these accounts between the growing acceptance of autism in these communities and the stigmatisation of autistic individuals and their families as well as between feeling supported, especially by family, and being socially isolated because of child preferences and shame associated with atypical behaviour.

Conclusions: The findings of this study demonstrate that there are multiple attitudes towards autism in Aboriginal and Torres Strait Islander communities. On the one hand, some of these attitudes potentially point towards under-identification or misdiagnosis. On the other hand, this study found that a widespread ethos of 'looking after each other' and of accepting individual differences may be contributing to some good outcomes for autistic children and adults. In this respect, Aboriginal and Torres Strait Islander attitudes towards autism provide a positive model of support for and acceptance of autistic children and their families.

324.003 *(Oral)* Inside the Portrait of Autism in Africa: Understanding Diagnostic Profiles and Comorbidities in Mental Health Clinics in National Referral Hospitals in Uganda

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Background: Autism Spectrum disorder (ASD) is a behaviorally defined neurodevelopmental disorder of increasing prevalence and global concern. Recent estimates in the United States show that as many as 1 in 59 school-aged children are affected. It is believed that the prevalence of ASD in low- and middle-income countries (LMICs) may be comparable to Western estimates. The average age of diagnosis for children in developed nations is around 5 years of age. Further, ASD is reported to co-occur with many developmental disabilities. However, there is little empirical evidence on the average age of ASD diagnosis in children in Sub-Saharan Africa. Additionally, studies characterizing comorbidities associated with ASD in African populations are limited. Understanding the clinical profiles of children with ASD living in low resource settings such as Uganda may provide insights to inform early detection, intervention, and research priorities in this part of the world.

Objectives: The purpose of this study was to determine the age of diagnosis and to describe common comorbidities associated with ASD in a clinical sample of young people receiving treatment in mental health clinics at National referral hospitals in Uganda.

Methods: Demographic and clinical profiles were collected through retrospective chart review for all children diagnosed with ASD at two tertiary mental health facilities in Uganda between 2014 and 2019. ASD and related comorbidities were diagnosed by child and adolescent psychiatrists using the DSM 5 diagnostic criteria. Descriptive statistics were computed to estimate the average age of diagnosis and to summarize the proportion of children with ASD and related comorbidities.

Results: A total of 237 (156 males, 81 females) children with ASD were identified over the five-year period. The average age of first-time diagnosis was found to be [6.99±4.04 years], which was significantly different between males and females [t= -2.106, p=0.036]. Out of the 237 who were diagnosed with ASD, 54.9% [n=130, mean age 6.7 years SD (3.8)] were identified as having ASD only, 18.9% [n=45, mean age 6.5 years SD (3.4)] had ASD and ADHD, 12.6% [n=30, mean age 8.7 years SD (4.7)] were found to have ASD and Epilepsy [n=30, mean age 8.7 SD (4.8)], and 2.9% [n=7, mean age 5.0 years SD (2.4)] were found to have ASD and Global Developmental Delay. 2.9% [n=7, mean age 6.3 years SD (5.3)] were also diagnosed with ASD and language delays, and less than 1% of the sample had ASD in addition to other psychiatric comorbidities such as depression, psychosis and challenging behaviors.

Conclusions: Findings suggest that African children receive formal diagnosis of ASD later compared to peers in developed countries. Furthermore, while a large proportion of children in these settings experience ASD only, the results show that ASD often co-occurs with other psychiatric and developmental problems. The study demonstrates that early identification remains a daunting challenge in Africa, underscoring the need to maximize screening and surveillance efforts across the region. Lastly, culturally appropriate and effective interventions need to be developed to address not only the symptoms of ASD but also related behavioral problems.

324.004 *(Oral)* Preliminary Outcomes of a Culturally Responsive Peer Counselling Program for Parents of Children with Autism in the South Asian Community

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Background: Parents of children with autism routinely report high levels of stress, which can impact their mental health (Hayes & Watson, 2013). In addressing these mental health challenges, it is important to consider how culture influences beliefs and practices related to raising a child with autism. Peer volunteers have been found to be effective in delivering psychosocial interventions when they come from the same culture and share similar experiences (Atif et al., 2016). The South Asian Autism Awareness Centre (Toronto, Canada) developed a manualized intervention (the CARES Program) to address the need for culturally responsive counselling for parents in the South Asian community.

Objectives: 1) Evaluate the preliminary mental health outcomes of this 6-week group-based peer counselling program. 2) Evaluate changes in parent self-reported wellbeing across sessions.

Methods: Findings are based on 63 parents (M_{age}= 43.7 years, 68 % mothers) who participated in the group counselling program (2 - 6 parents per group). Peer facilitators were volunteers from the community who were selected based on their experience working with vulnerable populations and shared experiences caring for someone with autism. The sessions addressed understanding and acceptance of children's diagnosis, coping skills, and goal setting. Parents completed the following measures before and after the program to assess changes in mental health and quality of life: the *Depression Anxiety Stress Scale* (DASS-21), the *Quality of Life Enjoyment and Satisfaction Questionnaire* (QLESQ-SF), the *Parental Stress Scale* (PSS), and *the Brief Family Distress Scale* (BFDS). Additionally, participants completed the Outcome Rating Scale (ORS) at each of the 6 sessions to evaluate changes in wellbeing.

Results: Wilcoxon signed-rank tests and paired sample t-tests were conducted to evaluate change in parent-reported mental health outcomes. Results demonstrated significant improvements on the DASS Depression Scale (Z = - 3.79, $p < .001$), Anxiety Scale (Z = -3.02, $p = .002$), and Stress Scale (Z = -4.38, $p = < .001$), as well as the QLESQ-SF ($t = 2.13$, $p = 0.03$), PSS ($t = -2.80$, $p = 0.007$), and BFDS (Z = -3.87, $p < .001$). McNemar tests indicated significant differences in clinical levels on the DASS Depression Scale (60% pre-intervention, 41% post-intervention, $p = 0.01$), Anxiety Scale (73% pre-intervention, 35% post-intervention, $p < 0.001$) and Stress Scale (54% pre-intervention, 35% post-intervention, $p = 0.004$). Multilevel modelling was used to assess change in parent reported overall wellbeing (ORS ratings) across sessions. The Session 1 score was used as the control timepoint, and compared with each subsequent session to assess change over time. Results demonstrated improved ORS scores from the initial session to each other time point (all $p < .001$), with posthoc analyses indicating significant changes after the first and second session, and stable high ratings across all other sessions.

Conclusions: Findings demonstrate the clinical utility of using trained peer volunteers to support the mental health of parents of children with autism in the South Asian community. There are implications for considering the kinds of adaptations that can allow for effective and accessible support services for families in other diverse communities.

Pediatrics

POSTER SESSION — **PEDIATRICS**
440 - Pediatrics Posters

440.001 *(Poster)* Assessing Caregivers' Perceptions about the Impact of Psychotropic Medication Treatment in a National Sample of Children with Autism Spectrum Disorder (ASD)

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Background: The Medication Outcomes for Developmental Delays (MODD) questionnaire was developed as a clinical tool to efficiently assess a caregivers' perceptions of the impact of psychotropic medications on their child's target symptoms in a population of children with autism spectrum disorder (ASD) and related developmental disabilities. The MODD has been found to significantly correlate with the Clinical Global Impression Severity Scale (CGI-S), and Clinical Global Impression Improvement Scale (CGI-I), indicating agreement between caregivers and clinicians regarding symptom control and side effects. The 16-item MODD includes 4 domains: Functional Impairment (FUNC; degree to which behaviors interfere with daily living), Developmental (DEV; symptoms related to core ASD features), Symptoms (SX; common co-occurring conditions in ASD), and Medication Impact (MED).

Objectives: To use the Medication Outcomes for Developmental Delays (MODD) questionnaire to assess caregivers' impressions about psychotropic medication treatment and compare outcomes between commonly prescribed classes of medication.

Methods: Caregivers of children with ASD enrolled in the Interactive Autism Network (IAN), a well-established, family-centered online research network, completed questionnaires, including the MODD, a demographic survey, and a questionnaire about psychotropic medication use. Descriptive statistics included proportions and means. Scores on the MODD were summed for each of the 4 domains and reported as a severity score (sum of FUNC, DEV, and SX) and Medication Impact Score (MED). Linear regression modeling was conducted controlling for gender, age, and ethnicity to determine the relationship between MODD scores and classes of psychotropic medications.

Results: Caregivers of 644 children with ASD (mean age 12.3 years, 82% male) completed the MODD survey. Of these, 351 children were taking psychotropic medication and the 4 most common classes included: anti-depressants (44%), alpha adrenergic agonists (35%), atypical antipsychotics (34%), and stimulants (31%). Caregivers viewed the impact of psychotropic medications favorably, with 69% indicating it was "very true" that positive benefits of medication outweighed negative side effects, and 58% reporting that their child's overall well-being improved since starting behavioral medication. Use of atypical antipsychotics and alpha agonists were each significantly associated with the MODD severity score (sum of FUNC, DEV, and SX scales) (β=0.309 and β=0.127, $p<0.001$), controlling for gender, age, and ethnicity, indicating these 2 classes of medication were associated with a greater degree of developmental disability / functional impairment. On the MED scale, use of stimulants was significantly associated with improved learning (β=0.171, $p<0.01$) and independence (β=0.20, $p<0.001$), and the total medication impact score (β=0.189, $p<0.001$). Use of antidepressants was associated with improved overall well-being (β=0.133, $p<0.05$).

Conclusions: The MODD questionnaire is a useful clinical tool for assessing caregiver perspectives about behavioral pharmacotherapy in children with ASD and related developmental disabilities with the potential to improve shared decision-making and track healthcare outcomes. While decisions to use psychotropic medications to address challenging behaviors are difficult, most caregivers view the impact of psychotropic medications positively.

440.002 *(Poster)* Caregiver Confidence in Reporting Anxiety Symptoms in Children with Autism Spectrum Disorder

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Background: Up to 40% of children diagnosed with autism spectrum disorder (ASD) also meet criteria for an anxiety disorder. As children with ASD and anxiety disorders are at higher risk for self-injury, depression, and parental stress than children with ASD without comorbid anxiety disorders, it is important for anxiety to be properly identified in this population so children can receive appropriate treatment.

Objectives: Anxiety is often assessed through parent questionnaires; however, due to the nature of the questions and verbal limitations often present in children with ASD, caregivers may experience difficulty completing such measures. Therefore, the objective of this study was to examine caregiver confidence in reporting anxiety symptoms in children with ASD.

Methods: English- or Spanish-speaking caregivers of children 6-12 years with an ADOS-confirmed ASD diagnosis (n=143) completed the CASI-4 ASD Anxiety Scale and rated their level of confidence responding to each item on a 1-4 point Likert scale (not at all confident, not so confident, somewhat confident, very confident).

Results: Overall, parents reported that they had high confidence in their anxiety ratings (average 3.75 score). However, when examining parental confidence on individual items, differences emerged based on question type. Behavior-based items were highly endorsed by parents. For example, more than 90% of parents reported that they were *very confident* of their choice of anxiety rating for their child on items such as your child has difficulty falling asleep and your child is afraid to go to sleep without a parent nearby. However, feeling- or thought-based questions were less confidently endorsed. For example, less than 70% of parents were *very confident* regarding their responses to questions about the child's difficulty controlling worries, having distressing thoughts, and experiencing nightmares about being separated from a parent.

Conclusions: Results indicated that parents had high overall confidence in rating their child's anxiety symptoms. However, parents reported lower confidence on items requiring verbal skills and/or inquiring about children's thoughts or feelings. Future analyses should examine confidence scores in relation to autism severity, communication ability, IQ, and anxiety score.

440.003 *(Poster)* Characterising Sleep Problems in Children with ASD and Intellectual Disability: An Exploration of Child and Family Factors.

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Background: Approximately, 40-80% of children with Autism Spectrum Disorder (ASD) experience behavioural sleep problems (Cortesi et al., 2010). In addition to sleep problems, children with ASD commonly experience co-morbidities such as emotional and behavioural disturbances (Maskey et al., 2013) and Intellectual Disability (ID), with approximately 36.8% of children with ASD experiencing a co-morbid ID (Braun et al., 2015). The mechanisms that underlie sleep problems in ASD are largely unknown, however several biopsychosocial factors related to the child have been proposed (Rzepecka et al., 2011). Family factors have also been shown to be related to sleep problems in ASD (Hodge et al., 2013; Tilford et al., 2015), although few studies have explored this association accounting for ID.

Objectives: The aim of this study was to compare the sleep profiles of individuals with ASD with and without ID. Additionally, this study aimed to examine commonly occurring parent and child factors (ID, ASD symptom severity, emotional and behavioural disturbance, parent psychological distress and parenting stress) and their impact on sleep problems in children with ASD.

Methods: Parents of 56 children with ASD (34 ASD+ID, 22 ASD) aged 6-13 years were recruited from a community sample. Children's ASD and ID diagnoses were confirmed by sighting clinical reports. Parents reported on their child's sleep problems (Children's Sleep Habits Questionnaire - ASD version), emotional and behavioural disturbances (Developmental Behaviour Checklist; DBC) and ASD symptom severity (Social Communication Questionnaire- Lifetime form). Parents also reported on their own parenting stress (Parenting Stress Index – Short Form) and psychological distress (Kessler Psychological Distress Scale). T-tests and regression analyses were conducted.

Results: Preliminary analyses revealed there were no significant group differences for total sleep problems or individual sleep problem subscales. There were also no significant group differences for parent psychological distress. Whilst there were no significant group differences for overall emotional and behavioural disturbances, significant differences between groups were evident for the self-absorbed subscale (p= .009) and the communication disturbance subscale (p <.001) of the DBC, with the ASD+ID group reporting significantly worse psychopathology. Additionally, whilst there were no significant group differences for total parenting stress, significant differences between groups were evident at the subscale level, with the ASD+ID group being significantly higher than the ASD only group for both the parent-child dysfunctional interaction (p= .004) and difficult child (p= .024) subscales. Regression analyses revealed there was a significant independent association between child sleep problems and experiencing emotional and behavioural disturbances *(β= 0.75, p <.001)*. There were no significant independent associations between total parenting stress, overall parent psychological distress or ASD symptom severity and total child sleep problems.

Conclusions: Our results demonstrate the importance of considering the influence of emotional behavioural disturbances when treating behavioural sleep problems in children with ASD. Future research should investigate the specific emotional and behavioural difficulties that may be contributing to sleep problems in larger samples of children with ASD.

440.004 *(Poster)* Echo Autism - Improving Primary Care Self-Efficacy in Educating Caregivers on Safety Skills and Injury Prevention in Children with Autism Spectrum Disorders

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Background: Individuals with autism spectrum disorders (ASD) are at increased risk for death secondary to preventable injuries, including those that result from wandering and elopement. In fact, nearly half of parents of children with ASD report that their children wander or elope from safe places. Wandering and elopement behavior increases a child's risk of requiring medical attention due to sustaining bodily injury and may even result in accidental death. Primary care physicians are on the front lines to empower caregivers about ways to keep their children safe and to build safety skills yet have little training and few resources to do so.

Objectives: The purpose of this pilot study was to examine primary care physician self-efficacy in counseling families of children with ASD about injury prevention and safety skills as part of ECHO (Extension for Community Healthcare Outcomes) Autism in Primary Care.

Methods: The study design was a pre- and post-survey of primary care physician self-efficacy in assessing risk for injury and educating caregivers about safety measures and injury prevention for children with ASD. With permission from the authors, the *Primary Care Assessment of Self-Efficacy* (Mazurek et al, 2017) was adapted to assess physician knowledge of assessing risk of injury and safety skills as well as providing resources to families of children with ASD. This survey was done before and after specific ECHO Autism teleclinics focused on injury prevention and safety skills.

During these specific ECHO Autism teleclinics, the Hub team included a dedicated Safety Team comprised of developmental pediatricians, psychologists, behavior therapists, nurses, speech and language pathologists, occupational therapists, social workers, and the hospital injury prevention coordinator. As part of these teleclinics and in line with the ECHO model, primary care physicians presented cases about wandering and elopement. The didactic portion of the teleclinics focused on injury prevention and safety for children with developmental differences, including ASD.

Statistical analyses utilized Mann-Whitney U tests to compare confidence levels pre- and post-session. A two-sided p value ≤ 0.05 was considered statistically significant. Qualitative data in the form of physician responses were also included in the study.

Results: 11 primary care clinicians participated in the ECHO Autism Safety teleclinics, and data collection is ongoing. All were pediatricians from the greater Chicago metropolitan area. Of the participants who filled out the survey pre-ECHO, 17-50% stated they had little to no confidence in assessing risks for injury and educating families about safety. After these specific ECHO teleclinics, their confidence significantly improved to 80-100% (p <0.02 for all topics).

Conclusions: This ongoing pilot study provides emerging evidence that ECHO Autism is an effective format to improve primary care self-efficacy in safety and injury prevention for children with developmental differences, including ASD. Future research includes assessing telementoring and telemedicine as intervention strategies to address safety and injury prevention for children with all developmental differences, including ASD.

440.005 *(Poster)* Examining Potential Benefit of Autism Webinars on Screening, Diagnosis, and Referral Practices for Pediatric Primary Pediatric Health Care Professionals

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Background: Early identification of autism spectrum disorder (ASD) facilitates earlier intervention and is a strong predictor of better outcomes (Rhoades, Scarpa & Salley, 2007). However, early identification of ASD (i.e. ASD-screening, diagnosis) is often delayed in the pediatric setting (Self, Parham, Rajagopalan, 2014). While rates of ASD-screening at well-child visits are high, few pediatric primary care providers (PPCPs) make ASD-specialist referrals following a failed screen, and even fewer evaluate for ASD themselves (Monteiro et al., 2019). Although PPCPs report an eagerness to improve services for patients with ASD, barriers include a lack of adequate diagnostic training and insufficient knowledge of treatment information (Rhoades et al., 2007; Mazurek, Brown, Curran, & Sohl, 2017). Accessible, evidence-based educational tools are greatly needed to address these barriers and increase early identification and treatment.

Objectives: To evaluate PPCP perspectives on the value and utility of an ASD educational webinar series, as well as changes in knowledge and confidence about ASD-screening, diagnostic, and referral practices following participation.

Methods: PPCPs from a hospital-affiliated pediatric network were invited via email to participate. A subsequent group of providers from an integrated medical home were invited following their request for ASD-diagnostic training. Pre- and post-test measures of knowledge and confidence were collected for each webinar (Screening, Diagnosis, Referral). Participants had the option of providing open-ended feedback following each post-test. PPCPs were incentivized with 1 continuing medical education (CME) credit for each webinar completed and the ability to download each presentation following post-test.

Results: Of 291 PPCPs invited, 37 (12.7%) completed Screening; 31 (10.7%) completed Diagnosis; and 28 (9.6%) completed Referral. Paired samples t-tests revealed statistically significant pre-post increases ($p< .001$) in knowledge and confidence scores for each webinar. Chi-square analyses comparing pre-post proportions of correct versus incorrect responses showed larger proportions of correct responses post-test. Additionally, themes and subthemes identified in analyses of provider feedback reflected high utility and acceptability, though inclusion of community resources was requested for improvement.

Conclusions: Results indicated substantive gains in both knowledge and confidence across webinars, suggesting their value as an educational tool. Although providers consistently request ASD- specific training (Carbone, Norlin & Young, 2016), as was the case for the current sample, response rates in the present study were surprisingly low. Future research investigating the discrepancy between the demand for training and the limited uptake of such freely available programs is warranted. Qualitative provider feedback suggested high utility and acceptability, which will assist in addressing this question and improving future webinars. Additional future directions include novel delivery methods (e.g., Podcasts) that would allow for access and reference 'on-the-go.' Additionally, future research should evaluate the usefulness of supplemental resources to assist providers with implementation of best practices in-clinic. For example, the utility of best-practice alerts (BPA) in combination with the educational webinars to provide immediate, in-clinic support to facilitate PPCPs' ASD diagnostic and referral practices should be investigated.

440.006 *(Poster)* Exploring Experiences and Support Needs of Parents of Children with Newly Diagnosed Autism Spectrum Disorder in Singapore: A Descriptive Qualitative Study.

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Background: Autism Spectrum Disorder (ASD) is a lifelong disorder that impacts a child and family in numerous ways. It is important to understand the experiences of these families so as to identify their support needs and subsequently design support networks for them. Although parental stress among children with ASD in general is known to be higher, literature in terms of experiences within this specific cultural context is limited.

Objectives: To explore the experiences and support needs of parents of children with newly diagnosed ASD in Singapore and to identify ways of better supporting them.

Methods: This was a qualitative descriptive design study undertaken at the Child Development Unit of a tertiary university hospital. Inclusion criteria was 1. Parent with a child with ASD aged between 2 to 10 years 2. Child diagnosis of ASD by formal psychological assessment (using the Autism Diagnostic Observation Schedule) within the last 2 years 3. Parent being one of the child's caregivers since birth. Exclusion criteria was: 1. Parent with another older child with ASD 2. Parent with mental health disorders or terminal medical illness and 3. Parent being unable to comprehend interview questions in either English or Mandarin. Parents who met eligibility criteria were purposively sampled from the outpatient clinics between October to December 2018. Semi-structured face-to-face individual interviews were conducted with the parent until data saturation was reached. Common themes were subsequently analyzed using constant comparative method to generate results.

Results: Data saturation was achieved after 13 interviews; which comprised of 11 interviews with the mother and 2 with the father. Parents reflected the major ethnicities in Singapore with 9 of Chinese ethnicity, and 2 each of Malay and Indian ethnicity. Mean age of children of parents interviewed was 4.6 years. Parent's experiences centered around three main themes with their respective sub-themes as follows: (1) Adjusting psychologically to the diagnosis (parent's own negative emotions and stigma and expectations from society), (2) Changing lifestyle of self and family (having to plan around the child, financial/employment adjustments and juggling needs of other family members), (3) Contending with hurdles to services (difficulty accessing educational resources and frustration with services in the healthcare system). Support needs centered on the areas of informational support, tangible support (time, financial) and emotional support. Parents also highlighted a lack of formal and informal support networks to address their needs.

Conclusions: Parents of newly diagnosed children with ASD experience multiple challenges post diagnosis. Services can be improved to provide targeted support for these parents; especially informational resources and affordable access to services. Establishing dedicated support networks for these parents and educating society on the condition could also be beneficial.

440.007 *(Poster)* Food Responsiveness and Attentional Bias to Foods in Autism

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Background: People with Autism Spectrum Disorder (ASD) are at substantially elevated risk of developing obesity (Curtin et al., 2014), which cascades to negatively impact their broader health (Croen et al., 2015). The mechanisms contributing to and driving these adverse health outcomes are unclear. Appetitive traits, such as food responsiveness, likely play a role. Among non-ASD children with higher than normal body mass index, evidence suggests an attentional bias towards food stimuli (Rojo-Bofill et al., 2019). To date, food responsiveness, broadly construed (including attentional bias towards food stimuli), has not been examined among children with ASD.

Objectives: Examine food responsiveness via parent report of appetitive traits and a selective attention task in children with ASD.

Methods: Study 1: Participants consisted of parents of children with ASD (n=188; M age=8.6; 136 males) and parents of typically developing [TD] children (n=113; M age=9.2; 53 males) who completed the well-validated and psychometrically sound Children's Eating Behavior Questionnaire (CEBQ; Wardle et al., 2001). Specifically, scores were derived from the Food Responsiveness subscale of the CEBQ. Study 2: An overlapping (with Study 1) group of children with ASD (n=15; M age=12.53; 12 males) and TD children (n=25; M age=11.44; 14 males) were invited to complete an in-person computerized task examining attentional bias to food using a dot probe paradigm. The primary task consisted of 144 trials with 96 food trials and 48 filler trials. Images were presented at a rate of 500 ms. Participants were asked to focus on a plus sign ("+") in the center of the screen. Then the subjects were presented with two images at different screen locations (top and bottom). Participants were instructed to look at the top picture. The picture then disappeared and a probe (either "E" or "F") appeared on either the top or bottom. The participants were instructed to match the probe to the labeled keyboard keys. Data were analyzed for accuracy and latency.

Results: Study 1: Parents rated children with ASD as more food responsive (CEBQ) than TD children (t=2.28, p<.05). Study 2: There was a significant interaction (p=.03) between group and condition wherein children with ASD demonstrated attentional bias to food (vs. non-food) stimuli while TD children did not in the context of the dot-probe task. Adding self-reported hunger ratings (even though groups did not differ at the time of testing) as a covariate in the ANOVA did not alter results.

Conclusions: In sum, this study was the first to examine food responsiveness in children with ASD. In contrast to their TD counterparts, children with ASD demonstrated increased food responsiveness per parent report and in the dot probe paradigm. These findings could pinpoint one of several underlying contributors to the increased risk for development of obesity in ASD. Future research could examine treatment approaches that seek to mitigate this attentional bias to food, as has been done in TD groups, in order to address risk of obesity development in children with ASD.

440.008 *(Poster)* Grey and White Matter Alterations in Rett Syndrome

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Background: Rett syndrome (RTT) is a devastating genetic disorder representing the most common genetic causes of severe intellectual disability in females. Most cases are caused by X-linked MECP2 gene mutations. Patients with RTT usually lose the ability to use words and experience poor hand use with severe cognitive and motor deficits. Pathologic studies showed reduced brain weight in RTT. Regional brain volume measurements reported decreased grey matter volume and reduced FA values compared to healthy controls. In this study, we employed voxel-based morphometry (VBM) and tract-based spatial statistics (TBSS) to investigate the grey matter and white matter alterations in RTT, the idiopathic ASD, and typically developing children as controls respectively. Compared to traditional region-of-interest based analytic method, VBM is automated full-brain analysis without manually delineations; while TBSS provides advantages with higher spatial comparability.

Objectives: To investigate the grey and white matter alterations in children with Rett Syndrome based on the structural MRI imaging, so as to provide reference for targeted treatment.

Methods: 73 children were included in the present study, including 22 with Rett Syndrome, 24 ASD children without pathogenic gene variation or pathogenic Copy Number Variations and 27 typically developed children. MR scans were obtained on a GE 3.0T Discovery 750 system with T1 BRAVO and EPI (15 directions) sequences. VBM analysis: TOM8 toolbox was used to create study specific TPM maps. These maps were utilized on CAT12 software in the DARTEL algorithm to create final templates for normalization and segmentation. Resulting statistical maps were thresholded at P<0.01 FWE corrected. TBSS analysis: All DTI datasets were first corrected for eddy current distortions and head movements using FSL. Then DTIFIT fitted a diffusion tensor model at each voxel to generate FA maps. The TBSS analysis was then performed. All FA images were aligned to form the target image then transform into MNI standard space. Tract-based spatial statistics were then tested with FA maps to create the "skeleton". Permutation tests were applied to the general linear model. Resulting statistical maps were thresholded at P<0.01 FWE corrected using TFCE approach.

Results: VBM post-statistical analysis between Rett group and ASD group, as well as Rett group and typical developed controls, clearly showed significant brain volume decreases mainly on left frontal gyrus, including left Frontal_Mid, Frontal_Sup, Frontal_Mid_Orb and Frontal_Sup_Orb (Figure 1). No significant altered brain volumes were found between ASD and typical developed controls. TBSS results demonstrated decreased FA values mainly on the corpus callosum and corona radiata in Rett group, including Genu_of_corpus_callosum, Body_of_corpus_callosum, Splenium_of_corpus_ callosum, Anterior_corona_radiata and Posterior_corona_radiata (Figure 2). Interestingly, no significant different FA values were found between ASD and typical developed controls.

Conclusions: This work demonstrated that, in children with Rett Syndrome, the brain volume decreases were mainly found at left MFG, SFG, OMF and OSF and the white matter abnomalities were at the corpus collosum and corona radiata. These brain structure alterations may elaborate the clinical manifestations of Rett Syndrome, including language, cognition and motor developmental delays. Further functional MRI studies may provide more evidence for the current conclusions.

440.009 *(Poster)* Iron and Vitamin D Deficiency in Young Children with Autism Spectrum Disorder in Singapore

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Background: Iron and vitamin D have been implicated to play an important role in cognition and neurodevelopment respectively. Existing evidence suggests that correcting deficiencies in both these nutrients can improve Autism Spectrum Disorder (ASD) symptoms. Children with ASD are also at greater risk for these deficiencies due to behavioural difficulties and food selectivity. Extant literature shows highly variable rates of these deficiencies and variable practices in routine screening among different populations.

Objectives: The objectives of this study were to 1. Determine occurrence of iron and vitamin D deficiency in the sample population, 2. Identify predictors of the presence of these deficiencies if any and 3. Elucidate factors influencing screening for these deficiencies in children with ASD.

Methods: This was a retrospective cross-sectional review of case records of all patients with ASD who were seen at a tertiary developmental paediatric centre in Singapore from January 2018 to June 2018. Inclusion criteria was 1. Child age 0 to 7 years and 2. Diagnosis of ASD following clinical evaluation by a developmental paediatrician or formal psychological evaluation with the Autism Diagnostic Observation Schedule. Exclusion criteria was 1. Chronic medical conditions and 2. Genetic syndromes. Information on demographic variables, ASD-related variables and other medical conditions was abstracted using a structured data collection form. Presence of iron deficiency (serum ferritin < 12µg/L or transferrin saturations < 10%), vitamin D deficiency (25-hydroxyvitamin D [25(OH)D] < 10 µg/L) and vitamin D insufficiency (25(OH)D between 10.1-29.9 µg/L) was determined from review of laboratory investigations. Descriptive statistics were used to assess for prevalence of iron and vitamin D deficiencies. Logistic regression was used to identify predictors of iron and vitamin D deficiencies and chi square tests were used to compare children who were and were not offered screening for these deficiencies.

Results: The sample consisted of 480 children (81% males, 19% females) with a mean age of 4.5 years (SD 1.3). Of this, only 20.2% (N=97) of children were screened for iron deficiency and 18.3% (N=88) were screened for vitamin D deficiency using blood tests. The prevalence of iron deficiency was 19% (N=18). Younger children were more likely to have iron deficiency (B=1.06, p=0.02). The prevalence of vitamin D insufficiency was 38% (N=33) and that of vitamin D deficiency was 1.1% (N=1). Older children were more likely to have vitamin D deficiency or insufficiency (B=1.07, p=0.01). Only 20.8% (N=100) of children from the entire sample were offered screening blood tests; children with greater severity of disease ($\chi 2$= 9.80, p=0.002) and those with a history of selective feeding ($\chi 2$= 8.27, p=0.004) were more likely to be offered screening tests.

Conclusions: The prevalence of both iron deficiency and vitamin D deficiency/insufficiency was high in this sample compared to the general population. Of note, only a small proportion of children were offered screening and eventually screened for these deficiencies. Apart from child age, there were no significant child or disease characteristics that predicted these deficiencies. Routine screening of all children with ASD for iron and vitamin D deficiency is recommended.

440.010 *(Poster)* Results from a Multidisciplinary Self Injurious Behaviour Clinic - 2 Years Later

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Background: Self Injurious Behaviours (SIB) is a distressing Restrictive and Repetitive Behaviour (RRB) that can impact up to 30% of those with autism; severe SIB is much less common but is an incredibly distressing behaviour. Identification and early specialised intervention of those who are at risk of severe SIB is a key component to reducing this RRB. Currently, in North America, there are few clinics that specialise in severe SIB. The multidisciplinary SIB Clinic has been operational in Vancouver for two years. We employ a novel approach to assessment of the most affected children in our province (British Columbia). It is a clinic that brings together general pediatrics, neuropsychiatry, pediatric neurology, pain, sleep specialists, psychology as well as allied health with a behavioural analyst, speech and language pathologist, occupational therapy and a social worker. Children are referred to the clinic by psychiatrists through British Columbia's Children's Hospital and we have been seeing approximately 1 patient per month.

Objectives: As we have been operational for two years and have assessed 17 patients this is an opportune time to review the patients we have assessed to date.

Methods: Demographic, intervention and investigational data has been gathered and has been reviewed. We have identified themes in presentation, treatment and assessment of severe SIB.

Results: The average age of children seen was 9.7 years, with the youngest being 4 and the eldest being 16. Almost all (15/17) of the children seen for assessment are male. The majority had a diagnosis of autism at presentation (15/17). Three patients had a genetic syndrome known to be associated with autism and while these children had been seen by multiple subspecialists (up to 7), many of the others were managed by psychiatry and pediatrics. Sleep issues, including insomnia, parasomnias, biphasic sleep and restless sleep affected most of the patients (14/17). 1/3 of the children were living the care of social services due to their behaviours. Many children were managing polypharmacy and had trialled multiple psychiatric medications (0-14) and over the counter medications. Few (2/17) had a prior Brief Functional Analysis completed, although all had some Behavioural Intervention in place. All had major deficits in communication, most (15/17) were non-verbal. In terms of prior investigations including bloodwork, imaging, and genetics only 3/17 had a reasonable workup for causes of SIB.

Conclusions: Through our novel 2 year operation we have identified several themes which are informative to practice. First, multidisciplinary clinics such as ours are rare and labour intense. Second, most of those affected by severe SIB are male, and although we see a range in age, the SIB has been a long standing issue. Third, likely based on behaviours, these children have had little to no investigations to assess causes of their SIB, or the underlying autism. Fourth, although we know that SIB is a form of RRB that requires interventions aimed at reducing the RRB, children have limited access to this specialised treatment. Finally, sleep and poor communication are common comorbidities in those affected by severe SIB.

Rare Genetic Disorders

POSTER SESSION — **RARE GENETIC DISORDERS**
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441.001 *(Poster)* A Study of the Impacts of AB-1224 on the Rett-like Phenotype and Intestinal Permeability in the Mecp2tm1.1Bird Mouse Model of Rett Syndrome

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Background: Rett syndrome (RTT) is a neurodevelopmental disorder primarily caused by spontaneous mutations in the methyl-CpG binding protein (*MECP2*) gene on the X-chromosome and occurs in ~1:10,000 live female births. Approximately 50% of RTT individuals have behaviors that meet criteria for an autism spectrum disorder (ASD) diagnosis at some point in their development (Wulffaert, J *et* al. Autism 2009). As in ASD, gastrointestinal (GI) complications are common in RTT individuals (>80%). In preclinical studies, Hsiao *et* al. (Cell 2013) demonstrated a relationship between gut dysbiosis and ASD symptoms that specifically implicated bacterial metabolites from the metabolism of tyrosine and tryptophan. Furthermore, that study established that *Bacteroides fragilis* (i.e. a live biotherapeutic product like AB-1224) was able to correct gut dysbiosis, aberrant metabolite levels, and ASD-like behaviors in a well-established mouse model of ASD. RTT individuals have been shown to have both dysbiosis and aberrant metabolite levels, and thus may benefit from treatment with AB-1224.

Objectives: The purpose of this study was to assess the therapeutic potential for AB-1224 to mitigate the RTT-like phenotypes found in *Mecp2*$^{tm1.1Bird}$ mice.

Methods: Study groups included AB-1224 dosed in applesauce 3 times during the 6th week of life to female heterozygous *Mecp2*$^{tm1.1Bird}$ mice (n=15), applesauce vehicle only in female heterozygous *Mecp2*$^{tm1.1Bird}$ mice (n=15), and an untreated female C57BL/6J (WT) control cohort (n=16). Mice were assessed at 8 and 12 weeks of age for hindlimb clasping (HLC), rotarod performance, startle response, and gait analysis. To measure intestinal permeability FITC-dextran was administered orally to all groups at 12 weeks of age and plasma concentrations were measured via fluorescence in 4-hour post-dose samples. Microbial metabolites measured in urine using LC-MS/MS. Inflammation and immune system regulation in these mice were characterized in plasma using a V-Plex Mouse Cytokine 29-plex kit from Meso Scale Discovery.

Results: Consistent with the expected phenotype in this model, *Mecp2*$^{tm1.1Bird}$ mice showed significant deficits in the rotarod performance, startle response, and gait, and significantly more HLC relative to the WT cohort. The AB-1224 treated cohort showed improvements in rotarod performance and HLC. Intestinal permeability was significantly increased in control *Mecp2*$^{tm1.1Bird}$ mice relative to the WT and the AB-1224 treated cohorts, suggesting that AB-1224 was able to prevent the development of increased intestinal permeability. A variety of microbial metabolites and immune regulatory markers were altered in these mice.

Conclusions: For the first time, to the best of our knowledge, female heterozygous *Mecp2*$^{tm1.1Bird}$ mice were found to have a robust leaky gut phenotype. Interestingly, treatment with AB-1224 restored GI integrity, and improved motor deficits (rotarod and HLC) in these mice. Taken together, these findings suggest that AB-1224 may warrant further investigation as therapeutic for the treatment of GI and motor dysfunctions in RTT.

441.002 *(Poster)* Can “Red Flags” for Autism Spectrum Disorder be Reliably Assessed Via Remote Parent Administration?

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Background: It is unclear whether autism-related "red flags" derived for idiopathic autism exist at similar base rates in genetically-associated autism risk groups, such as children with neurogenetic syndromes (NGS). Addressing this gap may inform more accurate early screening protocols and etiological models of autism, however studying NGS is challenged by the high cost and travel burden associated with geographically-dispersed samples. Here, we assess the feasibility and validity of using Parent-Administered Neurodevelopmental Assessment (PANDABox), a remotely-administered, caregiver-facilitated platform we developed for assessing autism risk via telehealth, to measure behavioral red flags in a national sample of children with NGS.

Objectives: Our goals were to assess (1) the feasibility of PANDABox for assessing autism-related red flags in NGS, and (2) consistency between observed behaviors and caregiver reports. We also (3) preliminarily examined whether base rates of red flags were higher in NGS.

Methods: Participants were 4- to 25-months-olds at low risk for autism (LR; n=20) and with NGS (n=33; Down, fragile X, and Angelman syndromes) and their caregivers. Discrete autism-presses (DAP) tasks were informed by well-validated screening tools and literature on early features of autism (Bryson, et al., 2008; Lord et al., 2012; Table 1). Tasks were coded offline by three coders who assigned codes based on typical versus atypical responses and usability of data. To assess validity, parents also completed the Modified Checklist for Autism in Toddlers (M-CHAT-R) and Vineland Adaptive Behavior Scales (VL-3). We hypothesized (1) similar feasibility across LR and NGS, as measured by coder reliability and rates of usable data, (2) valid measurement of red flags, as demonstrated by consistency between observed behavior and reports on parallel M-CHAT-R/VL-3 items, and (3) higher base rates of atypical behavior in NGS. We used nonparametric Fisher's exact tests to compare rates of feasibility, consistency, and atypical behavior.

Results: Average coding agreement across paired raters reached 81% (GAC Kappa=.80). LR and NGS groups did not differ by rates of unusable data codes across DAP tasks (insufficient behavior and out-of-view), with the exception of greater out-of-view presses in the LRC group during Joint Attention (30%; NGS=6%; p=.042). Most DAP task responses did not correspond to M-CHAT-R/VL-3 skills, with the exception that Peekaboo related to VL-3 (84% with typical DAP and VL-3; 50% with atypical DAP and VL-3; p=.065). In this preliminary sample, groups did not differ in their behavioral responses on DAP tasks (Figure 1).

Conclusions: Our results suggest PANDABox is a feasible method for examining "red flags" for autism in geographically-dispersed cohorts; work is needed to inform the validity relative to gold-standard protocols. Both groups demonstrated similar proportions of usable data across DAP tasks; however, behaviors did not demonstrate expected associations with caregiver-reported skills. This is consistent with reports that caregiver-reported symptoms contain valuable input for diagnostic evaluations but frequently differ from behavioral data (Sikora et al., 2007). We also did not find differences in atypical behavior across groups. Next steps will examine group differences in DAP responses and associations with clinical diagnoses in larger, representative samples.

441.003 *(Poster)* Characterizing Repetitive Behaviors in Fragile X Syndrome across the Lifespan: The Impact of Age, IQ, Gender, and Comorbid Autism Spectrum Disorder

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Background: Fragile X syndrome (FXS) is the leading heritable cause of intellectual disability that presents with a variable clinical phenotype, typically affecting males with the full mutation more than females. FXS is characterized by mild to severe ID with a series of other deficits including social communication deficits and restricted, repetitive behaviors (RRBs) resulting in high comorbid rates of autism spectrum disorder (ASD). Literature is limited on the specific RRB profile found in FXS across the lifespan. Verbal perseverations in boys with FXS is a hallmark feature of the FXS behavioral phenotype[1,2,3]. Increased rates of restricted interests, stereotyped, self-injurious, sensory motor, and sameness behaviors have been reported in FXS[4,5,6]. Characterizing the RRB profile specific to FXS is important for understanding the neurological underpinnings and behavioral mechanisms of RRBs that can affect behavioral and pharmacological treatments.

Objectives: This study utilizes a large, chronologically diverse sample of FXS participants to characterize the effects of age, IQ, gender, and comorbid ASD on RRBs and RRB subtypes.

Methods: Participants included 119 individuals with FXS (74% male) ranging from 3 to 50 years of age (M=17.26, SD=11.02). Caregiver report of participants' RRBs was obtained using the Repetitive Behavior Scale – Revised (RBS-R)[7]. The RBS-R consists of six subscales that combine to create a total score. Participants' IQ was obtained using the Stanford-Binet Intelligence Scales, Fifth Edition (SB-5)[8]. Participants' current ASD diagnostic status was obtained via clinician report (42% with a clinical ASD diagnosis). Current data come from two collection sites. A third site will be included at the time of the presentation.

Results: A regression revealed a significant relationship between RBS-R total score and age, F(1, 117)=11.44, p=0.001. Participant's RBS-R total score decreased 0.48 for each year of age. Pearson correlations revealed significant negative associations between age and the following subscales: Stereotyped Behavior, Routine Behavior, Sameness Behavior, and Restricted Behavior. A regression revealed a significant relationship between RBS-R total score and IQ, F(1, 100)=12.53, p=0.001. Participant's RBS-R total score decreased 0.39 for each IQ point. Pearson correlations revealed significant negative associations between age and all of the RBS-R subscales. Controlling for IQ, an ANCOVA revealed no significant group differences on RBS-R total score based on gender, F(1, 93)=0.13, p=0.719. An ANOVA revealed significant group differences on RBS-R total score based on current ASD diagnostic status F(1, 84)=29.18, p=0.000. Participants with a comorbid ASD diagnosis (M=36.86, SD=2.60) had higher RBS-R total scores in comparison to participants without a comorbid ASD diagnosis (M=18.46, SD=2.20). These findings remain across each subscale on the RBS-R (ps<0.01).

Conclusions: Findings suggest RRBs tend to decline with age and are more severe with lower IQ. Unexpectedly, rates of RRBs did not differ by gender, even when controlling for IQ, despite common gender differences found in FXS. Lastly, despite majority of the sample not having a comorbid clinical diagnosis of ASD, those with ASD experience more severe RRBs. Results build on the evidence that RRBs are specific to the FXS behavioral phenotype, with more severe RRBs potentially differentiating those with and without ASD.

441.004 *(Poster)* Differences in Resting State Alpha Power between LGD Mutations, Idiopathic ASD, and Typically Developing Individuals

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Background: Electroencephalography (EEG) oscillations have been used as a biomarker to assess cognitive processes and functioning. Specifically, alpha rhythms (oscillations ranging from 8-12 Hz) are associated with attention and sensation (Bernard & Gage, 2013; Garcia-Rill, 2015; Kropotov, 2009). These correlates of alpha make it a possible biomarker for Autism Spectrum Disorder, as ASD is associated with atypical sensory processing (Linke et al., 2017). Differences in alpha power occur during resting state (Wang et al., 2013) and imitation tasks (Bernier, Aaronson, & McPartland, 2013) between typically developing (TD) and ASD populations. Additionally, advances in genomics highlight the importance of taking a 'genetics-first' approach for research in subgroups of the ASD population, such as *Likely* Gene Disrupting (LGD) mutations, hindered protein function resulting from single allele damage (Iossifov et al., 2014). Phenotypic heterogeneity (Stessman, Bernier, & Eichler, 2014; Iossifov et al., 2014; Goin-Kochel, Trinh, Barber, & Bernier, 2017) and unique neurophysiological differences exist among those with LGD mutations (Hudac et al., 2017), thus warranting further investigation on individual differences among LGD mutation carriers.

Objectives: We sought to characterize alpha rhythm differences related to various genetic etiologies of ASD.

Methods: Data from 204 children (see Table 1) were included in analyses in three groups: 66 children with ASD but no known genetic etiology (ASD No Event group), 57 children with an ASD diagnosis and a likely-gene disruptive mutation to an ASD-risk gene (LGD mutation group), and 81 typically-developing children (TD group). A resting state EEG paradigm, displaying randomly selected screensaver-like videos of various shapes and colors were presented for two and a half minutes (16 trials per block) to participants as they were instructed to attend to the presentation monitor with their eyes open. Each child's peak alpha rhythm within the 8-12 Hz range was extracted from 8 different bilateral regions (see Figure 1) and included in linear mixed-effects analyses. A full factorial model included genetic group, region, and sex as predictors of alpha rhythm.

Results: Results indicated a significant group x region interaction, $F(1,14) = 9.08$, $p <. 0001$, that highlighted group differences at medial central (MC) electrode locations. Specifically, the LGD mutation group exhibited more alpha rhythm than the ASD No Event group, $p = .042$, and the TD group, $p = .033$. There were no differences between ASD No Event and TD group in this region, $p = .99$. However, this pattern was observed for females, p's < .0007, but males with an LGD mutation exhibited comparable levels of MC alpha rhythm to ASD No Event and TD groups , p's > .70 (Figure1).

Conclusions: Our results introduce sex differences in alpha power among those who carry an LGD mutation, but contradicts previous evidence of differing neural expression between males and females with ASD (Werling & Geschwind, 2013). Current findings suggest further research on sex-differential genetic and neurophysiological factors among the LGD mutation population with ASD. Future studies should focus on differences in alpha power between sex and various LGD mutations associated with ASD.

441.005 *(Poster)* Does a Dietary Intervention Affect Metabolic and Behavioral Phenotypes of the Autism-Associated 3q29 Deletion?

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Background: 3q29 deletion syndrome (3q29Del) is caused by a rare (~1:30,000) 1.6 Mb heterozygous deletion on chromosome 3 and is associated with a wide range of neurodevelopmental and neuropsychiatric phenotypes, diminished growth, and other physical features. Individuals with 3q29Del have significantly reduced birth weight compared to matched controls (15.04oz difference, p=1.5E-6); in Emory University's 3q29Del mouse model, a growth deficit persists throughout development (1.81g difference, 8% of body weight, p=8.8E-12). The consistency of this phenotype, and the presence of four mitochondria- or metabolism-associated genes within the 3q29 interval, suggests there may be an unidentified metabolic defect in 3q29Del.

Objectives: This study utilizes our mouse model of the 3q29 deletion to characterize the 3q29 deletion-associated growth defect mechanism and implements a postnatal dietary manipulation to determine whether metabolic or behavioral phenotypes are affected.

Methods: We used a mouse model of the 3q29 deletion created by Emory 3q29 Project investigators using CRISPR/Cas-9 technology. Adult C57Bl/6 wild type (WT) and 3q29 mice on standard chow (13% calories from fat) were subjected to indirect calorimetry and liver samples were collected for untargeted metabolomics ($n^3$8/group). These experiments were repeated in mice on a high-fat diet (HFD; 42% calories from fat); growth curves were also constructed for HFD mice and a behavioral battery was performed on a subset of HFD mice. All experiments included males and females.

Results: Via untargeted metabolomics, palmitoylcarnitine was significantly increased in liver of 3q29 animals on standard chow after adjusting for sex (p<0.05, FC=0.314). In stratified analyses, phosphatidate was significantly increased in female mutants versus WT (p=0.02, FC=1.997), with males showing a similar trend (p>0.05). Pathway enrichment analysis identified fatty acid metabolism pathways as enriched for significant metabolites (p<0.05). In metabolic cages, there were no differences between 3q29 and WT mice on standard chow for food and water consumption, activity, and energy expenditure ($n^3$8/group). Preliminary results indicate feeding mice a HFD reduces the 3q29 deletion-associated weight deficit (1.67g difference, 4.8% of body weight, p=0.0005), and metabolic cage data shows that HFD female 3q29 mice have significantly reduced respiratory exchange ratio (RER) peaks (p<0.006, n=10/genotype). Untargeted metabolomics on HFD liver will assess altered metabolic pathways, dietary fat absorption will be quantified for WT and 3q29 mice, and behavioral testing will identify behavioral changes resulting from the HFD intervention.

Conclusions: Metabolic cage data from mice fed standard chow confirm that the 3q29Del-associated weight deficit is not due to decreased feeding or increased energy expenditure, and instead likely results from altered metabolism. Metabolomics data indicates that the 3q29 deletion-associated weight deficit may be due to an alteration in fatty acid metabolism. Growth curves from the HFD mice suggest that increasing dietary fat calories can partially ameliorate the weight deficit in 3q29 deletion mice. Reduced RER peaks in HFD female 3q29 mice indicate that 3q29 mice are preferentially utilizing lipids as a primary energy source. Taken together, these data shed light on the nature of metabolic phenotypes in 3q29Del, and may highlight metabolic pathways relevant to autism, intellectual disability, and other neurodevelopmental and neuropsychiatric phenotypes.

441.006 *(Poster)* Nonverbal Communication in Children with FOXP1 Syndrome

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Background: FOXP1 syndrome is a rare neurodevelopmental disorder caused by mutations and deletions in the Forkhead-Box P1 (FOXP1) gene. Previous studies identified FOXP1 as a common single-gene cause of autism spectrum disorder (ASD). In addition to ASD traits, language deficits are reported in all documented cases and include delayed acquisition of speech, varying levels of speech complexity (nonverbal to fluent speech), and significant articulation problems. Intellectual disability, motor delays, hypotonia, and externalizing psychiatric symptoms are also commonly reported. Given known expressive language deficits, understanding nonverbal communication in this population may offer critical insight into the influence of FOXP1 mutations on communication skills more broadly.

Objectives: To examine clinician-rated nonverbal communication skills in children with FOXP1 syndrome.

Methods: Sixteen children with mutations in FOXP1 (12 female; ages 3-11; 25% ASD) received autism-focused evaluations using gold-standard diagnostic tools including the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2). The ADOS-2 was administered to all participants by research reliable clinical psychologists. Five children received a Module 1, eight children received a Module 2, and three children received a Module 3. Nonverbal ADOS-2 items that overlapped across modules were selected for analyses: (1) use of gestures, (2) eye contact, and (3) facial expressions. Given differences across modules in scoring criteria for these items, all scores were dichotomized to reflect intact (score=0) or impaired (score³1) skills. A nonverbal communication composite score was also calculated. Relationships between nonverbal communication skills and DSM-5 consensus diagnosis based on psychiatric evaluation, ADOS-2, and the Autism Diagnostic Interview-Revised (ADI-R) were explored

Results: Participants' use of nonverbal communication skills varied across skills measured (see Figure 1). During the ADOS-2, 66.7% of participants demonstrated appropriate use of modulated eye contact. The majority of the sample (80.0%) presented with reduced use of gestures and approximately half (46.7%) exhibited a limited range and/or poorly directed facial expressions. Chi-square tests revealed that participants' use of eye contact (χ^2 (1, N= 16) = 4.26, p=.04) and facial expressions (χ^2 (1, N= 16) = 4.78, p=.03) significantly correlated with ASD consensus diagnosis. There was no significant relationship between use of gestures and ASD consensus diagnosis (χ^2 (1, N=16) = 1.36, p=.24). A composite score based on all three measures of nonverbal communication was moderately correlated to ASD consensus diagnosis (r=.640, p=.01).

Conclusions: Children with FOXP1 syndrome presented with a range of nonverbal communication skills during the ADOS-2. Eye contact was preserved in the majority of participants, although use of facial expressions and, to a greater degree, gestures, was notably limited. While children with limited use of facial expression were more likely to meet DSM-5 diagnostic criteria for ASD, use of gestures was not significantly correlated with ASD consensus diagnosis. Limited use of gestures may be related to high rates of motor delays and hypotonia, rather than an underlying social communication deficit. These findings have meaningful implications for the evaluation and treatment of social communication deficits in children with FOXP1 syndrome. Future studies should include additional assessments to assess the impact of FOXP1 on nonverbal communication skills.

441.007 *(Poster)* Predicting Change in Autism Symptomatology in Young Males with Fragile X Syndrome

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Background: Fragile X syndrome (FXS) has the highest penetrance of any single gene disorder implicated in ASD, with 60-75% of individuals meeting criteria for ASD and upwards of 90% exhibiting at least one symptom. Little is known about the stability of ASD diagnoses in young children with FXS, and how symptom trajectories are related to diagnostic stability.

Objectives: The present study aims to utilize the Brief Observation of Social Communication Change (*BOSCC*) to measure change in autism symptomatology in young males with FXS. Two research questions were proposed, 1) What are the stability patterns of ASD in young males with FXS?, 2) Do patterns of change in autism symptomatology differ in young males with FXS dependent on their clinical best estimate diagnosis of ASD, and the stability of that diagnosis?

Methods: Participants included 28 males with FXS between 2-8 years. Participants are a subset of a parent study that conducted diagnostic assessments using the *ADOS-2*, at 2, 3, 4 and 5 years of age, with some variability at the age of enrollment. Clinical best estimate diagnoses of ASD were determined at each visit to track stability. For inclusion in the present study, participants were required to have at least 2 video recorded diagnostic assessments with the *ADOS-2* (range 2-4). Select video clips from the *ADOS-2,* designated by the authors of the *BOSCC*, were combined to create video segments that were coded and scored using the *BOSCC* codes. Participants were grouped based on the stability of their ASD diagnoses. Multilevel models were used to examine longitudinal trajectories of *BOSCC* total scores.

Results: Regarding diagnostic stability, 75% of the participants demonstrated stable positive or negative ASD diagnoses (Stable ASD; n =15 and Stable noASD; n=6), and 25% demonstrated unstable diagnoses (i.e., Unstable ASD (i.e., false negative, n=4) and Unstable noASD (i.e., false positive, n=3)). On average, participants in the Stable ASD group had initial BOSCC scores at 24 months of 31.64 (t = 14.40, p = 0.00) which were higher than the Stable NoASD group (b = -16.49, p = 0.00), and Unstable ASD group (b = -9.86, p = .034), but not different from the Unstable NoASD group (b = 0.68, p = .924). Slopes did not differ between the Stable ASD group and the Stable NoASD or Unstable ASD groups. However, Unstable NoASD participants evidenced a negative slope (b = 0.42, p = .065).

Conclusions: Results suggest that 75% of young males with FXS display a high degree of stability in ASD diagnostic categorization for both the presence and absence of ASD. Young males with FXS and stable ASD display the most severe symptomatology, with symptom levels remaining high across time. In a parallel pattern, participants with a stable diagnosis of FXS noASD, evidence much lower levels of autism symptomatology at 24 months with symptoms remaining low and stable over time. In contrast, the Unstable noASD participants display similar levels of ASD symptoms to the Stable ASD group at 24 months, however show a significant improvement in symptoms over time.

441.008 *(Poster)* Psychiatric Features of Children and Adolescents with Phelan-McDermid, ADNP, FOXP1, and DDX3X Syndromes

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Background: Deletions and mutations in the SHANK3, ADNP, FOXP1, and DDX3X genes represent four common single-gene causes of autism spectrum disorder (ASD) and/or intellectual disability (ID). All four syndromes are characterized by significant impairments in cognitive, language, and motor functioning. Comorbid psychiatric features are also present, although poorly characterized in existing literature.

Objectives: To examine the psychiatric profiles of individuals with Phelan-McDermid (SHANK3), ADNP, FOXP1, and DDX3X syndromes.

Methods: Caregivers of 34 participants with Phelan-McDermid syndrome (PMS; 16 females; ages 3-17, 73.5% ASD), 19 participants with ADNP syndrome (8 females; ages 2–17; 57.9% ASD), 17 participants with FOXP1 syndrome (11 females; ages 2–17; 23.5% ASD), and seven participants with DDX3X syndrome (7 females; ages 4–16; 57.1% ASD) completed an age-appropriate version of the Child Behavior Checklist (CBCL). Overlapping scales between the two versions were included in analyses. The CBCL is a standardized caregiver-report questionnaire used to obtain information about the behavioral, social, and emotional functioning. The CBCL produces empirically-based syndrome scales (e.g., Attention Problems, Anxious/Depressed, Aggressive Behavior) and DSM-oriented scales (e.g., Attention Deficit/Hyperactivity Disorder, Anxiety, Oppositional Defiant Problems). *T*-scores≥65 represent clinically significant symptomatology.

Results: Within the PMS group, all participants scored within normal limits on the overall externalizing symptoms domain, although clinically significant Attention Problems (55.9%) and ADHD symptoms (29.4%) were reported. In the area of internalizing symptoms, 9.7% of participants scored in the clinically significant range overall. The most prominent internalizing symptoms included Withdrawn/Depressed (32.4%) and Depressive Problems (35.3%).

In the ADNP syndrome group, 47.4% reported clinically significant externalizing symptoms and 15.8% reported clinically significant internalizing symptoms. Externalizing symptoms included Attention Problems (68.4%), ADHD (52.6%), Aggressive Behavior (47.4%), and Oppositional Defiant Problems (21.1%). Internalizing symptoms included Depressive Problems (31.6%), Somatic Complaints (26.3%), Withdrawn/Depressed (21.1%), and Anxiety (15.8%).

Within the FOXP1 syndrome group, 35.3% of participants scored within the clinically significant range on the externalizing symptoms scale and <1% on the internalizing symptoms scale. Clinically significant externalizing scores included Attention Problems (82.4%), ADHD (64.7%), Aggressive Behavior (29.4%), and Oppositional Defiant Problems (23.5%).

In the DDX3X syndrome group, both externalizing and internalizing symptoms were reported by 28.6% of caregivers. Externalizing symptoms included Attention Problems (57.1%), ADHD (71.4%), and Aggressive Behavior (28.6%). Internalizing symptoms included Withdrawn/Depressed (42.9%) and Depressive Problems (42.9%). No participants fell in the clinically significant range on the Anxiety scale.

Conclusions: With regard to externalizing symptoms, caregiver-reports across the four syndromes revealed clinically significant attention problems in over half of the participants in each group. Aggressive behavior was prominent in the ADNP group, although present in a subset of individuals with FOXP1 and DDX3X syndromes. Clinically significant internalizing symptoms, such as withdrawal and depression, were reported in a substantial proportion of participants with ADNP, DDX3X, and Phelan-McDermid syndromes. Results suggest that proper evaluation and management of psychiatric comorbidities in children and adolescents with genetic conditions associated with ASD and ID is critical. Further research in this area is necessary to better understand the behavioral health needs of these understudied populations.

441.009 *(Poster)* Psychopathological Profiles across Individuals with PTEN Mutation

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Background: Autism spectrum disorder (ASD) is an etiologically and phenotypically heterogeneous disorder. It has been suggested that focusing on individuals who share a common genetic etiology holds promise for improving our understanding of symptom etiology, and informing the development of targeted treatments. Although evidence of a relationship between germline heterozygous *PTEN* mutations and ASD is well established, a significant knowledge gap exists in terms of the impact on the expression and fine-grained profile of psychopathology symptoms and disruptive behaviors. Importantly, limited progress has been made towards understanding whether *PTEN* mutation with or without ASD is associated with specific co-morbidity profiles when compared to idiopathic ASD.

Objectives: To compare: (1) concurrent psychopathology profiles across individuals with *PTEN* mutation with no ASD (PTEN-No ASD), *PTEN* mutation with ASD (*PTEN*-ASD) and ASD with macrocephaly but no *PTEN* mutation (macro-ASD) groups using the Child Behavior Checklist (CBCL) and the Aberrant Behavior Checklist (ABC); and (2) the trajectory of psychopathology symptoms and disruptive behaviors across the patient groups.

Methods: Sample included 28 individuals with *PTEN* no ASD (10 females; M_{age}= 9.19 years, *SD*= 4.91), 43 with *PTEN*-ASD (9 females; M_{age}= 11.79 years, *SD*= 5.34), and 33 with macro-ASD (5 females; M_{age}= 9.21 years, *SD*= 4.72). The CBCL and the ABC were completed by parents at 6 month intervals to explore outcome variable trajectories.

Results: There were significant group effects for both CBCL (Internalizing: *F*= 4.67, *p*= .012; Externalizing: *F*= 8.64, *p*< .001) and ABC (Irritability: *F*= 3.29, *p*= .042; Lethargy: *F*= 7.80, *p*= .001; Stereotypy: *F*= 7.48, *p*= .001; Hyperactivity: *F*= 3.74, *p*= .028; Inappropriate Speech: *F*= 3.55, *p*= .033) subdomain scores. Post-hoc comparisons indicated that for CBCL, *PTEN* no ASD group had significantly lower Externalizing and Internalizing scores than *PTEN*-ASD group (*p*= .01 and .003 respectively) and significantly lower Externalizing scores than macro-ASD group (*p*= .001). For the ABC subscales, *PTEN* no ASD group had significantly lower scores for Lethargy (*p*= .001), Stereotypy (*p*= .002), and Inappropriate Speech (*p*= .04) than *PTEN*-ASD group and significantly lower Irritability (*p*= .037), Lethargy (*p*= .004), Stereotypy (*p*= .003) and Hyperactivity (*p*= .028) than macro-ASD group. CBCL or ABC subscale scores did not differ for *PTEN*-ASD and macro-ASD groups. Generalized Linear Modelling showed that CBCL scores were largely stable, with the exception of a significant increase in Internalizing scores for *PTEN*-ASD (*F*= 29.92, *p*< .001) and *PTEN* no ASD (*F*= 18.80, *p*= .001) groups from baseline-6 months. Similar observations were observed in Externalizing scores for macro-ASD (*F*= 4.66, *p*= .044) and *PTEN* no ASD (*F*= 9.25, *p*= .008) groups. ABC subscale scores were mostly stable with the exception of baseline-6 months increase in the Irritability (*F*= 7.44, *p*= .013) and Hyperactivity (*F*= 8.95, *p*= .007) subscales in macro-ASD group.

Conclusions: Our findings provide evidence of specific behavior profiles across *PTEN* no ASD, *PTEN*-ASD, and macro-ASD groups, and shed light on symptom trajectories and disruptive behavior patterns. These findings are important for informing assessment and treatment approaches across these groups.

441.010 *(Poster)* Relationship between Ethnicity, SES, and the Time between First Developmental Concern and Diagnosis of an ASD-Linked Genetic Event

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Background: Individuals with Autism Spectrum Disorder (ASD) & related genetic disorders may experience disparities in accessing various medical services due to their ethnicity and socio-economic status (SES), including access to genetic testing and research (Sankar et al., 2004; Shaw, 2014), genetic counseling (McGrath et al., 2009), and diagnostic treatment services for ASD (Begeer et al., 2009; Broder-Fingert et al., 2013). Concerns about atypical development are often raised within the first year of life for children with ASD (Baio et al., 2018), but diagnosis is consistently delayed for lower-SES and non-White families (Fountain, King, & Bearman, 2011; Mazurek et. al, 2014). Disparities in access to genetic testing have been documented for genetic disorders including ASD (Case et al., 2007), yet it is currently unknown whether individuals with single-gene events associated with ASD experience similar disparities.

Objectives: Investigate the impact of ethnicity and income on time between age of first parental concern to age of genetic diagnosis among individuals with an identified genetic event causally linked to ASD.

Methods: Ninety-five participants with a known ASD-associated single gene disruption were included in analyses. Self-reported ethnicity and household income were derived from a background history assessment. Participants endorsing ethnicity other than White/Caucasian (n = 15) were coded as “Non-White.” Age of parents’ first developmental concern was derived from the ADI-R (Rutter, LeCouteur, & Lord, 2008) and age of genetic diagnosis was derived from the genetic report. Elapsed time between age of first parental concern and age of genetic diagnosis was calculated and compared between ethnic groups using a *t*-test. Chi-square analyses were used to investigate relationships between income & ethnicity, and linear regression was used to determine whether ethnicity predicted time between first concern and diagnosis after controlling for IQ.

Results: White and non-White participants did not differ significantly in time between first concern and genetic diagnosis, t (92)= .33, p =0.65 (see Table 1), even after controlling for IQ , $R^2 = 0.06$, $F(2,69) = 0.22$, $p = .81$. Ethnic groups did not differ by SES , $X^2(7) = 11.17$, $p = 0.13$. Importantly, the analyzed cohort was predominantly White (n = 83) and positively skewed (s = 1.09) as compared to the non-White group (n = 15, s = 0.16).

Conclusions: Time between first parental concern and genetic diagnosis did not significantly differ between White & non-White individuals with disruptive events in high confidence ASD-associated genes. Notably, the sample includes over five times as many White participants as compared to non-White participants. Given that risk of de novo genetic variants related to ASD is influenced by biological factors rather than ethnicity or SES (Cuna-Hidalgo, Veltman, & Hoischen, 2016), findings likely reflect differences in access to and participation in genetic research. SES is a powerful driver of disparities in care (LaClair et al., 2019), and no differences in household income were found in this sample. Future research must address differential access to clinical research before conclusions can be drawn regarding disparities in time from concern to diagnosis for individuals with ASD-associated genetic events.

441.011 *(Poster)* Seizure Onset, Intractability, and Developmental Outcomes Among Individuals with SCN2A or DYRK1A Mutations

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Background: Mutations to *SCN2A* or *DYRK1A* are associated with autism spectrum disorder (ASD), intellectual disability (ID), and seizures, but the mechanisms by which these mutations contribute to neurodevelopmental disabilities and seizures differ notably (Earl et al., 2017; Sanders et al., 2018). *SCN2A* encodes the neuronal sodium channel NaV1.2, and mutations to *SCN2A* can lead to infant or childhood onset seizures according to their impact on NaV1.2 activity (Sanders et al., 2018; Wolff et al., 2017). In contrast, *DYRK1A* encodes for a kinase involved in phosphorylation and mutations to *DYRK1A* impact multiple aspects of neuronal development (Dang et al., 2018). Among individuals with *DYRK1A* mutations, febrile seizures in infancy often progress to generalized tonic-clonic seizures (Ji et al., 2015). Early seizure onset and seizure intractability generally contribute to poorer developmental outcomes (Thompson & Duncan, 2005; Vasconcellos et al., 2001), but these associations have not yet been examined in individuals with mutations to *SCN2A* or *DYRK1A*.

Objectives: To determine if associations between age of seizure onset, intractability, and cognitive and adaptive outcomes vary between *SCN2A* and *DYRK1A* mutation groups.

Methods: Participants are individuals with a pathogenic or likely pathogenic mutation to *SCN2A (n* = 19, *M* age = 7.18 years) or *DYRK1A (n* = 26, *M* age = 9.77 years). Caregivers reported on seizure history, age of seizure onset, and whether seizures had been described as intractable (occurring at high frequency or medication resistant). IQ was measured using the Differential Abilities Scale-II (Elliott, 2007) or the Mullen (Mullen, 1995), and adaptive behavior was measured using the Vineland-II (Sparrow, Balla, and Cicchetti, 2005) or Vineland-III (Sparrow, Cicchetti, & Saulnier, 2016). Chi-square and t-tests were conducted to assess whether seizure prevalence, onset, and intractability differed across mutation groups, while bivariate correlations and t-tests were conducted to determine whether age of onset and intractability were associated with cognitive and adaptive skills within each group.

Results: 69% of participants with a *DYRK1A* mutation and 89% of participants with a *SCN2A* mutation had a history of seizures; seizure prevalence did not differ between groups. Age of non-febrile seizure onset ($t(44) = 4.47$, $p = .02$) and intractability ($X^2(2) = 8.09$, $p = .004$) differed between groups, with the *SCN2A* group demonstrating earlier seizure onset and higher intractability. Age of onset was not associated with verbal IQ, nonverbal IQ, or adaptive behavior among individuals with *SCN2A* or *DYRK1A* mutations. Intractability was not related to cognitive or adaptive skills for individuals with *SCN2A* mutations; intractability analyses for *DYRK1A* were not completed as only one participant's seizures were described as intractable.

Conclusions: Seizures in individuals with *SCN2A* mutations have earlier onset and greater intractability than in those with *DYRK1A* mutations, which likely reflects the impact of *SCN2A* mutations on sodium channel functioning, which has a strongly established connection to seizure activity. No significant associations between seizure onset or severity and cognitive or adaptive skills were identified across groups, suggesting that alternate mechanisms might be contributing to variability in developmental outcomes for individuals with mutations in *SCN2A* or *DYRK1A*.

441.012 *(Poster)* Social Activity Monitoring Among Carriers of Disruptive Mutations to DYRK1A

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Background: Disruptive mutations to *DYRK1A* are associated with ASD (O ' Roak et al., 2012) and samples of *DYRK1A* mutation carriers show ASD diagnostic rates as high as 88% (Van Bon et al., 2016). *DYRK1A* haploinsufficiency results in a unique clinical phenotype marked by microcephaly, dysmorphic features, medical conditions, intellectual disability, and language delays (Ji et al., 2015), a profile which may represent a genetically-defined subtype of ASD (Earl et al., 2017). Although previous work demonstrates a categorical association between disruptive *DYRK1A* mutations and ASD diagnosis, work is needed to quantify behavioral symptoms shared with the canonical ASD phenotype, such as atypical patterns of attention to social agents during activities (Shic et al., submitted). However, the clinical profile of *DYRK1A* poses a challenge for traditional behavioral assessment. Eye-tracking technology provides a sensitive, noninvasive, and low-demand measurement of attention to social interactions and activities.

Objectives: We sought to quantify social activity monitoring among carriers of disruptive mutations to *DYRK1A* compared to carriers of likely gene-disrupting mutations to other known ASD-risk genes and individuals with idiopathic ASD.

Methods: Data from individuals with disruptive mutations to *DYRK1A* (DYRK1A, $n = 10$), likely gene-disrupting mutations to other known ASD-risk genes (LGDM, $n = 11$), and idiopathic ASD (iASD, $n = 12$) were included in these analyses. An eye-tracking paradigm measured patterns of visual attention to social scenes depicting two social agents engaged in a shared activity. Proportion scores of time visually fixating on specific areas of interest (AOIs: Head, Body, Shared Activity, and Background) were calculated for conditions in which the agents were looking at each other (i.e., mutual gaze) and both looking to the shared activity (i.e., activity-directed gaze). Linear mixed-effects analyses with random effects tested group differences in condition for each AOI.

Results: A main effect of group revealed that DYRK1A looked significantly less to the agents' heads compared to iASD, $F(2, 30) = 3.87$, $p = .032$. Group and interaction effects (p's $< .037$) revealed that iASD looked more at the shared activity compared to LGDM, $p = .0034$. Unlike other groups, DYRK1A looked more at the shared activity during the mutual gaze condition than the activity-directed gaze condition, $p = .0078$. The iASD group looked more to the shared activity during the activity-directed gaze condition compared to the LGDM group, $p = .031$. A main effect of condition revealed that all groups looked more at the body in the activity-directed gaze (vs mutual gaze) condition, $F(1, 138) = 4.17$, $p = .043$. There were no effects of proportion looking to the background, p's $> .091$.

Conclusions: Preliminary analyses revealed that carriers of disruptive mutations to *DYRK1A* showed markedly reduced patterns of visual attention to the heads of social agents while viewing an interactive social activity, particularly compared to individuals with idiopathic ASD. These preliminary results suggest that disruptive mutations to *DYRK1A* are associated with atypical patterns of social activity monitoring characteristic of the ASD phenotype, but may represent a uniquely diminished attentional pattern.

441.013 *(Poster)* Using EEG to Examine Brain Activity and Functional Connectivity in Phelan Mcdermid Syndrome (PMS) and Autism.

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Background: Phelan McDermid Syndrome (PMS) is caused by haploinsufficiency of the SHANK3 gene. Around 70-80% of PMS individuals have Autism Spectrum Disorder (ASD). EEG studies have highlighted differences in brain activity and functional connectivity associated with social (theta activity) and attentional (alpha activity) processing in ASD, but little is known about PMS.

Objectives:

- To investigate EEG power in theta (4-6hz) and alpha (7-10hz) bands within children with PMS, ASD, and typically developing (TD) controls whilst viewing social and/or object videos.
- To examine differences in functional brain connectivity between groups whilst viewing videos.

Methods: EEG was recorded from 12 PMS ($\bar{x}$ age = 10 years), 12 ASD ($\bar{x}$ age = 9 years), and 10 TD ($\bar{x}$ age = 4 years) children as they watched social and object videos (session = 4mins). Fast Fourier Transforms (FFTs) were computed using a Hanning window. Power values were logged and averaged. Mixed model ANOVAs of stimulus type (social and object) x Region of Interest (ROI) were conducted for theta and alpha bands seperately. Functional brain connectivity was computed on all trials (social + object) using debiased weighted phase lag indexes (dbwPLIs) averaged across all possible electrode combinations.

Results: Group differences in power were observed for both theta ($F_{(2,31)} = 9.558$, $p < .01$, $\eta_p^2 = .381$) and alpha ($F_{(2,31)} = 11.178$, $p < .001$, $\eta_p^2 = .419$). Post hoc tests for theta revealed reduced power in PMS and ASD vs. TD respectively at $p < .05$ (MD = -1.24, SE = .28; MD = -.6057, SE = .23). For alpha, PMS individuals elicited reduced power compared with ASD and TD groups respectively at $p < .05$ (MD = -.648, SE = .23; MD = -1.118, SE =.24). Interactions between ROI*stimulus type were found in both theta ($F_{(3,93)} = 3.196$, $p < .05$, $\eta_p^2 = .093$) and alpha ($F_{(3, 93)} = 4.154$, $p < .05$, $\eta_p^2 = .118$), although simple effects were ns.

Functional connectivity differed between groups within theta ($\chi^2_{(2)} = 8.169$, $p < .05$, $\eta^2 = 0.206$), with reduced connectivity in PMS ($\bar{x}$ = .0048, SD = .0050) versus TD ($\bar{x}$ = .0118, SD = .0114, $p < .01$), and marginally reduced connectivity in PMS versus ASD ($\bar{x}$ = .0142, SD = .0100, p = .058).

Functional connectivity also differed between groups within alpha ($\chi^2_{(2)} = 9.923$, $p < .05$, $\eta^2 = 0.264$), with reduced connectivity in PMS ($\bar{x}$ = .0064, SD = .0024) versus TD ($\bar{x}$ = .0164, SD = .0077, $p < .01$), and marginally reduced connectivity in PMS versus ASD ($\bar{x}$ = .0236, SD = .0234, p = .052).

Inspection of functional connectivity as a function of frequency (1-20hz) revealed no peak for the PMS children. Meanwhile, peaks within theta (10hz) and alpha (6hz) were observed for TD and ASD groups respectively.

Conclusions: On average, both PMS and ASD individuals showed reduced activity associated with social processing. However, PMS was characterized by reduced functional connectivity during social and attentional processing.

441.014 *(Poster)* Variability in Externalizing Behavior Problems Among Individuals with ASD-Associated Disruptive Mutations

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Background: Externalizing behavior problems are elevated among individuals with autism spectrum disorder (ASD; Bauminger, Solomon, & Rogers, 2010), but the biological and genetic mechanisms that influence externalizing behavior severity in ASD are not well understood (Ibrahim et al., 2019). Phenotyping individuals with disruptive single gene mutations associated with ASD may increase understanding of how genetic mechanisms influence externalizing behavior in ASD. Case series have noted elevated externalizing problems among individuals with mutations in specific ASD-associated genes (e.g., Siper et al., 2017), but rates and predictors of externalizing behavior have not been systematically reported or compared across gene groups. Individuals with mutations in ASD-associated genes also may exhibit factors associated with externalizing behavior severity in ASD, such as elevated ASD symptoms, adaptive behavior deficits, and gastrointestinal problems (Beighley et al., 2019; Hartley, Sikora, & McCoy, 2008; Jang, Dixon, Tarbox, & Granpeesheh, 2011; Neuhaus, Bernier, Tham, & Webb, 2018); variability in these factors could also influence externalizing behavior severity among individuals with ASD-associated mutations.

Objectives: To examine if externalizing behavior severity differs across ASD-associated mutation groups and whether differences persist after controlling for demographic, clinical, and medical factors.

Methods: 196 individuals (mean age = 7.25 years, 51% female) with a disruptive mutation to one of 14 ASD-associated genes were drawn from an ongoing genetics-first study and the Simons Variation in Individuals Project (Simons VIP Consortium, 2012). Caregivers completed assessments including the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001), the Vineland-II (Sparrow, Balla, and Cicchetti, 2005) or Vineland-III (Sparrow, Cicchetti, & Saulnier, 2016), the Social Responsiveness Scale-II (Constantino & Gruber, 2012), and a medical history interview. The Externalizing Problems CBCL T-score was used to measure externalizing severity. A one-way ANOVA was conducted to compare externalizing severity across gene groups, and a one-way ANCOVA was conducted to determine whether cross-gene differences remained significant after controlling for age, adaptive behavior, ASD symptom severity, and GI problems (severe constipation or diarrhea).

Results: Externalizing severity significantly differed across gene groups, $F(13, 182) = 4.20$, $p < .001$. 23% of participants had externalizing behavior problems in the clinically significant range; however, rates of clinically significant externalizing problems ranged from 0% to 100% across groups. Cross-gene differences in externalizing severity remained significant after controlling for ASD symptom severity, adaptive behavior, age, and GI problems, $F(13, 113) = 2.68$, $p = .003$. ASD symptom severity was significantly associated with externalizing severity, $F(1, 113) = 26.27$, $p < .001$; age, adaptive behavior, and GI problems were not associated with externalizing severity. Post-hoc pairwise comparisons (Bonferroni correction applied) indicated that after controlling for the above factors, cross-gene differences were driven by high externalizing in the *ADNP* and *FOXP1* groups and low externalizing in the *PACS1* group.

Conclusions: Externalizing behavior problems vary across ASD-associated mutation groups, with individuals with *ADNP* and *FOXP1* mutations displaying elevated externalizing severity as compared to individuals with mutations in other ASD-associated genes. Future research should examine genetic and environmental mechanisms that contribute to significant externalizing problems in these specific groups and across individuals with ASD-associated mutations.

Sensory Physiology

PANEL SESSION — **SENSORY PHYSIOLOGY**

219 - Brain Dynamics from Synapses to Systems: Bridging Rodents to Humans to Examine Brain Sensory Reactivity/Responsivity and How It Is Altered in Neurodevelopmental Conditions

Panel Chair: Grainne M. McAlonan, *NIHR-Biomedical Research Centre for Mental Health at the Institute of Psychiatry, Psychology and Neuroscience, South London and Maudsley Foundation NHS Trust, London, United Kingdom*

The panel will build from rodent studies of experience dependent plasticity to examine brain dynamics (including 'habituation') in response to ‘lower-order’ sensory and ‘higher-order’ social stimuli in individuals with and without autism spectrum condition (ASC). Dr Samuel Cooke will present preclinical work from his lab (King’s College London; KCL) interrogating the neuroscience of cortical plasticity and its relevance to neurodevelopmental conditions. Dr Jannath Begum Ali (Birbeck) will then report how infants with Neurofibromatosis Type 1, who have an elevated likelihood of developing ASC, process repeated low level auditory stimuli. Next, Dr Nicolaas Puts (Johns Hopkins) will describe how neuroimaging methods (edited MRS of GABA) and transcranial magnetic stimulation can be used to examine the relationship between neurotransmitter concentration, GABA-receptor function, quantifiable aspects of altered sensory perception, and clinical manifestations of ASD in ASC. Finally, Dr Nichol Wong (KCL) will present evidence for differences in the (5HT) neurochemical control of the temporal dynamics of limbic responses to facial emotions in adults with and without ASC. We suggest that these insights into brain dynamics of plasticity and stability and their relationship to sensory and social-cognitive function in ASC will both inform causal mechanisms and identify novel treatment targets in neurodevelopmental conditions.

219.001 *(Panel)* Biomarkers of Synaptic Plasticity, Cortical Inhibition and Neural Feedback Accompanying Habituation and Novelty Detection

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Background: Habituation enables organisms to suppress behavioural response to neutral stimuli and devote attention to elements of the environment that reward, punish or are novel and therefore have the potential to bring either. It is a fundamental form of cognition that is often disrupted in neurodevelopmental psychiatric disorders such as intellectual disability, autism and schizophrenia. Habituation is equally critical to mice and we have developed new assays to measure this foundational form of learning in mice, which afford a wide range of experimental approaches to deeply understand underlying processes.

Objectives: Here we describe our observations of response dynamics in primary visual cortex (V1) across different timescales of visual habituation, what we understand about the cellular and circuit origins of those dynamics and the results of interventions to disrupt them and observe the consequences for habituation.

Methods: We have used behavioural analysis in head-fixed mice, single unit recordings, local field potential recordings, electroencephalogram (EEG), optogenetics, chemogenetics and genetic knockdown.

Results: We have found that, during short-term visual habituation, thalamo-cortical synapses in primary visual cortex (V1) undergo depression, consistent with previous work. By contrast, long-term habituation is accompanied by paradoxical synaptic potentiation. Blockade within V1 of the NMDA receptor, and other canonical mechanisms of Hebbian synaptic plasticity, prevents learning and plasticity alike. Using local field potential (LFP) recordings and surface electroencephalogram (EEG) recordings in awake viewing mice (n = 27), we have now also identified a striking switching over the course of a few seconds between two cortical processing modes: The first of these modes is characterised by high voltage slow oscillations, which reflect neuronal bursting activity, and this emerges with stimulus familiarity. The second is characterised by high gamma oscillations, which require the activity of parvalbumin-expressing inhibitory neurons (PV+) and is driven by presentation of novel stimuli. Only during these gamma oscillations do animals distinguish novel and familiar stimuli, either physiologically or behaviourally. We now have multiple lines of evidence demonstrating a critical role for both PV+ neurons and feedback from cortex to thalamus in this gating of the detection of novelty. Finally, we present recent observations of disruptions of this visual cortical plasticity in a mouse model of Tuberous Sclerosis Complex (n = 12 per genotype), which is a neurodevelopmental disorder of defined genetic origin that often includes features of intellectual disability and autism.

Conclusions: Thus, a simple but fundamental form of cognition drives a variety of signals that are often aberrant in neurodevelopmental psychiatric disorders, and the mouse provides a system to deeply understand their origins and dysfunction. Based on our results, we also believe that the potential exists in the future to record these signals non-invasively using EEG from human populations for patient stratification and assessment of response to treatment.

219.002 *(Panel)* Early Differences in Auditory Processing in Infants with Neurofibromatosis Type 1

J. Begum Ali[1], *A. Kolesnik*[2], *T. Del Bianco*[3], *S. Garg*[4], *J. Green*[4], *E. J. Jones*[1] *and M. H. Johnson*[1], *(1)Centre for Brain and Cognitive Development, Birkbeck, University of London, London, United Kingdom, (2)Centre for Brain and Cognitive Development, Birkbeck University of London, London, United Kingdom of Great Britain and Northern Ireland, (3)Centre of Brain and Cognitive Development, Birkbeck College, University of London, London, United Kingdom, (4)University of Manchester, Manchester, United Kingdom of Great Britain and Northern Ireland*

Background: Neurofibromatosis Type 1 is a genetic disorder that results from a mutation of the NF1 gene on chromosome 17. The NF1 gene produces the neurofibromin protein that is responsible for regulating cell growth. Whilst NF1 presents with a number of physical symptoms, the condition has also been associated with neurodevelopmental disorders. For example, individuals with NF1 are five times more likely to receive an Autism Spectrum Disorder (ASD) diagnosis (Bilder et al., 2016) than the general population. Thus, prospective longitudinal studies of infants with NF1 may provide translational insights into the mechanisms that underpin symptom emergence.

Objectives: Here, we assessed neural habituation to repeated auditory stimulation in a group of infants with NF1 tested at 5 and 10 months. Habituation is a particularly important function as it is necessary to determine the level of processing that occurs for incoming sensory information. Research has demonstrated atypical habituation patterns in neurodevelopmental disorders such as Fragile X Syndrome and ASD (Ethridge et al., 2016; Guiraud et al., 2011; Gomot et al., 2006) and more recently in infants with later ASD (Kolesnik et al., 2018). If individuals cannot reduce the sensory response to repeated incoming stimuli (i.e., habituate), this may underpin core symptoms of ASD such as sensory hypersensitivity.

Methods: 30 infants with NF1 and 46 age-matched typically developing infants were assessed longitudinally at 5- and 10 months of age. Infants listened to 150 repetitions of trains of tones; a single 'train' was made up of three consecutive 'Standards', a /u/ vowel sound administered at 500Hz before a final 'deviant' sound. As we are particularly interested in the habituation process, current analysis focused on the 'Standards'. Each tone was presented for 100ms, with a 5ms rise and fall time and the inter-stimulus interval was jittered around 500ms. Neural activity was recorded over the whole scalp using a high density EEG array, with analysis focused on fronto-central regions of interest.

Results: Examining the mean amplitude of the auditory evoked potential in the first 200ms after stimulus onset, preliminary analysis showed that that the TL group demonstrated a reduction in amplitude between the first and second repetition of each stimulus at both 5 [$F(2,177)=17.79$, $p<.001$, $\eta_p^2=.23$] and 10 months of age [$F(2,231)=25.55$, $p<.001$, $\eta_p^2=.18$]. In comparison, infants with NF1 demonstrated this pattern of habituation only at 10 months [$F(179)=17.79$, $p<.001$, $\eta_p^2=.12$] of age; at 5 months, this group showed no evidence of habituation [$F(2,93)=6.58$, $p=.002$, $\eta_p^2=.12$] (see Figure 1).

Conclusions: Our findings show that infants with NF1 demonstrate developmental delays in the emergence of neural habituation to auditory stimuli. Further analysis will examine how individual differences relate to later diagnostic outcome. We discuss the potential cascading effects of these early differences with respect to how infants process, and engage with, the world around them.

219.003 *(Panel)* Using Multimodal Approaches to Study Altered Gabaergic Inhibition in Children with Autism Spectrum Disorder

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Background: Despite decades of study, the neurophysiological basis of ASD remains poorly understood. Multiple lines of evidence (e.g. mouse models, expression of GABA receptor genes, reduced interneuron density) suggest that γ-aminobutyric acid (GABA), the main inhibitory neurotransmitter in the brain, plays a role in the pathophysiology of ASD. However, it remains unclear how the GABA system is altered and how inhibitory dysfunction relates to the behavioral phenotypes in humans with ASD. Over the past years we have used edited Magnetic Resonance Spectroscopy (MRS) of GABA to measure brain GABA levels in vivo, Transcranial Magnetic Stimulation (TMS) to measure $GABA_A$ and $GABA_B$-receptor function, and behavioral psychophysics - linked to inhibitory function - to study inhibitory dysfunction in children with ASD.

Objectives: Here, we investigate the relationship between brain GABA levels, GABA-receptor function, sensory perception, and clinical ratings in children with ASD. We hypothesize that altered GABA function associates with psychophysical and clinical sensory abnormalities and comorbid ADHD.

Methods: In total, we included 103 children with ASD, 52 children with ASD + comorbid ADHD, 108 children with ADHD, and 210 typically developing children (TDC); 8-12 years old. *MRS*. GABA levels were measured over sensorimotor cortex (SM1) and thalamus using spectral editing (MEGA-PRESS and HERMES; TE/TR 68 & 80/2000 ms; 320 averages). *TMS.* Data were acquired using short- (SICI; 2.5 ms ISI, probing $GABA_A$) and long-interval intracortical inhibition (LICI; 100 ms ISI, probing $GABA_B$) paired-pulse TMS approaches. *Psychophysics* We measured static and dynamic detection threshold (probing feed-forward inhibition), amplitude discrimination (probing lateral inhibition) and temporal order judgement.

Results: We will give an overview of our data up to date including measures of GABA+, MM-suppressed GABA, and glutathione (preliminary) in children ASD. Our prior work shows children with ASD have reduced sensorimotor GABA levels, which predicts tactile abnormalities ($R = 0.54$, $p < 0.05$). Children with ASD show normal SICI (inhibition of motor evoked potentials, $p = 0.5$), but abnormal *modulation* of SICI ($p < 0.001$). Children with ASD show reduced LICI compared to TDC ($p > 0.05$) and LICI in ASD is not significantly different from 1 (no inhibition, $p < 0.01$). Tactile psychophysical measures show different patterns of abnormal perception between ASD and ADHD, which relate to disorder-specific (e.g. autism severity in ASD and ADHD severity in ADHD) and disorder-general (hyperresponsivity) dimensional ratings.

Conclusions: We show that GABA is affected at both the presynaptic and postsynaptic level in children with ASD. Reduced cortical GABA levels associate with altered behavioral performance. Children with ASD appear to show an absence of $GABA_B$-receptor driven inhibition (LICI), consistent with abnormal tactile detection threshold (linked to $GABA_B$ feedforward inhibition) and prior work linking altered $GABA_B$ receptor subunits to ASD. Children with ASD also show abnormal modulation of $GABA_A$ receptor function which may relate to inflexibility in neuronal processing. Tactile behavioral findings correlate with disorder-general and specific clinical measures. Imaging and psychophysics can provide important neurochemical and behavioral biomarkers for ASD, linking cortical function to behavioral outcome - key in developing biologically and potential patient-specific treatments.

219.004 *(Panel)* Citalopram Differentially Modulates the Temporal Dynamics of Negative Facial Emotion Activation in Adults with and without ASC

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Background: Facial emotion processing is often altered in autism spectrum conditions (ASC), but its biological basis remains poorly understood[1] and may include neurochemically mediated differences in the responsivity of key 'limbic' regions. Serotonin (5-HT) has been shown to be a key regulator of both facial emotion processing[2] and brain temporal dynamics[3], and 5-HT abnormalities have been consistently implicated in ASD[4]. However, to our knowledge, no-one has examined how 5-HT influences the temporal dynamics of facial emotion processing in ASC.

Objectives: Therefore, we compared the influence of an acute dose of the selective 5-HT reuptake inhibitor (SSRI) citalopram on the responsivity of the temporal dynamics during facial emotion processing in adults with and without ASC in a pharmacological-fMRI study.

Methods: 18 male adults with ASC and 21 age and IQ matched neurotypical male adults were included in the current randomised double-blind crossover study. Participants with ASC were diagnosed by consultant psychiatrists according to ICD-10 and all participants completed two MRI scanning sessions. They were given either 20 mg citalopram or placebo before scanning, during which an emotional face-matching task[5] was administered. The task asked the participants to respond to blocks of trials of angry/fearful faces and geometric shapes (**Figure 1A**). The preprocessed task-based fMRI data were analysed with a general linear model approach using FSL and block-wise beta of the limbic regions were retrieved for subsequent analyses.

Results: We found significant group×drug interaction effects in the temporal dynamics in amygdala, ventromedial prefrontal cortex and nucleus accumbens during processing of negative facial emotion in adults with and without ASC ($p_{corrected}<0.001$), where sustained activation after citalopram was only observed in adults with ASC (**Figure 1B**).

Conclusions: Serotonergic homeostatic control of the temporal dynamics in limbic regions is distinct in ASC.

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ORAL SESSION — SENSORY PHYSIOLOGY
325 - Sensory Responsiveness: Physiology and Behaviour

325.001 *(Oral)* Attenuated Pupillary Response Mediates Slower Reaction Time in Autism Spectrum Disorder

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Background: Attention is a central cognitive ability of selective information processing that is often measured as reaction time (RT) in behavioral tasks. Studies reported slower RT in Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD), which has been interpreted in both cases as altered attention by atypical arousal regulation. Phasic activity of the Locus Coeruleus – Norepinephrine (LC-NE) system is a promising underlying mechanism of arousal regulation, which has never been compared between ASD and ADHD. Phasic activity of the LC-NE system can be assessed by stimulus-evoked pupillary responses (SEPR).

Objectives: We compare attention performance between ASD and ADHD in an established reaction time task with concurrent assessment of pupillometry. We hypothesize attenuated SEPR to predict slower RT across groups and explore SEPR between groups. This would indicate atypical arousal regulation to contribute to atypical attention, which might be specific to ASD or ADHD.

Methods: We assessed 90 adolescents with either ASD (n=18, age=13.8/2.6[1], IQ=108/12, gender=2/16 [m/f]), ADHD (n=28, age=13.5/2.4, IQ=104/14, gender=3/25 [m/f]), ASD and comorbid ADHD (ASD+ADHD, n=13, age=12.2/2.8, IQ=103/15, gender=1/12 [m/f]), and neurotypical controls (NTC, n=31, age=14.4/2.7, IQ=111/14, gender=16/15 [m/f]). Participants completed a cued reaction time task ('fast task') while pupillometry was assessed by infrared remote eye-tracking. The task manipulates arousal regulation by two conditions: A baseline condition with a long foreperiod (8s) that is associated with lower arousal and a fast condition with a short foreperiod (1s) *and* rewards for fast reaction times that is associated with higher arousal. We applied three linear mixed models with (1) RT or (2) SEPR as dependent variable, ASD and ADHD as dummy-coded fixed effects, task condition as fixed effect, and fixed-effect interactions. We further included sex, age, and IQ as covariates. In a third model (3), SEPR was included as fixed effect with RT as dependent variable to investigate the mediation of RT differences between groups.

[1] Mean / SD.

Results: (1) We found RT differences between groups specific to conditions (βs < -0.14; *p*s < .002). Post-hoc contrasts indicated that all clinical groups showed slower RT in the baseline condition (baseline-fast contrast: ASD=216ms [203-229][2]; ADHD=217ms [206-228]; ASD+ADHD= 250ms [234-266]) compared to NTC (192ms [181-202]). (2) Only in ASD, we observed a lack of SEPR change between conditions (baseline-fast; -0.08 [-0.19 – 0.03]) compared to ADHD (-0.12 [-0.21- -0.02]), ASD+ADHD (-0.25 [-0.39 - -0.11], and NTC (-0.18 [-0.26 - -0.09]). (3) Inclusion of SEPR delivered a strong effect on RT across groups (β= -0.52 [-0.64 - -0.41] that mediated reaction time differences between groups in the baseline condition (*p*s > .07).

[2] 95% confidence intervals.

Conclusions: Full mediation (see figure 1) is only observed for ASD. A lack of SEPR change indicated atypical arousal regulation in ASD, but not in ADHD or ASD+ADHD. This supported atypical LC-NE phasic activity as underlying mechanism of slower RT specific to ASD without comorbid ADHD. We outlined that different mechanisms probably underly slower reaction times in ASD and ADHD. LC-NE phasic activity could represent a promising biomarker in future ASD research.

325.002 *(Oral)* Exploring Heterogeneity in Auditory Electrophysiological Responses of Young Autistic and Typically-Developing Children Using Hierarchical Clustering

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Background: Atypical autistic (AUT) sensory processing is related to quality of life (Lin & Huang, 2019), but attempts to investigate atypical sensory processing are complicated by the heterogeneity of AUT sensory features (Uljarević et al., 2017). Prior studies exploring AUT sensory heterogeneity have relied largely on caregiver-report questionnaires (DeBoth & Reynolds, 2017), which leave variability at the neural level unclear.

Objectives: The present study aims to explore clusters of AUT and typically-developing (TYP) participants defined on the basis of auditory ERP responses. AUT and TYP participants were clustered together to situate the diagnostic groups in relation to one another. While it is not clear that these data are strictly categorical rather than dimensional, imposing categories permits data exploration.

Methods: ERPs were examined in 130 AUT participants (110 male, M_{Age} = 38.50 months, SD_{Age} = 6.02; $M_{DQ\ (MSEL)}$ = 65.25, SD_{DQ} = 20.91) and 81 TYP controls (52 male, M_{Age} = 37.09 months, SD_{Age} = 6.46; M_{DQ} = 106.37, SD_{DQ} = 11.58). While watching a quiet video, participants heard, via headphones, brief complex tones randomly varying in loudness (50, 60, 70, or 80 dB SPL). 200-300 trials were collected in each loudness condition at an ISI randomly varying between 1-2s. 61-channel EEG was sampled at 1000 Hz and average-referenced. Second-Order Blind source Identification (SOBI; Belouchrani et al., 1997) was used to remove artefacts. To minimize variability from biophysical factors such as skull thickness, averaged ERP amplitudes were rescaled, separately for each participant and time point, such that each participant's highest amplitude in any channel or condition became 1 and the lowest became 0. Participants' rescaled data were then averaged, separately by condition, within seven topographical regions in consecutive 25ms windows between 51-350ms, and hierarchically clustered using Ward's method.

Results: Three clusters (C1-3) were defined. A late negativity, referred to in previous literature as the N2, had shorter latencies in C2 and seemed more delayed in C1; in C3, a positivity was observed in the N2 latency range. N2 responses were not always evoked by softer sounds. Though overlap of diagnostic groups was extensive, proportions of AUT and TYP participants varied across clusters, $\chi^2 = 6.84$, $p = .03$; there were more AUT participants than expected in C3, corrected $p < .05$. Among AUT participants, age also varied across clusters, Kruskal-Wallis $\chi^2 = 11.22$, $p = .004$; age was younger in C3 than C2, Wilcoxon corrected $p = .007$, or C1, Wilcoxon corrected $p = .02$. Among TYP participants, clusters varied in Noise Distress on the Short Sensory Profile (McIntosh, Miller, & Shyu, 1999; Williams et al., 2018), Kruskal-Wallis $\chi^2 = 6.35$, $p = .04$; post-hoc effects were nonsignificant after correction but scores appeared more typical in C2.

Conclusions: Disproportionately more and younger AUT participants displayed an unusual pattern of positive voltages fronto-centrally in lieu of the N2. TYP participants with clear, early N2 responses may be protected against experiencing noise distress. These inter-individual differences may caution against over-reliance on simple group comparisons in research.

325.003 *(Oral)* Heart Rate Responses to Aversive Sensory Stimulation and Their Relationship to Brain and Behavioral Markers of Sensory over-Responsivity

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Background: Individuals with autism spectrum disorder (ASD) commonly display sensory over-responsivity (SOR), which is associated with physiological and attention abnormalities (Leekam et al., 2007; Chang et al., 2012; Baranek et al., 2007) and atypical brain responses to aversive sensory stimuli (Green et al., 2015). Since most MRI studies include older, verbal participants, the neural mechanisms underlying SOR are not well understood among other ASD populations. Peripheral physiological measurements such as heart rate (HR) could provide a proxy of brain response for individuals unable to complete MRI scans. However, little is known about the relationship between physiological and neural responses to sensory stimulation in autism. We investigated both HR response (arousal) to sensory stimulation and orienting response, an initial decrease in HR following aversive stimulation, which allows processing of information prior to responding (Bradley, 2009).

Objectives: To investigate how HR responses (mean HR and orienting) during aversive sensory stimulation relate to 1) behavioral SOR severity and 2) fMRI response to the same stimulation.

Methods: Participants were 50 ASD (38M) and 31 TD (21M) youth aged 8-18. SOR severity was measured using tactile and auditory SOR subscales from the Short Sensory Profile and Sensory Over-Responsivity Inventory (Dunn, 1999; Schoen et al., 2008) to divide ASD participants into high or low SOR groups. Participants experienced six 15-sec blocks each of mildly aversive tactile, auditory, and joint (tactile+auditory) stimuli first during fMRI then outside of the scanner during HR measurement. Orienting response was calculated as the slope of the inter-beat interval (IBI) from 0-2 seconds of stimulation. Mean HR and orienting responses were averaged across stimuli then used to predict brain responses in whole-brain analyses (thresholded/corrected at $z>2.3/p<0.05$).

Results: There were no diagnostic group differences in mean HR controlling for HR baseline, but the ASD-high-SOR group had higher mean HR responses Higher mean HR was correlated with greater brain activation to sensory stimuli in primary visual cortex, lingual gyrus, and left frontal regions including middle frontal gyrus (MFG; Fig.1). ASD participants, particularly those with high SOR, showed less HR deceleration than TD participants, followed by increased HR acceleration, indicating high SOR is associated with reduced orienting response to aversive sensory stimulation. Reduced orienting response was associated with greater activation in lateral occipital cortex, lingual gyrus, left temporal regions, and left MFG (Fig.2).

Conclusions: Results suggest that higher mean HR and reduced HR deceleration (orienting) were related to SOR severity in youth with ASD. Both HR measures were also associated with fMRI response to aversive sensory stimulation in sensory cortical regions unrelated to the sensory stimulation, a pattern associated with SOR (Green et al., 2019), as well as regions implicated in reorienting to internal cues (MFG; Thiel et al., 2003). Deficits in initial regulated processing of sensory stimuli may increase subsequent arousal and reduce the ability to produce planned responses in individuals with SOR. Results have implications for using HR metrics to identify SOR and predict brain responses in individuals with ASD who cannot undergo MRI.

325.004 *(Oral)* Examining Gamma Oscillatory Response As a Marker of Disrupted Excitatory/Inhibitory Balance in Autism Spectrum Disorder and Phelan-Mcdermid Syndrome

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder behaviorally defined by a core set of features, including social communication deficits and restricted and repetitive behaviors. Sensory abnormalities are present in up to 90% of affected individuals. Phelan-McDermid syndrome (PMS) is a rare disorder caused by deletion or mutation of the *SHANK3* gene on chromosome 22. Over 80% of individuals with PMS meet diagnostic criteria for ASD. Neural oscillations are a key mechanism by which communication and synchronization occur within the brain, in turn driving coordinated cognition and behavior. Gamma band oscillations reflect GABAergic synaptic function, and alterations in the balance between inhibitory GABAergic and excitatory glutamatergic activity have been identified in ASD. *SHANK3* codes for a scaffolding protein localized to excitatory synapses, such as the glutamate receptor complex, resulting in disrupted glutamatergic function in individuals with PMS. Auditory steady-state response (ASSR) is a neurological response that occurs when the brain entrains to rapid auditory stimuli presented at a given frequency. ASSR in the gamma frequency range (30-50 Hz) has been identified as a robust measure of abnormal neural oscillations in other disorders where excitatory/inhibitory balance is disrupted. Measurement of gamma oscillations may offer a valuable biological tool to reveal mechanisms underlying cognitive dysfunction and behavioral symptomatology. We hypothesized ASSR would be diminished in individuals with ASD as well as in PMS compared to typically-developing (TD) controls.

Objectives: 1) Use electroencephalography (EEG) to test for alterations in gamma band response during auditory entrainment using an ASSR paradigm. 2) Explore differences in gamma band response among PMS, idiopathic ASD and TD populations.

Methods: Twenty-two individuals participated in the study: 8 with ASD (63% male), 5 with PMS (40% male), and 9 TD controls (67% male). EEGs were recorded using 128-channel Hydrocel Geodesic Sensor Nets and Philips/EGI NetStation software. The auditory stimulus was a 500ms click train with a stimulation rate of 40Hz, presented 150 times (inter-trial interval: 50ms). We calculated inter-trial phase coherence (ITC), a value between 0 and 1, where 0 represents a random distribution of phase angles and 1 reflects absolute neural synchrony. Group differences were computed using a one-way ANOVA with post-hoc t-tests.

Results: Results revealed significant differences in 40Hz gamma-band ASSR among groups, $F(2,19) = 8.60$, $p = .002$. Both ASD (0.25 ± 0.09; $t(15) = -3.99$, $p = 0.001$) and PMS (0.27 ± 0.11; $t(12) = -2.85$, $p = 0.015$) groups had significantly weaker ITC than controls (0.43 ± 0.10). ASD and PMS groups did not differ significantly ($p = 0.68$).

Conclusions: These results reinforce prior findings of diminished ASSR response in individuals with an ASD and extend them to PMS, a syndromic form of ASD with known excitatory dysfunction. ASSR is collected through a passive, non-invasive task, making it a promising potential biomarker for screening and stratification, particularly in lower-functioning populations. ASSR may also be useful to assess change in clinical trials, particularly for medications targeting the GABAergic system or in rare diseases with known excitatory/inhibitory balance disruption.

POSTER SESSION — SENSORY PHYSIOLOGY
442 - Sensory physiology Posters

442.001 *(Poster)* Altered Sensorimotor Postural Control of ASD Subjects: Findings from the Physiological Profile Approach

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Background: Effective sensorimotor postural control to maintain an upright stance is a crucial component for daily functional activity. A sound postural control system underlines a spatiotemporal integration of sensory and motor and systems. Evidence suggests that Autism Spectrum Disorder (ASD) population present postural control disruption.

Objectives: A cross-sectional study was carried out aimed at investigating sensorimotor contributions to postural control and behavior in children and adolescents with ASD compared to typically developing (TP) peers through the Physiological Profile Assessment – long form (PPA).

Methods: ASD and TD age-matched TD subjects were consecutively recruited in a northern metropolitan city in Italy. Participants were assessed with the PPA by residents in physical medicine and rehabilitation clinician. PPA includes 17 tests: Visual acuity with high- and low-contrast, Edge contrast sensitivity, Depth perception, Touch sensitivity, Tactile lower limb Proprioception, Simple reaction time of hand and foot, Isometric knee extensor and flexor muscle strength, Ankle isometric dorsiflexion strength, Postural sway with eyes open and closed, first on a firm surface, then on a medium density foam rubber mattress, Maximum balance range and Coordinated stability. Percentiles of each PPA subset were computed from the TD peers. PPA performances of ASD participants were compared to the TD percentiles.

Results: Eighteen ASD individuals' (16/2 male/female), mean age (SD) 12.4 (3.7) years, were included. Their intellectual disability ranged from mild (n=5), moderate (n=11) to severe (n=2). In the TD age-matched group, 135 subjects (100/35 male/female) were enrolled of the following ages: 6 years (n=11), 8 years (n=16), 11 years (n=21), 12 years (n=12), 13 years (n=14), 14 years (n=24), 16 years (n=18) and 18 years (n=19). ASD individuals' scores were above the 90th percentile, i.e., poor performance, in most motor, sensory, and balance subtests. In particular: half of our sample of children and adolescents with ASD performed poorly in the tests of visual acuity, particularly when the lighting conditions were poor (low contrast). Tactile sensitivity was inferior in our ASD population, with three-quarters of participants scoring above the 90th percentile and one performing below the 10th percentile. One-quarter of ASD participants performed poorly in the test of proprioception. More than half of our participants performed above the 90^{th} percentile in the tests of simple reaction time at the finger and the foot. Over a quarter of the children and adolescents with ASD presented muscle weakness in at least one of the three lower limb muscle groups we investigated. Performance in the majority of PPA significantly improved with older age in the TD group but not in the ASD group.

Conclusions: These findings suggest how poor balance performance may be due to sensorimotor deficiencies integration in ASD children and adolescents. The investigation of the mechanisms underlying impaired age-related maturation of sensorimotor systems should drive the research agenda of the scientific community.

442.002 *(Poster)* Effective Postural Control Complexity As a Biomarker for Autism Spectrum Disorder

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Background: Complex neurodevelopmental disorders like ASD may be characterized by subtle brain function signatures which can be measured using advanced machine learning tools. Sound postural control system requires the interaction of sensory, motor and integration systems. There is evidence that individuals with Autism Spectrum Disorder (ASD) present postural control deficits but is not known if the complexity of sensorimotor contribution can play a role.

Objectives: The aim of the study is to compare the degree of complexity of sensory and motor functions in a group of subjects with autism with a matched group of Typically developing children and adolescents.

Methods: The study sample included 18 children and adolescents with ASD and 18 age-matched typically-developing (TD) individuals, (age range 6-18 years; 16 males for both groups). Participants completed a Physiological Profile Assessment, which includes 17 tests : Visual acuity with high- and low-contrast, Edge contrast sensitivity, Depth perception, Touch sensitivity, Tactile lower limb Proprioception, Simple reaction time of hand and foot, Isometric knee extensor and flexor muscle strength, Ankle isometric dorsiflexion strength, Postural sway with eyes open and closed, first on a firm surface, then on a medium density foam rubber mattress, Maximum balance range and Coordinated stability. The complexity of interaction among these physiological functions has been explored with Maximally Regular Graph (MRG) theory applied to the Semantic Connectivity map produced by a fourth-generation artificial neural network (Auto-CM system; Semeion, Rome, Italy). MRG is the graph whose hubness function attains the highest value among all the graphs generated by adding back to the original Minimum Spanning Tree (MST), one by one, the connections previously skipped during the computation of the MST itself. In other words, starting from the MST, the MRG, presenting the highest number of regular microstructures, highlight the most important connections of the dataset. The resulting “diamond” volume expresses the complexity core of the system and in our specific case, the core of the physiological system.

Results: The map relative to TD group showed a coordinating role of Maximal Balance Range with respect to physiological functions on study. The MRG was generated by the addition of twelve links to MST involving eight Nodes. At variance, the map relative to ASD group showed a coordinating role of touch sensitivity. The MRG was characterized by only six additional links involving five nodes (Figure 1).

Conclusions: This proof-of-principle study suggests that ASD postural physiology is characterized by a loss of complexity in its component interaction which in the future might become a useful biomarker for early detection of risk for ASD.

442.003 *(Poster)* Electroencephalography (EEG) during Auditory Perception in Children with Autism Spectrum Disorder: An Investigation of the Predictive Coding Hypothesis

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Background: The brain's ability to encode temporal patterns and to predict upcoming events is critical for speech perception as well as other aspects of social communication. Deficits in predictive coding may contribute to difficulties with language function and social communication as well as overreliance on repetitive predictable environments in individuals with ASD. We explored this hypothesis in individuals with ASD associated with variable levels of verbal ability using electroencephalography (EEG) during an auditory mismatch negativity (MMN) task using rhythmic tone sequences of varying complexity.

Objectives: We tested the hypotheses that 1) individuals with ASD have reduced neural MMN response to auditory stimuli that deviate in presentation timing from expected patterns, particularly as pattern complexity increases, and that this reduction will be most pronounced in individuals with lower language abilities and 2) amplitude and/or latency of MMN signal is inversely correlated with level of impairment in the domains of social communication and restrictive interests/repetitive behaviors in individuals with ASD.

Methods: During an unattended task, EEG was continuously acquired as individuals (age 8-21 years) listened to repeated five rhythm tones that varied in the baseline complexity of the rhythm across three separate conditions. Conditions included an isochronous condition in which the tones were evenly spaced in time, and conditions with medium (1 bit) entropy and high (2 bit) entropy (Shannon entropy: $H(X)=-\sum P(xi)\log_2 P(xi)$). Within each condition, the majority of the tones conformed to the established rhythm (standard tones); occasionally the 4th tone was presented 300ms early (deviant tones). In typical adults, this paradigm has revealed that high-entropy stimuli are more difficult to model for the brain, resulting in less confident predictions and yielding smaller MMN signals for deviant sounds. Social communication and repetitive behaviors were measured in all subjects using the Social Responsiveness Scale (SRS-2) and Repetitive Behavior Scale (RBS-R).

Results: The mismatch negativity response to deviant tones in each of the conditions was compared between experimental groups (1-nonverbal/minimally verbal individuals with ASD; n=1, 2-fluent individuals with ASD; n=10, 3-age and IQ-matched controls; n=10). Consistent with previously described findings in typically-developing adults, both typically developing children and children with ASD who are fluent speakers show a stepwise decrease in MMN as a function of entropy. Mixed design ANOVA reveals no statistically significant difference between these two groups. Data collection in all groups with emphasis on nonverbal/minimally verbal individuals with ASD is ongoing.

Conclusions: Children with high functioning ASD do not differ from typically developing controls in neural mechanisms of prediction error when presented auditory rhythms of varied temporal complexity. However, given the particular importance of temporal modelling of patterns for language development, we predict that individuals with ASD who have lower verbal ability may be differentially affected.

442.004 *(Poster)* Extremely Wide Temporal Binding Windows in a Subgroup of Individuals with Autism

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Background: A critical aspect of sensory processing in autism spectrum disorder (ASD) is the ability to integrate what we see and hear in order to make sense of the world. Previous research shows that individuals with autism may not integrate auditory and visual information in the same timeframe as those without autism and this wider temporal binding window (TBW) may contribute to core deficits in autism. Standard testing of audio-visual integration often excludes some individuals with autism since their data did not fit a normal distribution and thus a TBW was unable to be calculated. Our prior study found 8 ASD participants whose TBWs were not able to be calculated using the standard 500msec testing.

Objectives: We **hypothesized** that some individuals with ASD have extremely wide TBWs beyond what is typically tested and may constitute a subgroup within the broader autism spectrum disorder phenotype. Therefore, the goal of the present study was to bring back participants from our prior study to retest their TBW using the same with a much wider timeframe (up to 1,500msec) to determine whether these individuals have extremely wide TBWs or whether they may not be complying with task demands.

Methods: We recruited 27 age-matched participants (typically developed [TD] n=17(9F) Mean age=25.4±6.1 years; ASD n=10(3F) Mean age=22.5±4.6 years; two-tailed *t*-test p=0.15). A simultaneity judgment task was used to measure each person's audio-visual TBW. Participants were seated approximately 60cm from a 100Hz refresh rate monitor in an isolation booth and presented with a white circle on a black background that was accompanied by a tone. The tone was either presented synchronously with the circle or asynchronously (offset by 10msec to 1,500msec). During the asynchronous presentations the tone either occurred prior to the appearance of the circle, constituting the Left TBW, or occurred after the circle was presented, constituting the Right TBW. A sigmoid curve was fit to the data points to calculate the Left and Right TBWs with the zero (synchronous) timepoint included for both. Task compliance was monitored via a video camera mounted in the isolation booth. Behavioral measures included the Autism Quotient and Social Responsiveness Scale (SRS)for all participants and the Autism Diagnostic Observation Scale (ADOS-2) Module 4 for ASD participants.

Results: The ASD group included 3 participants whose TBWs were previously unable to be calculated. Retesting showed that one participant had a TBW that fell within the range of the ASD group (Left=162; Right=393), but the other 2 participants had Right TBWs that exceeded 500msec with one participant having a total TBW>1,000msec. The groups differed significantly in the Left TBW (TD Mean=168±63.3; ASD Mean=275±97.8; Kruskal-Wallis p=0.005) and in the Right TBW (TD Mean=266±108; ASD Mean=397±128.3; Kruskal-Wallis p=0.016). The ASD group had significantly higher SRS scores compared to controls (TD Mean=29±19.6; ASD Mean=77±28.0; Kruskal-Wallis p<0.001).

Conclusions: While this data suggests that a small subgroup of ASD participants may have extremely wide TBWs, this data is exploratory and we are continuing to recruit the remaining 5 participants whose TBWs were previously unable to be calculated.

442.005 *(Poster)* Lived Experiences of Interoceptive Challenges in ASD

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Background: "Interoception," is a process by which the brain detects, discriminates, and regulates internal bodily signals to maintain healthy bodily functioning (Khalsa et al. 2018). Atypical interoception may contribute to co-occurring social cognitive and health challenges in ASD, such as impaired face processing, alexithymia, anxiety, depression, and atypical eating patterns (Murphy et al. 2017). To date, there has been no qualitative study of interoception in ASD, which is needed to better understand atypical interoception in this population.

Objectives: The purpose of this study is to understand the self-reported nature of interoceptive difficulties in ASD.

Methods: Data were collected from Wrongplanet.net, a publicly accessible online resource for the ASD community. Data were collected from keyword searches on forum pages of Wrongplanet.net that included various combinations of the following terms: "interoception," "interoceptive," "internal signals," "body signals," "introspection," "internal sensory," "bodily feelings," "body sensations," "mind body," "hunger," "thirst," "nausea," "heartbeat," and "alexithymia." Data were transcribed into NVivo and subsequently analyzed using qualitative content analysis (Babbie & Benaquisto, 2009) to identify themes.

Results: (Preliminary Themes)

1) ***Difficulty reading body cues of emotion.*** Participants (22 posts) expressed difficulties recognizing physiological indicators of affect—For example, failing to recognize that certain gut sensations or increases in heart rate may be associated with feelings of anxiety or anger.

2) ***Difficulty recognizing hunger, thirst or satiation.*** Many (56 posts) described rarely feeling thirsty or hungry, in some cases leading to dehydration or fainting. Conversely, others described not knowing when they are completely full, contributing to weight gain, binge-eating, or other atypical eating behavior.

3) ***Hyposensitivity to nausea and sickness.*** Some participants (10 posts) described rarely knowing when they are sick. For example, some said they are surprised when they vomit without warning beforehand or that others tell them they look sick before they feel sick themselves.

4) ***Incontinence.*** Some (9 posts) described not knowing when they needed to go to the bathroom, sometimes resulting in toileting accidents.

5) ***Hypersensitivity/hypochondria.*** While most data concerned a failure to detect interoceptive cues (hyposensitivity), a smaller proportion of data (13 posts) concerned *hypersensitivity* to internal sensations. Some likened this constant awareness and sensitivity to internal cues to "sensory overload," in which they constantly process internal sensory information without accurately identifying the meaning or significance of those cues. Others expressed constant worry about minor or benign bodily sensations, consistent with hypochondriasis.

6) ***Strategies.*** Some (8 posts) described the utility of schedules to remind them when to eat or when to go to the bathroom. One person lined up several water bottles on their desk daily to make sure they drank enough. Others (3 posts) noted the utility of mind-body meditation practices—exercises that focus one's attention on internal bodily processes, which over time, improved awareness and correct classification of internal signals.

Conclusions: The findings offer the first nuanced account of first-person perspectives on interoception in ASD. Findings reveal categories of concerns and strategies that can inform future research on interoception and its relationship to other features of ASD and on novel intervention strategies.

442.006 *(Poster)* Otoacoustic Emissions in a Critical Frequency Band Do Not Improve with Age in Children with ASD

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Background: Autism spectrum disorder (ASD) is a behaviorally diagnosed disorder characterized by impairment in social communication, and restricted/repetitive behavior and sensory atypicalities. Some of the earliest signs of ASD involve auditory processing, and a recent study found that hearing thresholds in children with ASD in mid-range frequencies were significantly related to receptive and expressive language measures. In addition, otoacoustic emissions, an objective measure of auditory function, has been used to detect reduced cochlear function in the presence of normal audiometric thresholds. We previously determined that older children and adolescents with ASD showed robust differences in otoacoustic emissions in mid-frequency ranges compared to typically developing (TD) controls, but this has not been tested at younger ages.

Objectives: Our objective was to determine if group differences we found in older children—in critical band (1-2 kHz) but not other (4-8 kHz) frequencies —extend to younger children with ASD. Our objective was to specifically measure baseline otoacoustic emissions (distortion-product otoacoustic emissions [DPOAEs], and transient-evoked otoacoustic emissions [TEOAEs]) in children with ASD compared with aged-matched TD controls, both inside and outside this critical frequency band.

Methods: Participants were children and adolescents ages 4-17 years with ASD (n=48) and typically developing controls (n=67). Participants were rigorously characterized via ADOS-2, plus ADI-R and/or SRS-2, and matched on age and gender. All children had normal audiometry. Exclusion criteria included neurological or genetic disorders or other conditions/illnesses that could affect hearing. Cochlear function was tested in a sound attenuated room, using baseline DPOAE and TEOAE in the right and left ears, over frequencies spanning 1 kHz to 8 kHz. To measure age differences cross-sectionally, groups were further divided via a median split into younger (<10 years) and older (≥10 years) subgroups.

Results: OAEs were examined via mixed-model MANOVAs with 2 groups (ASD, TD) x 2 ages (younger, older) x 2 frequencies (lower [1-2 kHz], higher [4-8 kHz]) x 2 ears (right, left). The DPOAE analysis yielded a significant group x age x frequency interaction (p=.001). Follow-up analyses yielded a significant group x age interaction only at lower frequencies (p=.01), reflecting an age-related improvement in the TD group in this critical band but no developmental change in the ASD group. In particular, ASD and TD groups were similar at younger ages (p=.93) but differed significantly at older ages (p=.001). In contrast, the groups had comparable DPOAE function across both younger and older age groups for higher frequencies. Analyses of the spectral features of TEOAEs yielded a similar patterns of results, including group differences in the 1-2 kHz band for older but not younger subgroups. No significant differences were noted in DPOAE or TEOAE noise floors between ASD and TD groups.

Conclusions: While older children with ASD demonstrated impairments in both DPOAEs and TEOAEs in the critical 1-2 kHz region, younger children with ASD did not show impairments. This robust pattern may reflect differences in auditory maturation; attention to specific-frequency deficits using measures of cochlear function is important for understanding auditory processing impairments found in ASD throughout the lifespan.

442.007 *(Poster)* Physiological Synchrony in Parent-Child Dyads with and without Autism Spectrum Disorder and Sensory Processing Dysfunction

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Background: Parent-child dyadic synchrony is believed to capture reciprocity and mutuality in the relationship. This synchrony supports the child's overall development, and emotional regulation. Dyads including children with autism spectrum disorder (ASD) and co-occuring sensory processing dysfunction may have disrupted synchrony that impacts the quality of parent-child interactions as they support their child in everyday tasks. Poorly processing sensory input during self-care activities may induce emotional and physiological responses that interfere with children with ASD and SPD's ability to complete self-care routines.

Objectives: To assess levels and synchrony of physiological responses of parent-child dyads during the child's toothbrushing and viewing of a muted video of parent-child dyads with ASD and SPD compared to parent-child dyads with typical development (TD) and without SPD.

Methods: In Taiwan, seven mother-child dyads with ASD and SPD (5-9 years, mean = 6.80) were compared with seven age-, gender-, and IQ-matched dyads with TD and without SPD (5-9 years, mean = 6.81). Electrodermal activity (EDA), a sympathetic nervous system (SNS) measure of the intensity of emotional arousal, was continuously measured by a Q Sensor during five weekday morning toothbrushing routines and while watching a muted video together once (only visual input). Both the parent and child wore Q sensors on their wrists during the child's toothbrushing and video-watching. *T*-tests were used to compare EDA between two groups, and multiple linear regression analyses were used to examine physiological synchrony in mother-child dyads.

Results: During toothbrushing and video-watching together, the child EDA in ASD group was significantly lower than child EDA in the TD group. The mother EDA in ASD group was significantly higher than mother EDA in TD group during toothbrushing, but was significantly lower than in TD group during video-watching together. During toothbrushing, some mother-child dyads were always or sometimes in the same space, and some were always in different spaces. During toothbrushing, mother and child staying in the same space or not was a significant predictor for child EDA for both groups, and child EDA was lower when dyads were in the same space. The group moderated the association between child and mother EDA. In TD group, child EDA and mother EDA fluctuated together in the same direction; however, in ASD group, when mother EDA increased, child EDA decreased. During video watching together, child EDA and mother EDA fluctuated together in the same direction in both groups. Again, the group moderated the association between dyadic EDA and the influence of mother EDA on child EDA was larger in TD group than in ASD group.

Conclusions: Children in the ASD group appeared to demonstrate hypoarousal in SNS, and atypical mother-child synchrony patterns compared to the control group in some conditions. In low-demand, low-challenge sensory conditions (video watching) and dyads in the same space, ASD dyads demonstrated synchrony in EDA. When in the same space allowing mothers to support the child's self-care performance, mothers EDA increased while children's EDA diminished. This suggested that mothers were experiencing greater arousal whereas children may be hypoaroused or suppressing their responses.

442.008 *(Poster)* Sensory and Emotional Responses to Smell and Taste Cues in Autism Spectrum Disorder.

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Background: Autism spectrum disorder (ASD) is associated with significant sensory challenges that influence feeding behavior, leading to inadequate nutritional balance. Additionally, food evoked emotions have been shown to affect food acceptability and choice. While previous studies in this field have been done with autistic children, this study focused on adults, due to the lack of research and dissimilarities in child and adult eating behavior.

Objectives: The objectives of this study were to better understand the sensory experiences of adults with ASD and their responses toward food and beverages, and to determine whether ASD influences sensory and emotional responses to smell and taste stimuli.

Methods: In Study 1 (*smell*), 20 adults with ASD (12 males; mean age ± SD = 30 ±13) and 20 well-matched adults in the control group (12 males; mean age ± SD = 30 ±12) participated. Participants were given odor discrimination and odor identification test from an odor kit containing food and non-food odors. They were also asked to rate the intensity, liking, pleasantness, arousal, familiarity, and edibility of the odor samples on categorical scales. In Study 2 (*taste*), 20 adults with ASD (13 males; mean age ± SD = 29 ± 12) and 20 well-matched adults in the control group (12 males; mean age ± SD = 27 ±12) participated. Five basic taste solutions at low and high concentrations were used: salty, sweet, sour, bitter, and umami. Intensity and liking ratings for taste solutions were measured using line scales. Food evoked emotional responses toward the taste solutions were measured using self-report and facial expression analysis.

Results: In Study 1, the ASD group showed impaired odor identification and odor discrimination ability. Odors with trigeminal sensation (e.g., peppermint and lemon) were more arousing and intense for the ASD group than the control group. In Study 2, the ASD group showed increased sensitivity to sweet taste and decreased liking of sour taste for high concentrations when compared to the control group. The control group reported a higher number of emotions evoked by taste solutions. For sweet taste at high concentration, the ASD group reported feeling more aggressive and more disgusted. Facial expression analysis showed higher "sadness" for the ASD group for sweet and sour tastes at high concentrations.

Conclusions: This study was able to identify sensory challenges that potentially cause unusual feeding behavior. This study also found that similar emotions to tastes are not elicited by the ASD group and control group, indicating differences in food appreciation. The results from this study can be useful in developing interventions directed toward feeding habits to improve nutritional adequacy and ultimately the quality of life.

Sensory, Motor, and Repetitive Behaviors and Interests

ORAL SESSION — SENSORY, MOTOR, AND REPETITIVE BEHAVIORS AND INTERESTS
326 - Sensorimotor Subtyping

326.001 *(Oral)* Dissecting the Phenotypic Heterogeneity in Sensory Behaviours in Autism Spectrum Disorder: A Factor Mixture Modelling Approach

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Background: Heterogeneity in the phenotypic presentation of Autism Spectrum Disorder (ASD) is apparent in the profile and the severity of sensory symptoms, which has hampered progress towards understanding etiological mechanisms, developing effective treatments, and predicting outcomes. A number of studies have utilised both variable-centered approaches such as confirmatory or exploratory factor analysis (CFA/EFA) and person-centered approaches such as different types of cluster analyses and latent class/profile analysis in an attempt to characterise noted heterogeneity yielding mixed and inconclusive findings. However, no studies to date have attempted to simultaneously model categorical and dimensional structures of sensory behaviours in ASD. This approach, psychometrically represented by the Factor Mixture Modelling, has the potential to enable a more fine-grained understanding of heterogeneity in sensory behaviours in ASD.

Objectives: This is the first study to utilise Factor Mixture Modelling (FMM) to test a multidimensional factor model of sensory processing in ASD by identifying more homogenous sensory subgroups/classes in ASD that differ in both their severity within and across classes along continuous factor scores. We also investigated class membership in relation to different clinical variables of interest: sex, age, full-scale IQ, ASD core symptoms, and symptoms of anxiety and ADHD.

Methods: 332 children and adults with ASD as part of the EU-AIMS LEAP cohort between the ages of 6 and 30 years with IQs varying between 40 and 148 were included. First, three different CFAs were fit to the 38 items of the Short Sensory Profile (SSP) to test a 7-factor, 6-factor and a novel 5-factor solution. Then, four different LCA models (with two-to-five classes) were evaluated. The best performing CFA, the 7-factor structure, was subsequently used in two FMMs that varied in the number of classes: a two-class, seven-factor model and a three-class, seven-factor model.

Results: A direct comparison of all competing models demonstrated that the 'three-class/seven-factor' FMM provided the best fit to the data and was superior to all other models based on different goodness-of-fit criteria (AIC=34,902; BIC=35,473). Class 1 ("sensory severe", *N*=24) endorsed more frequently severe sensory behaviours across all seven SSP domain scores compared to class 2 ("sensory moderate", *N*=51) and class 3 ("sensory low/mild, *N*=257). Participants in the severe sensory group were more likely to have more severe social-communicative symptoms compared to the mild sensory group (p=.003, d=1.24). Difference in social-communicative symptoms was approaching significance for the moderate vs. mild sensory group (p=.056, d=.52). Symptoms of anxiety also differentiated sensory classes overall (p=.024), and particularly the sensory moderate vs. mild sensory group, with the former presenting with more severe symptoms (p=.006, d=.37).

Conclusions: Modelling simultaneously categorical and dimensional structures of sensory behaviours in ASD allowed a more fine-grained understanding of heterogeneity in sensory behaviours in ASD. Our results suggest that sensory behaviours can be best described by three more homogeneous sensory subgroups that differ in sensory severity gradients within and between classes along seven continuous factor scores. Current social-communicative symptoms and symptoms of anxiety differentiated sensory classes, providing novel evidence on the associated clinical correlates of sensory subgroups.

326.002 *(Oral)* Felt but Not Seen: Observed Restricted Repetitive Behaviors Are Associated with Self-Report - but Not Parent-Report - OCD Symptoms in Youth with ASD

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Background: Restricted and repetitive behaviors (RRBs) are a core diagnostic feature of autism spectrum disorder (ASD). However, they also can appear similar to compulsive behaviors that are hallmark symptoms of obsessive-compulsive disorder (OCD; Jiujias et al., 2017). While the subjective distress caused by OCD obsessions may drive behavior meant to diminish unpleasant affect, RRBs are theorized to be reward- or sensory-driven, and may be stress-relieving. Phenotypic overlap between RRBs and OCD rituals may be due in part to a reliance on parent- and clinician-based assessments to classify observable behaviors, without fully considering what motivates them or how they are experienced (Leekam et al, 2011). Integrating information from multiple informants on both observable and subjective experiences of OCD symptoms and RRBs is vital for disentangling the overlap between these symptoms and informing intervention efforts.

Objectives: To determine the relationship between OCD symptoms (observable and subjective) with both clinician-observed and parent-reported RRBs, while controlling for current ASD-related social-communication symptoms.

Methods: Participants were 92 youth ages 7-17 (Table 1) with ADOS-2-confirmed (Lord et al., 2012) ASD and IQ>70 (per KBIT-2 ; Kaufman & Kaufman, 2004) Parents completed measures of their child's current ASD symptoms (SRS-2; Constantino, 2012) and general psychopathology (CASI-5; Gadow & Sprafkin, 2012). In addition, youth and their parents completed a measure of the child's OCD symptoms (MASC-2; March, 2012). Clinician-observed RRBs were indexed by the RRB subscale of the ADOS-2, while parent-reported RRBs were indexed by the RRB subscale of the CASI-5. First, we examined the bivariate correlations among all variables. Next, we ran hierarchical multiple regressions between parent- and self-reported OCD symptoms and clinician-observed and parent-reported RRBs. Finally, we utilized a novel technique (commonality analysis; Rowell, 1996) to better tease apart the unique contributions of each predictor on each dependent variable including both parent-and child-report of OCD symptoms as predictors.

Results: All parent-report measures correlated with each other, while clinician-observed RRBs and self-report OCD symptoms only correlated with each other (all *p*s<.05). While controlling for parent-reported current ASD social-communication symptoms, parent-report of OCD symptoms significantly predicted parent-reported, but not clinician-observed, RRBs (Table 2). In a comparable model, child-report of OCD symptoms significantly predicted both parent-reported and clinician-observed RRBs. Commonality analyses indicated that child self-reported OCD symptoms were the largest predictor of clinician-observed RRBs, uniquely explaining 67.04% of the variance; meanwhile, parent-reported current ASD symptoms were the best predictor of parent-reported RRBs, uniquely explaining 45.39% of the variance.

Conclusions: Results indicated that greater child self-reported, but not parent-reported, symptoms of OCD were associated with greater clinician-observed RRBs. Although both parent- and child self-reported OCD symptoms were associated with parent-reported RRBs, links between parents' reports of OCD and their reports of RRBs were likely explained by common method variance. This study suggests that children exhibiting objectively-observed RRBs may be experiencing relatively greater levels of subjective distress associated with restricted behavior patterns. These results provide guidance for better distinguishing and treating OCD behavior in youth with ASD, and open the door to new conceptualizations of the phenotypic overlap between these two conditions.

326.003 *(Oral)* Differential Presentations of Restricted Repetitive Behaviors in Individuals with Tuberous Sclerosis Complex and Autism Spectrum Disorder

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Background: Despite a breadth of research focused on the social communication profile of individuals with tuberous sclerosis complex (TSC; Jeste et al.,2016; McDonald et al.,2017), a common population for examining the emergence of autism spectrum disorder (ASD) symptoms, few studies have examined restricted repetitive behaviors (RRBs). It has been noted that despite the presence of ASD-specific behaviors, both caregivers and clinicians do not immediately recognize the proper diagnosis as being ASD (Capal et al.,2017). As such, increased understanding of RRBs seen in individuals with ASD within the TSC population may aid early detection, diagnosis, and treatment of affected individuals.

Objectives: To define the presence and profile of RRBs in individuals with TSC, particularly those with comorbid ASD.

Methods: Participants included 196 individuals with TSC participating in a multisite longitudinal study through the TSC Autism Center of Excellence Network (TACERN) or Rare Diseases Clinical Research Network (RDCRN). 111 individuals participated in the TACERN study (M_{age}=3.05 years,*SD*=0.14) and 85 individuals participated in RDCRN (M_{age}=8.90 years,*SD*=4.8). Within TACERN, 19.8% of individuals received an ASD diagnosis, as opposed to 45% in the RDCRN sample. Of note are the differential recruitment parameters between the two studies, barring direct study-to-study comparisons. Cognitive ability was assessed via the Mullen Scales of Early Learning or the Stanford-Binet-5, adaptive functioning via the Vineland Adaptive Behavior Scales-2, and RRBs via the Autism Diagnostic Interview-Revised (ADI-R). RRBs were further examined in RDCRN via the Repetitive Behavior Scale-Revised (RBS-R).

Results: Mann-Whitney U tests with Bonferroni-adjusted alpha levels of .007 per test were run to compare RRBs on the ADI-R between ASD and non-ASD groups. The ASD group had significantly higher scores for Total Number of Endorsed Items, Severity of Endorsed Items, and Total Number of Items Scored a 1 and 2 on the ADI-R in both studies (p's<.001). The ASD group from the RDCRN study showed significantly more stereotypic, self-injurious, compulsive, and ritualistic behaviors (p's<.001) on the RBS-R, but not sameness behavior (p>.05). Endorsement of each RRB item on the ADI-R was compared between diagnosis groups using chi-square tests of independence (Table 1). The RDCRN ASD group showed significantly higher endorsement on all variables except compulsions/rituals, while only repetitive use of objects, unusual sensory interests, and hand/finger mannerisms were significant for TACERN ASD (p's<.001).

Conclusions: Individuals with ASD in both studies exhibited a greater total number and severity of RRBs endorsed in comparison to individuals without ASD. However, when considered at the item level, there were differences in the patterns of significance between TACERN and RDCRN. In the older and more impaired participants (RDCRN), the ASD group had significantly higher scores on almost all ASD-specific behaviors, while younger and higher functioning groups (TACERN) differed only on repetitive use of objects, unusual sensory interests, and hand/finger mannerisms. Although less than the ASD group overall, the non-ASD group did not exhibit an absence of RRBs, rather they demonstrated elevated levels of many types of RRBs. There is potential for screening measures to be developed based on the unique profile of RRBs exhibited.

326.004 *(Oral)* Utilizing Quantitative Motor Measures to Improve Identification of Motor Differences in Infants at High Familial Risk for Autism

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Background: Motor development is an early observable benchmark of developmental progress and is crucial in driving multiple cognitive processes. During the first year of life, infants acquire a set of motor skills that fundamentally transform their experiences with the environment and people and support advances in cognition, language, and social interaction (Piaget, 1952). Impairments in motor development are ubiquitous in autism spectrum disorder (ASD), and studies in infants at high risk (HR) for ASD have posited that these impairments might be the first sign of atypical development (Piven et al., 2017). However, these studies have produced varying results. One reason for this is that current standardized measures of infant motor function use subjective categorical ratings of a limited range of infant motor milestones and do not objectively identify subtle and specific motor impairments. Quantitative analysis of infant motor skills can provide objective results and may improve early detection of motor impairments that are associated with clinical risk for ASD.

Objectives: Utilize a quantitative wearable sensor to identify distinct motor differences in HR infants compared to low risk (LR) infants in the first year of life, and to identify motor differences in HR infants associated with ASD behaviors.

Methods: Participants included 12 LR infants and 15 HR infants (5 HR infants with behavioral outcomes). HR infants had one older sibling with ASD. LR infants had no elevated concern for ASD. Full day quantitative measurement of spontaneous leg movements was obtained utilizing the opal wearable sensor at 4 time points across the first 12 months of life. Two novel quantitative features of the movement data were developed to measure amount of leg movement and variability in leg movement patterns. Standardized motor assessment using the Alberta Infant Motor Scale (AIMS) was conducted at these time points. ASD symptoms were measured at 18 months with the Autism Diagnostic Observation Schedule toddler module.

Results: HR infants showed significantly lower leg movement rates compared to LR infants [p=0.032, Figure 1]. All HR infants scored within the norms on the AIMS, despite showing lower leg movement rates compared to LR infants. Lower leg movement rates were associated with greater concern for ASD. HR infants with severe concern for ASD showed significantly lower variability in leg movement patterns compared to HR infants with no concern for ASD (p=0.017, Figure 2).

Conclusions: Specific quantitative motor measures can differentiate HR and LR infants, while the standardized motor assessment did not. Furthermore, HR infants showed lower leg movements rates which could be a potential marker of fewer volitional movements. Moving forward, this metric could be applied in different environmental and caregiver interactions to evaluate whether infants move less in specific social situations. HR infants also showed less variability in leg movement patterns. Lower variability suggests more repetitive movements, and this metric could serve as a measure of repetitive behaviors, a core diagnostic feature of ASD. These results support the use of quantitative motor measures to aid in early identification of motor impairments that could be associated with risk for ASD.

POSTER SESSION — SENSORY, MOTOR, AND REPETITIVE BEHAVIORS AND INTERESTS
443 - Sensory, Motor, and Repetitive Behaviors and Interests Posters

443.001 *(Poster)* A Conversation on Twitter: Autistic Adults Perceptions of Physical Activity

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Background: Recent evidence (Garcia-Pastor et al., 2019) suggests that autistic adults are less likely to be physically active than children and adolescents on the spectrum. Suggesting that physical inactivity is either maintained or increases as individuals age. Given the myriad of potential benefits from physical activity engagement (Bremer & Lloyd, 2016; Healy et al., 2018; Saunders et al., 2016; Schuch & Stubbs, 2019), the rate of physical inactivity among autistic adults is discouraging. Yet, little focus has been given to the experiences of autistic adults regarding physical activity, nor on how to utilize affinities and increase access; more-so-even in populations often missed by traditional recruitment techniques.

Objectives: Therefore, through a phenomenological inquiry, the purpose of this study was to gather information from autistic adults about their experiences with physical activities and the role it has in their daily lives utilizing the social media platform, Twitter.

Methods: Through Twitter, a total of 21 participants recruited that had a diagnosis of autism or identified as autistic; though only 11 participants engaged for the duration of the study. Of those that consented, a majority self-identified as “female” (n = 14); two individuals self-identified as “male”, one as a “transgender male”, one as “female/Agender”, one as “female/Demigirl”, and one as “female with masculine tendencies”. Over half of those consented self-reported a motor-related issue such as dyspraxia, low muscle tone, hypermobility, motor planning, or arthritis. A total of 6 “Twitter chats” were used as open, focus groups using the hashtag #AutStudy. A total of 35 questions were posed across the 6 chats; the first 5 chats had 5 questions each and the 6th chat had 10 questions. The primary author tweeted each question during a predesignated day and time; all authors followed up with each “reply”. Data were aggregated and thematically analyzed (Braun & Clarke, 2006) for common themes among the responses.

Results: Overall, several themes emerged from the data. Participants, each, recognized the importance of physical activity in their daily lives and connected participation in physical activity to improvements in mental health. However, most participants stressed the difficulty with access to physical activity spaces, a lack of knowledge about what to do, increased physical issues (e.g., joint pain, dizziness) due to physical activity engagement, the necessity for executive function capacity to plan for physical activity, and a need to balance current mental health with physical activity engagement.

Conclusions: Through the use of Twitter, this study was able to gather data from a broader sample than through a traditional method of recruitment. Findings suggest that autistic adults understand the importance of physical activity, but may not have the knowledge base to know what to do or may not have access to accommodating spaces for physical activity. Further, while most participants participated semi-regularly (i.e., at least once per week) in physical activity, this was often counterbalanced an individual's mental health status. Despite acknowledged benefits, if an individual was having difficulty coping, they would forego physical activity.

443.003 *(Poster)* A Pilot Evaluation of the Ignite Challenge, an Advanced Gross Motor Skills Assessment for Children with ASD to Help Get Them "into the Game."

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Background: Children with ASD participate in less physical activity (PA) than their typically developing peers due to communication/social interaction challenges, environmental and societal barriers. Gross motor deficits related to balance, fine and gross motor skills may further contribute to reduced motivation, confidence, positive affect, physical competence, and knowledge to participate in PA (key components of physical literacy). Search for an advanced motor skills measure that tapped into co-ordination, balance, speed motor planning and associated listening skills and focus revealed a measurement gap. Thus, our research team created the *Ignite Challenge* (*I-Challenge*), derived from the advanced motor skills measure known as the *Challenge-CP,* developed and validated by the senior author's CP research team for children with cerebral palsy to address similar motor areas and offer a positive and engaging assessment process. The *I-Challenge* is shorter than the *Challenge-CP* (13 versus 25 items) with more stringent time cut-points to make it a better fit for children with ASD and amenable for use by instructors within a busy community setting. Each item is scored on an item-individualized 5-point (0 to 4) accuracy/time-based scale.

Objectives: The purpose of this study is to investigate the *I-Challenge*'s discriminant validity, individual item profiles and reported item enjoyment in a convenience sample of children with ASD undertaking the *I-Challenge* as part of a larger body language evaluation study. This study is the first research evaluation of the *I-Challenge* in North America, and is running in parallel with a two-year reliability study (2018–2020) in Adelaide, Australia with our research partners there.

Methods: Thirty participants are being recruited. Inclusion criteria are: diagnosis of ASD, age 6 to 12 years, no medical contradictions to physical activity, and ability to follow complex 3-step instructions. Participants completed the *I-Challenge* and then rated enjoyment of item performance. For these ratings, each participant first created a personalized scale (10-cm line) by drawing in anchor boxes of their favourite activity (10/10), least favourite activity (1/10) and an activity that they neither like nor dislike (5/10). Photos of the researcher completing each *I-Challenge* item were viewed after the testing, and the participant rated enjoyment of each task on their personalized scale.

Results: Seventeen participants (1 female) with mean age 9.1 years (SD 1.9) have completed the *I-Challenge* thus far. The *I-Challenge* mean score (based on n=17) was 42.6/60 (SD 7.9, minimum=25, maximum=56). Item mean scores varied from 1.2 (SD 0.8) for the standing long jump and 3.4 (SD 0.7) for the stopping on a line after a 10m pathway run. Overall mean enjoyment was 7.6/10 (SD 0.7). The least enjoyed item was 'jumping jacks' (mean score 6.1 [SD 2.3]), while most enjoyed was 'step ups' (mean score 8.5 [SD 2.1]).

Conclusions: There was a wide range of item/total scores demonstrating the *I-Challenge's* ability to detect performance skill differences among children with ASD. The interactive and positive nature of the *I-Challenge* appeared to support children's engagement and enjoyment. Future research will compare the psychometric properties of the *I-Challenge* to current motor skills assessments being used clinically.

443.003 *(Poster)* A Longitudinal Study on Autism, Hyperlexia, and the Acquisition of Language in Monozygotic Twins

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Background: Hyperlexia is defined by a strong orientation towards written materials along with a discrepancy between the precocious acquisition of decoding skills and weaker comprehension abilities. Although the hyperlexic profile might characterize over 20% of autistic children, there are few accounts of how this skill develops prior to becoming obvious, and how it evolves as the child grows up and enters school. While some articles suggest that hyperlexia is an obstacle to oral language acquisition, others hypothesize that it is a strength that grounds future language skill, providing a potential bridge between no speech at all and fluent speech. Consequently, strategies guiding how precocious decoding skills should be approached in intervention have not been detailed.

Objectives:

- Provide an in-depth description of hyperlexia in two prototypical cases;
- Document the longitudinal development of oral language and hyperlexia in parallel;
- Document natural strategies established by the parents in the face of hyperlexia.

Methods: We followed the cognitive and language development from ages 4 to 7 of two monozygotic twin brothers who presented with unambiguous autism and hyperlexia, with 16 data points between 2016 and 2019. Five sessions provided an initial cognitive evaluation and in-depth assessment of their expressive and receptive language. Three sessions consisted of questionnaires targeting aspects of their interests, strengths, and family environment. Four sessions were dedicated to additional language assessments, four sessions to the observation and evaluation of reading and writing skills, and the intervention strategies employed and how they related to the children's interest in written material.

Results: At 4y, both children could not complete most of the sub-tests on the WPPSI-IV and scored under the 5th percentile on the few they completed. In contrast, their scores on the Raven Color Progressive Matrices placed both above the 90th percentile. Their results on the Vineland Adaptive Behavior Scales were similarly uneven, with above-average motor and written skills and delayed communication and socialization aptitudes. Their language was minimal and challenging to assess. At 5y6m, the CELF, consistently with other assessments, revealed receptive and expressive language skills under the 1st percentile. Both children could spell the alphabet forward and backward at 12m and write complex words at 2y. One of them also had a strong interest in drawing, while the other built elaborate structures with Lego. The parents developed strategies to use the children's interests in daily activities to foster the development of other skills. Between 5y and 7y, their language developed quickly towards the use of full sentences in mutual interactions. Most new words were first pronounced after being read, and their interest in letters merged with their other interests (*e.g.* drawing and writing names of *Angry Birds* characters), thus becoming more complex.

Conclusions: These results provide a proof of concept that hyperlexic skills can be harnessed to favour oral language development and allow us to more clearly define the specificities of autistic hyperlexia as opposed to precocious reading in typical children, hence contributing to a more precise definition of hyperlexia and the development of individualized intervention strategies.

443.004 *(Poster)* A Transdiagnostic Assessment of Restricted and Repetitive Behaviors in School-Age Children with ASD and ADHD

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Background: There is overwhelming evidence that symptoms of autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) often co-occur in the same children. However, the specific role and the extent of overlap in restricted repetitive behaviors/interests (RRB) has been understudied.

Objectives: Accordingly, we aimed to 1) quantify the prevalence and severity of RRB in a sample of school-age children with ADHD relative to age-matched ASD children; 2) examine RRB type, ADHD-related symptoms, as well as general psychopathology as a function of RRB severity within and across diagnostic groups.

Methods: We analyzed data from a well-characterized sample of children (N=168, M=8.7±1.7, range=5.6-11.9 years; n=33 females) with DSM-5 ADHD-only or ASD (N=101, N=67, respectively). Presence of RRB was indexed by computing a meta-z-score derived by averaging across all subjects z-scores obtained from parent and clinician RRB ratings (Restricted and Repetitive Behavior Scale-Revised [RBS-R] and Autism Diagnostic Observation Schedule-2ndEdition [ADOS-2], respectively). Children with meta-z-scores above average ($z \geq 0$) were identified as High-RRB, those below average as Low-RRB. After identifying the diagnostic composition of Low- and High-RRB groups, univariate ANOVAs were used to explore RRB type, sensory, ADHD, and general psychopathology symptoms based on the RBS-R subscales, sensory experience questionnaire (SEQ), Strengths and Weaknesses of Attention (SWAN), and Child Behavioral Checklist (CBCL), respectively. Main effects of DSM-5 diagnosis, RRB group, and their interaction were determined significant at $p<0.05$.

Results: High- and Low-RRB groups (N=82, n_{ASD}=51, ADHD n_{ADHD}=31; N=86, n_{ASD}=16, n_{ADHD}=70, respectively) were not significantly different in age, sex, nor IQ. Analyses of the SEQ and RBS-R subscale revealed a significant effect of RRB group only for hyposensitivity, stereotype and compulsive behavior subscales. A main effect of diagnostic group was observed only for hypersensitivity. In contrast a main effect of group and diagnosis were observed for ritualistic, sameness and restricted interest subscales, their interaction was significant for the sensory seeking subscale. Results from analyses on the SWAN and CBCL ratings showed significant main effects of RRB-group, irrespective of diagnosis.

Conclusions: Our preliminary findings suggest that a subset of school-age children with ADHD (30%) show RRB severity similar to those observed in ASD exists. A closer look revealed that one set of RRB is similar across ASD and ADHD (e.g., stereotypic behavior), some RRB are ASD-specific, regardless to their severity (e.g., sensory hypersensitivity), and another set of RRB is ASD-specific as a function of their severity (e.g., sensory seeking) – i.e. differences between high and low-RRB groups are specific to diagnosis. Further, consistent with prior findings, children with high RRB have more severe ADHD and psychopathology symptoms, regardless of their DSM-5 diagnosis. Further transdiagnostic investigations of RRB using multimodal behavioral and biological assessments are necessary for improved characterization and understanding of underlying mechanisms in order to develop more individualized treatment.

443.005 *(Poster)* Achilles Tendon Shortening Is Related to TIP-TOE Behavior Severity in ASD Subjects: A CROSS-Sectional Study

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Background: Toe-walking is a phenomenon present in 20-30% of ASD subjects. Persistent tip-toe behavior (TTB) can produce a shortening of the Achilles's tendon (made up by the soleus muscle – SM, and gastrocnemius muscle - GM) in ASD subjects. It is currently unclear why some ASD subjects develop this tendon shortening while others do not. One possible contributing factor could be the amount of time subjects spend in TTB during the day. In a previous study, we described three mutually exclusive clinical functional TTB classes of increasing severity: TTB present only in running (TTBclass1), in walking and running (TTBclass2), in standing, walking and running (TTBclass3). We also found the existence of a positive correlation between the severity of TTB presence and the Achilles's tendon shortening using a qualitative testing approach.

Objectives: The aim of this cross-sectional study is to evaluate the relationship between the quantity of TTB expressed during both static and dynamic tests and the Achilles tendon shortening in a cohort of TTB and NON-TTB ASD subjects.

Methods: The cross-sectional study included 51 consecutive ASD subjects (44 males, 7 females, mean age = 13.9 years – 3.67 SD) diagnosed according to the DSM V criteria and under observation at our Institute. The ASD severity was established through ADOS (2nd version). A therapist assessed the amount of TTB during both standardized static and dynamic tests previously described. The intensity of TTB expression during the static and dynamic tests was quantified as percentage of time spent on the tip-toes and as the percentage of toe steps, respectively. Two therapists, blind to the TTB quantitative testing, assessed both the soleus and gastrocnemius muscle lengths using a manual goniometer.

Results: The overall ADOS calibrated severity score (CSS) of all the subjects was 7.61 (1.65 SD). Overall 21/51 subjects presented TTB. Two subjects were in TTBclass1, 10 in TTBclass2 and 9 in TTBclass3.The mean percentage of time spent in TTB during the static test was 5.96% (15.68 SD) (range: 0%-96%). The mean percentage of toe steps during the dynamic test was 15.39% (26.51 SD) (range: 0%-100%). The mean length of the left and right GM of the sample were 6.84° (6.2 SD) and 7.9° (6.07 SD) respectively. The mean length of the left and right SM of the sample were 16.1° (6.89 SD) and 15.96° (6.36 SD) respectively. Using a Pearson's correlation test we found a significant inverse correlation between the percentage of time spent on the tip-toes and both the GM and SM lengths (left GM: $r=-0.703$, $p<0.001$; right GM: $r=-0.678$, $p<0.001$; left SM: $r=-0.541$, $p<0.001$; right SM: $r=-0.518$, $p<0.001$ respectively). We also found an inverse correlation between the percentage toe steps and both the GM and SM lengths (left GM: $r=-0.484$, $p<0.001$; right GM: $r=-0.425$, $p=0.002$; left SM: $r=-0.386$, $p=0.005$; right SM: $r=-0.363$, $p=0.009$ respectively).

Conclusions: The quantitative data show the existence of an inverse relationship between TTB intensity during both the static and the dynamic tests and the Achilles's tendon shortening in ASD subjects. Further research is required to confirm the results.

443.006 *(Poster)* Activity Participation Predictors in Children with Disabilities

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Background: Participation in meaningful activities or occupations is the essence of a healthy, happy, thriving person. Research indicates that those individuals who engage in meaningful occupations have higher quality of life, more satisfaction with life, and are healthier physically and mentally. Many with autism spectrum disorders (ASD) and intellectual disability (ID) are negatively impacted by difficulty participating in occupations, which contribute to adult problems with living independently, employment, secondary education, and getting married. It is important to better understand the predictors of difficulty participating in meaningful occupations across all participation areas.

Objectives:

1. Examine the differences in participation difficulties of children with ASD without ID, ASD + ID, ID alone, and controls in the areas of home life, friendships, classroom learning, and leisure activities by controlling for selection bias (e.g., sex, age).
2. Identify and compare the magnitude of various predictors of activity participation difficulties in children with ASD without ID, ASD + ID, and ID alone and controls.

Methods: The 2011 Survey of Pathways to Diagnosis and Services is a national dataset of a survey of caregivers of children in the US with special needs developed to better understand their pathway to services and the difficulties experienced (Child and Adolescent Health Measurement Initiative, 2015). Approximately 4,000 interviews and 3,000 written questionnaires were administered to parents of children aged 6-17 years who were ever diagnosed with ASD, developmental disorder, or ID across the United States.

We used chi-square tests and ANOVA to compare the factors among the groups of children with ASD without ID, ASD + ID, and ID alone. Next, we plan to use multivariate regression models to examine the relationship and predictive capacity of strengths and difficulties, skills, and participation in occupational therapy and sensory integration intervention on activity participation from the Pathways survey. We will use multivariate regression models to examine the predictive capacity of environmental, personal, body structures and function, and activity level variables on participation.

Results: We found that the greatest mean difficulty levels were seen in friendships and classroom learning for all groups. The children with both ASD and ID had the most difficulty in all areas, followed by the group with ASD alone, followed by the group with ID alone. For classroom learning, the groups with ASD alone and ID alone had equal difficulty.

Next, we will analyze potential predictors of difficulty with participation in those areas. Our findings will increase our knowledge of what areas we should address earlier in life for children with autism and intellectual disability to improve the trajectory of their activity participation outcomes.

Conclusions: The knowledge gained from this study will help to determine the impact of a group of factors that can be addressed by therapy services for individuals with ASD and ID to increase their activity participation. It will also reveal the possibility of inadequate therapy services for children with ASD without ID.

443.007 *(Poster)* Adults with Autism Who Achieve Different Functional Outcomes Show Distinctive Trajectories of Rrbs from Age 2 to 18

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Background: Restricted and repetitive behaviors (RRBs) are a core diagnostic feature of ASD, and can cause substantial functional impairment. Higher-order RRBs (e.g., circumscribed interests, unusual preoccupations) increase with age, while lower-order RRBs (e.g., mannerisms, sensory interests) are more prevalent in those with lower IQ and decrease with age. However, longitudinal studies of RRBs are limited, and research has not identified how trajectories of RRBs from early childhood to young adulthood are related to adult outcomes.

Objectives: Examine differences in RRB trajectories from ages 2-18 for groups of individuals with ASD who show different functional outcomes at age 25.

Methods: Eighty-nine individuals with ASD (78 male) for whom functional outcome data at age 25 was available were drawn from a sample of 192 children followed longitudinally from age 2-25. Participants were classified into More Cognitively-Able (MA; age 25 verbal IQ ≥ 70) and Less Cognitively-Able (LA; verbal IQ < 70); within each group, participants were further classified into three groups based on the number of functional outcomes achieved at age 25 (**Table 1**). RRBs were assessed at age 2, 3, 9 and 18 using the Autism Diagnostic Interview-Revised. General linear mixed models were used to investigate how RRBs developed across time, and whether adult functional groups showed distinct trajectories, for individual behaviors and higher-/lower-order clusters, while controlling for non-verbal IQ and language level at age 2 or 3.

Results: For the LA group, a main effect of age emerged such that higher-order RRBs increased and lower-order decreased from 2-18; for MA individuals, lower-order RRBs also decreased significantly with age. For the LA group, a main effect of group emerged for both lower-order and higher-order RRBs, with those meeting no functional outcomes demonstrating significantly more RRBs than the other two groups. In the MA group, there was a main effect of group for one lower-order RRB (complex mannerisms), with the group who met no functional outcomes showing a more severe presentation across ages. For LA and MA groups, there was an interaction between group and age for lower-order RRB (**Figure 1**). Lower-order RRBs in LA individuals who met all three functional outcomes decreased from age 2 to 9 whereas the lower-order RRBs in those who met fewer outcomes increased until 9. MA individuals who did not achieve any functional outcomes showed an early decrease in lower-order RRBs from age 2 to 9 then remained constant, whereas lower-order RRBs in those who met all three functional outcomes decreased continuously from 2 to 18 years.

Conclusions: Trajectories of lower-order RRBs from 2 to 18 years could serve as a potential indicator of positive adult outcomes among individuals with comparable cognitive functioning. For the LA group, the group who achieved the most optimal outcomes showed a decrease in lower-order RRBs in early childhood, whereas those who met fewer positive outcomes as adults showed stability. For the MA group, those who achieved the most positive outcomes in adulthood were differentiated by a sharp decrease in lower-order RRBs between 9 and 18 years.

443.008 *(Poster)* Altered Multisensory Facilitation in Younger and Older Autistic Individuals

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Background: Atypical sensory processing is an important aspect of the current autism diagnosis (APA, 2013). The *integration* of multiple sensory inputs (multi-sensory integration (MSI)) is thought to be idiosyncratic in autistic individuals (Wallace and Stevenson, 2014) and may have cascading effects on the development of higher-level processing such as speech perception (Stevenson et al., 2017). Thus far, there is mixed evidence as to whether altered MSI in autistic individuals is related purely to the social context employed in many MSI tasks (Feldman, 2019), and exactly how this process develops with age remains unclear.

Objectives: Our aims were twofold: (1) explore MSI in autistic and neurotypical individuals using a task void of social context and (2) assess performance differences in younger and older participants.

Methods: Multisensory facilitation was assessed using a target detection paradigm in 45 autistic and 111 neurotypical individuals. Participants were divided into younger and older age groups at a cut-off age of 15 (as reflected in the Sensory Profile (Dunn, 2014)). Participants were matched on age and performance IQ using the WASI-II. Three different types of stimuli were presented as targets: auditory (A; beep), visual (V; flash) or simultaneous audiovisual (AV; beep and flash). A, V and AV trials were presented in a randomized order with varying stimulus onset delays. Participants were required to respond to the stimulus (A, V or AV) as fast as possible via button press and reaction time (RT) was recorded.

Results: Redundancy gain (RG) was calculated for each participant ((mean bimodal RT - fastest mean unimodal RT)/ fastest mean unimodal RT). Overall, RG was greater in both typical groups compared to autistic groups [autistic young group mean RG: 12.33% (SD 9.34%), autistic older group: 11.22% (9.88%), typical young group: 16.34% (7.33%) and typical older group: RG of 17.76% (7.60%)]. Variance in RG was assessed using a 2-way ANOVA (2 groups x 2 ages), revealing a significant main effect of group: $F(1,152) = 13.67$, $p < 0.001$. No significant effect of age or significant interactions were found. Next, we applied a race model analysis which computes a bound value that represents the facilitation effect provided by MSI. If the mean RT on the audiovisual trials is shorter than this bound at any percentile, the race model is "violated", indicating multisensory integration. Our results revealed MSI facilitation occurred (violation of the race model) in neurotypical individuals, and with more efficient MSI in older participants. In both the younger and older autistic groups, we found reduced MSI facilitation (no or limited violation of the race model), with increased variability in both autistic groups.

Conclusions: Autistic participants showed reduced multisensory facilitation compared to typical participants in a simple target detection task, void of social context. This remained consistent for younger and older autistic individuals. Our results support evidence that autistic individuals integrate low-level, non-social information in an atypical fashion, possibly leading to higher-level, core difficulties such as sensory processing and speech perception in autism.

443.009 *(Poster)* An Evaluation of Autism Symptomatology and Toe Walking Severity in Children with and without Autism Spectrum Disorder (ASD)

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Background: The prevalence of toe walking is significantly higher among individuals with ASD than individuals with intellectual disability (ID), developmental disabilities (DD), or typical development (TD; Barrow, Jaworski, & Accardo, 2011; Sala et al., 1999). Despite the fact that toe walking is the most frequently studied gait abnormality in individuals with ASD (Weber, 1978), there are mixed findings on the factors that are associated with higher frequency of toe walking (Engström, Van't Hooft, & Tedroff, 2012). Among children with ASD, a positive relationship between autism symptomatology and toe walking has been found (Kantzer, Fernell, Gillberg, & Miniscalco, 2013; Shetreat-Klein, Shinnar, & Rapin, 2012).

Objectives: The purpose of this study was to evaluate toe walking severity in children with ASD, ID, atypical development (AD), and typical development. Additionally, the study evaluated if ASD symptom severity predicted the presence and severity of toe walking in children with ASD.

Methods: A Kruskal-Wallis H test was conducted to determine if there were differences in toe walking severity between four diagnostic groups: ASD, ID, AD, and TD. Toe walking severity was assessed using an item rating score on the Autism Spectrum Disorder- Diagnostic Child Version (ASD-DC; Matson & Gonzalez, 2007). Participants included 401 children between the ages of 2 and 8 years (M = 5.59, SD = 1.71). Subsequent analyses were conducted to evaluate if total ASD severity and body use severity, assessed using the Childhood Autism Rating Scale, Second Edition (CARS-2-ST; Schopler, Van Bourgondien, Wellman, & Love, 2010), predicted the presence and severity of toe walking. A binomial logistic regression was conducted to determine if ASD symptomatology predicted the presence of toe walking, and an ordinal regression was conducted to determine if ASD symptomatology predicted toe walking severity. Participants included 110 children between the ages of 2 and 8 years (M = 5.23, SD = 1.73).

Results: There were significant differences in in toe walking severity ratings between groups $\chi^2(3) = 43.05$, $p = .000$. A Bonferroni correction for multiple comparisons was performed, and statistical significance was accepted at the $p < .0083$ level. Post hoc analyses revealed statistically significant differences in toe walking severity between the ASD (Mdn = .00) and AD groups (Mdn = .00; $p = .001$) and ASD and TD groups (Mdn = .00; $p = .000$), but not between the ASD and ID groups. The logistic regression model was not statistically significant ($\chi^2(8) = 9.550$, $p = .298$). The model explained 11.3% of the variance in the presence of toe walking and correctly classified 65.5% of cases. The ordinal logistic regression was not statistically significant $\chi^2(3) = .097$, $p = .755$.

Conclusions: The current findings indicate that children with ASD exhibit higher severity of toe walking than children with AD and TD, but not children with ID. Higher total ASD severity and body use severity were not found to be significant predictors of the presence and severity of toe walking. Further research on ASD symptomatology and toe walking is needed for effective assessment and treatment of toe walking.

443.010 *(Poster)* Are Early Emerging Individual Differences in Repetitive Behaviour Subtypes Predictive of Subsequent Emotional and Behavioural Problems?

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Background: Repetitive sensory motor behaviours (RSM) and Insistence on Sameness (IS) are two subtypes of restricted and repetitive behaviour (RRB) that have consistently emerged in a range of factor analyses across both ASD and normative samples (e.g. Evans et al., 2017; Leekam et al., 2007; Richler et al., 2010). Although a typical feature of early development, the persistence of RRBs into later childhood has been associated with poorer developmental outcomes (e.g. Evans et al., 2014; Ghanizadeh & Moeini, 2011; Thelen, 1981), and linked to RRBs in neurodevelopmental disorders including autism spectrum disorder (ASD; Leekam et al., 2011). However, the limited research to date on the association between RRB and different cognitive, language and emotion (anxiety) outcomes, suggests that outcome depends on the type of RRB being measured (Evans et al., 1999; Larkin et al., 2017; Lidstone et al., 2014; Rogers et al., 2012). Another consideration is that RSM and IS RRBs also show different developmental trajectories (Arnott et al., 2010; Çevikaslan et al., 2014; Evans et al., 1997; Uljarević et al., 2017). Therefore timing is also important. The current study examined the selective association between RRB subtypes at different ages and later emotional and behavioural developmental outcome assessed as internalising and externalising behaviours. This is an important area to address in order to understand whether the persistence of either RSM or IS RRBs beyond their typical trajectory has a negative impact on subsequent outcomes.

Objectives: To examine the differential association between early and late RSM and IS behaviours and emotional and behavioural difficulties in children.

Methods: Parents of 485 children were recruited as part of the Gateshead Millennium Study and Tees Valley Baby Study, an opportunity-sampled cohort studied prospectively from 8 months. RRBs were measured using the Repetitive Behaviour Questionnaire-2 (RBQ-2; Leekam et al., 2007) at 24 (Time 1) and 77 (Time 2) months. Emotional and behavioural difficulties were measured at Time 2 using the Strengths and Difficulties Questionnaire (SDQ; Goodman et al., 1997). Hierarchical linear regression analyses were conducted to investigate predictors in internalising and externalising scales of the SDQ (step 1=socio-economic status; step 2=Time 1 RSM and IS mean scores; step 3=Time 2 RSM and IS mean scores).

Results: Elevated rates of Externalising behaviour outcome at 77 months were significantly predicted by RSM RRBs at both Time 1 (t=-2.173, p=.016, β=-.110) and Time 2 (t=6.899, p<.001, β=.325). However, only the final model (step 3) accounted for a significant proportion of the variance (12.5%; $F_{(5,479)}$=14.873, p<.001). Internalising behaviours were significantly predicted by Time 2 IS RRBs only (t=4.894, p=.001, β=.237), with the final model accounting for 8.2% of the variance ($F_{(5,479)}$=9.607, p<.001).

Conclusions: Elevated RRBs beyond early childhood were significantly associated with emotional and behavioural difficulties, with selective association between IS RRBs and internalising behaviours, and between RSM RRBs and externalising behaviours. These findings are an important first step towards better understanding how RSMB and IS affect subsequent development and thus have the potential to inform both the future assessment and treatment efforts.

443.011 *(Poster)* Auditory Hyper-Reactivity, Anxiety and Social Avoidance in Autism

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Background: Children with autism spectrum disorders (ASD) suffer from a variety of comorbidities, such as auditory hyper-reactivity and anxiety, that have the potential to exacerbate the inherent social skills deficits associated with ASD. Although auditory hyper-reactivity is suggested to be the most common sensory-perceptual abnormality seen in children with ASD (Gomes, Pedroso, and Wagner, 2008), little is known about how auditory hyper-reactivity, specifically, relates to anxiety and social participation. The present study was conducted to further investigate whether relationships exist between auditory sensory hyper-reactivity features of ASD, anxiety, and social skills.

Objectives: Although anxiety and auditory hyper-reactivity are common among children with autism spectrum disorders (ASD), little is known about the functional impact of auditory hyper-reactivity. It is reasonable to suspect that social avoidance occurs concomitantly with auditory hyper-reactivity due to avoidance of noisy crowded environments and that anxiety would also be elevated. This study aims to evaluate the possible relationships between hyper-acusis, anxiety and social avoidance through parent report measures.

Methods: Twenty-seven parents/legal guardians of children with ASD were recruited through the Center for Autism and Related Disabilities (CARD) across the State of Florida. Participants were asked to complete a 15-minute online survey. Criteria for participating in this study required that parents/guardians were over the age of 18 and had children diagnosed with ASD between the ages of 7 and 13 and who also have difficulties tolerating some sounds. The online survey consisted of three caregiver questionnaires including: (1) a pediatric version of the Modified Khalfa Hyperacusis Questionnaire (Khalfa et al., 2002), to assess the child's level of auditory hyper-reactivity (20 items); (2) the Spence Children's Anxiety Scale – Parent Report (Spence, 1999) to assess the severity of anxiety symptoms (38 items); and (3) the Social Worries Questionnaire (Spence, 1995) to assess social avoidance behaviors. Spearman's correlations were conducted to evaluate potential relationships between hyper-acusis, anxiety and social participation.

Results: Results suggest a significant correlation between auditory hyper-reactivity and anxiety ($p = .028$) and a weaker relationship between auditory hyper-reactivity and social avoidance ($p = .059$).

Conclusions: These findings highlight the need for effective sensory interventions to address auditory hyper-reactivity as well as any symptoms of anxiety. Additionally, the impact on social function and avoidance of social situations should be considered and addressed. It remains reasonable to assume that social avoidance may occur concomitantly with auditory hyper-reactivity. Particularly in patients who demonstrate avoidance of noisy, crowded social settings. Future studies with a larger sample size may be able to better identify potential relationships or other connections between social avoidance and auditory hyper-reactivity. Additionally, it may be beneficial to consider additional limiting social skills/behaviors rather than avoidance/worry alone. Patients with ASD and auditory hyper-reactivity may demonstrate improvements with social engagement following treatment for auditory hyper-reactivity symptoms. Further research is warranted regarding the connection between these symptoms and behaviors.

443.012 *(Poster)* Behavioral Inflexibility and Anxiety in Autism Spectrum Disorder

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Background: Behavioral inflexibility (BI) has been defined as the inability of the individual to tolerate change to his/her surrounding even when the situation calls for it. Both BI and anxiety are frequently reported as elevated to clinically significant levels in ASD. Anxiety prevalence rates in ASD range between 11 to 84%. Restricted and repetitive behaviors and cognitive inflexibility have been found to predict anxiety in ASD (Lawson et al., 2016; Rodgers et al., 2012), however it is unclear how BI specifically contributes to anxiety compared to other variables known to increase the likelihood of co-occurring, such as ASD diagnosis, IQ and biological sex.

Objectives: To understand how BI is associated with anxiety in a large sample of children and adolescents (3 – 17 years) with a diagnosis of ASD.

Methods: 237 individuals (3-17 years) and their caregivers were recruited from three sites into one of two groups; ASD (N=145) or typical development (TD; N=92). Parents completed the Behavioral Inflexibility Scale (BIS; Boyd et al., 2018); a 38-item parent report measure of behavioral inflexibility of children with ASD rated on a scale from 0 to 5. Parents also completed the Parent-Rated Anxiety Scale for ASD (PRAS-ASD; Scahill et al., 2019); a 25-item parent report measure of anxiety for youth with ASD rated on a scale from 0 to 3. Children completed the abbreviated Stanford-Binet 5. We ran a stepwise linear regression to investigate the relative contributions of diagnosis, sex, chronological age, IQ, and BI on anxiety.

Results: BI and anxiety were highly correlated in ASD ($r=.68$, $p<.001$) and TD ($r=.70$, $p<.001$). Diagnosis was a significant predictor in steps 1, 2 and 3, accounting for 38% of the variance in anxiety scores. This was driven by individuals with ASD having higher anxiety scores ($F=114.84$, $p<.001$). Biological sex and chronological age were not significant predictors in steps 2 or 3. The inclusion of IQ in model 3 increased the variance explained, with both diagnosis ($p<.001$) and IQ significantly predicting anxiety ($p=.001$). Higher IQ scores associated with higher anxiety scores in the ASD group only ($r=.26$, $p=.008$). In step 4, the inclusion of BI scores was highly significant ($R2 =.74$). In a subsequent model which included BI, both chronological age ($p =.01$) and biological sex ($p =.008$) became significant. Older children in our ASD group had marginally higher anxiety scores ($r=.14$, $p=.08$). Females had higher anxiety scores ($F=4.61$, $p=.03$), particularly in the ASD group ($F=5.04$, $p=.02$).

Conclusions: Anxiety appears to be strongly associated with ASD, independent of other characteristics that often mediate changes in ASD phenotype such as age, biological sex, and IQ. BI appears to be strongly associated with anxiety, at least when jointly measured by parent report; however by modeling the combined effects of diagnosis, age, biological sex, IQ and BI we found that the relation between BI and anxiety was strongest in individuals with ASD, with higher cognitive ability, and in females. Future work is warranted to examine the distinct and overlapping underlying neural mechanisms that contribute to BI and anxiety.

443.013 *(Poster)* Blurring Speaker's Eyes Enhances Audiovisual Speech Integration in Children with Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) have deficits in audiovisual speech integration (e.g., Feldman, et al., 2018). Audiovisual speech integration is often measured by "McGurk effect" (e.g., Bebko, et al., 2014; Stevenson et al., 2014). McGurk effect is the fused perception when an auditory phoneme is dubbed onto a different visual phoneme (McGurk & McDonald, 1976). Eye region is socially threatening to children with ASD according to "eye avoidance hypothesis" (Tanaka & Sung, 2013). It remains unknown whether the socially threatening information conveyed by eye region would influence the audiovisual speech integration in children with ASD.

Objectives: The current study aimed to examine whether reducing socially threatening information of the speaker's eye region by blurring speaker's eyes could improve the audiovisual speech integration in children with ASD. We also explored whether this effect was mediated by eye-looking time in children with ASD. Similar to previous studies, we measured audiovisual integration using "McGurk effect" (e.g., Bebko, et al., 2014; Stevenson et al., 2014).

Methods: Participants included 30 children with ASD and 30 typically-developing (TD) children. The two groups were matched on both age and IQ. Participants watched videos of a female speaker articulating syllables. Syllables contained audiovisual congruent phonemes (/ba/ and /ga/) and audiovisual incongruent phoneme (/AbVg/; auditory /ba/ was dubbed onto visual /ga/). The audiovisual incongruent /AbVg/ was designed to elicit the McGurk effect, which occurred when it was perceived as /da/ (McGurk & McDonald, 1976). The speaker's eyes were either clear or blurred, which was defined as clear-eyes condition and blurred-eyes condition separately. Participants were asked to report what the speaker said.

Results: Children with ASD showed stronger McGurk effect in blurred-eyes condition than in clear-eyes condition, but TD children showed equal McGurk effect in both conditions (Figure 1). That is, blurring speaker's eye region improved the audiovisual speech integration in children with ASD but not in TD children. Eye movement analysis displayed that both groups showed less eye-looking time in blurred-eyes condition than in clear-eyes condition. Mediation analysis showed that blurring speaker's eye region could enhance the audiovisual speech integration in children with ASD through shortening their eye-looking time (Figure 2). No mediation effect was found in TD children.

Conclusions: The present study found that reducing socially threatening information of speaker's eye region improved the audiovisual speech integration in children with ASD. This improvement was mediated by their eye-looking time. It indicated that the socially threatening information conveyed by eyes was one mechanism of the weaker audiovisual speech integration in children with ASD. It also implicated that future intervention for audiovisual speech integration in children with ASD could be achieved by reducing socially threatening information of speaker's eye region.

443.014 *(Poster)* Characterizing Intense Personal Interests in Young Children with Autism Spectrum Disorder

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Background: Intense personal interests are present in ~75-95% of individuals with autism spectrum disorder (ASD; Turner-Brown et al., 2011; South et al., 2005). Interests provide joy and therapeutic utility as rewards (Harrop C., et al. 2019) but interest intensity may interfere with other areas of life including educational opportunities or relationship formation. We know little about what leads to intense interests in ASD, and less is known about this symptom in young children. Hypotheses proposed to explain this symptom in ASD include: increased interest engagement due to reduced responsiveness to social or other reward stimuli (Zeeland et al., 2010), difficulty disengaging from interests due to executive functioning deficits in ASD (Granader et al., 2014), or that the hedonic value of personal interests mediates elevated levels of anxiety (Kim et al., 2000). Despite several theories, the mechanisms underlying this symptom are still unclear and different hypotheses have yet to be examined in the context of a single study.

Objectives: Our overarching goal is to characterizing intense interests in young children with ASD and examine relationships between intense interests and other cognitive and behavioral traits. We first aimed to characterize personal interests in 3 – 6-year-old children with ASD by comparing interest intensity and diversity to typically developing controls. We then aimed to investigate associations between interest intensity and reward sensitivity, attention shifting, and anxiety to uncover shared variability.

Methods: Preliminary data reported here was collected from parents of 3 – 6-year-old children with ASD (N=29) and parents of typically developing controls (N=40). Parents completed the Interests Scale (Bodfish, 2003) to quantify their child's interest diversity and intensity. To evaluate reward sensitivity, executive functioning, and anxiety, parents respectfully completed: The Behavioral Approach and Behavioral Inhibition System (BISBAS; Vervoort et al., 2015), Behavior Rating Inventory of Executive Functioning Preschool Version (BRIEF-P; Gioia et al., 2003), and Behavior Assessment System for Children (BASC-3; Reynolds & Kamphaus, 2015).

Results: Two sample t tests showed higher interest intensity in the ASD group ($p < 0.001$) but similar interest diversity between groups ($p = 0.9$). Pearson's correlations on data from the ASD group show interest intensity is associated with deficits in attention shifting (BRIEF-P Shift Subscale, $r = 0.5$, $p = 0.01$), but not reward responsiveness (BISBAS Reward Responsiveness Subscale; $r = -0.1$, $p = 0.5$) or anxiety (BASC-3 Anxiety Subscale; $r = 0.09$ $p = 0.6$). Recruitment will continue into 2020. A larger sample will be used to examine associations and interactions in a multivariate model and explore the potential that subgroups exist in our population. This data will be included in the final conference presentation.

Conclusions: This study supports the early presence of intense interests in ASD and describes relationships with other traits. The relationship between executive functioning and interests in this sample indicates that interventions targeted at improving attention shifting may also be beneficial for managing the interference of intense interests in other aspects of life.

443.015 *(Poster)* Characterizing Peripheral and Central Olfactory Processing in Children with Autism Spectrum Disorder, Sensory Processing Dysfunction, and Typical Development

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Background:

Sensory dysfunction is a commonly reported symptom of autism spectrum disorder (ASD), affecting multiple sensory modalities. Much attention has been devoted to visual and auditory modalities but research into olfactory processing remains inconclusive.

Objectives:

To assess olfactory processing, specifically odor detection, identification, and perceived pleasantness, in children with ASD, sensory processing dysfunction (SPD), and typically developing children (TYP), determine whether olfactory performance varies by target odorant or perceived pleasantness, and consider whether olfactory performance is associated with autism-related behaviors.

Methods:

43 children with high-functioning ASD (Age=10.21±1.63), 44 children with SPD (Age=9.98±1.62), and 46 TYP children (Age=10.32±1.44) participated in this study. Group inclusion was determined by the Autism Diagnostic Observation Schedule (ADOS2), Autism Diagnostic Interview (ADI-R), and Child Sensory Profile-2 (CSP-2).

Three measures of olfactory processing were assessed. Odor detection threshold was measured for two separate odorants (phenylethyl alcohol/PEA, vanillin) using Sniffin' Sticks Threshold Test. Perceived pleasantness of these odorants was assessed with a 7-point Likert scale (0=Very Unpleasant, 6=Very Pleasant). Smell identification was measured using the University of Pennsylvania Smell Identification Test (UPSIT). Autism severity was assessed using ADOS-2 calibrated scores. All statistical analyses were completed with SPSS Version 18.0.

Results:

Children with ASD showed no significant difference in Sniffin' Sticks scores for either odorant, compared to SPD and TYP children. The ASD group showed reduced UPSIT scores (M_{ASD}= 25.73, SD_{ASD}= 6.35) relative to the TYP group (M_{TYP}= 30.76, SD_{TYP}=3.36, t(84)=4.68, p<.001).

In contrast, both PEA and vanillin Sniffin' Sticks scores were reduced among children with SPD, relative to TYP children (for PEA, M_{SPD}=7.23, SD_{SPD}=4.39, M_{TYP}=9.03, SD_{TYP}=3.78, t(86)=2.10, p_{PEA}=.039; for vanillin, M_{SPD}=6.04, SD_{SPD}=2.72, M_{TYP}=7.28, SD_{TYP}=2.78,t(88)=2.15, p_{vanil}=.035). The SPD group also showed reduced UPSIT scores (M_{SPD}=27.17, SD_{SPD}=5.91) relative to the TYP group (M_{TYP}=30.76, SD_{TYP}=3.36, t(85)=3.53, p=.001). UPSIT scores did not differ between the ASD and SPD groups.

No significant difference in pleasantness rating was observed between the groups (for PEA, M_{ASD}=4.31, SD_{ASD}=1.52, M_{SPD}=3.58, SD_{SPD}=1.96, M_{TYP}=4.39, SD_{TYP}=1.30; for vanillin, M_{ASD}=5.08, SD_{ASD}=1.55, M_{SPD}=4.81, SD_{SPD}=1.58, M_{TYP}=5.00, SD_{TYP}=1.16).

Pleasantness rating for PEA was corelated with UPSIT scores in the ASD group (r(23)= -.422, p=.036) and the TYP group (r(31)= -.361, p=.039), but no such correlation was observed in the SPD group. Pleasantness ratings for vanillin were correlated with UPSIT scores only in the ASD group (r(22)= -.425, p=.038).

Within the ASD group, UPSIT scores demonstrated a negative correlation with the ADOS Total Score (r(38)= -.431, p=.005) and Social Affect Score (r(38)= -.424, p=.006). This relationship was not observed in the SPD group. No correlation was observed between UPSIT scores and ADOS Restricted Repetitive Behaviors.

Conclusions:

Children with ASD show impaired odor identification, reflecting possible central processing deficits in secondary olfactory cortices, while children with SPD show deficits in peripheral odor detection and identification, reflecting dysfunction along the entire olfactory pathway.

Our results indicate that odor-averse children have better odor identification skills, suggesting involvement of multiple secondary olfactory regions. Additionally, the relationship between odor identification and autism-related social behaviors points to a shared neural substrate underlying central processing of both secondary olfactory and social information.

443.016 *(Poster)* Deficits in Feedback and Feedforward Processes Are Distinct in Individuals with Autism Spectrum Disorder

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Background: Motor abnormalities are among the most common comorbid features of ASD, are related to core social and cognitive impairments, and predictive of worse functional outcomes. Reported deficits implicate dysfunction of both rapid feedforward processes executed prior to availability of sensory feedback, and continuous movements requiring dynamic adjustment of motor commands based on sensory feedback.

Objectives: The current study characterized rapid (saccade) and continuous (precision grip) motor behaviors in individuals with ASD and healthy controls to determine individual differences in feedforward and feedback processes and whether these behaviors differ as a function of age.

Methods: Individuals with ASD (N=72, age = 4-38) and healthy controls (N = 78, age = 4-38) completed two precision grip tests and one visually-guided saccade test (VGS). During the grip tests, participants viewed two parallel, horizontal bars (FORCE and TARGET) and pressed to raise the FORCE bar to the level of the TARGET bar across multiple force levels (Force test) and visual gain levels (Gain test). Force variability (force SD) and regularity (ApEn) were examined. During the VGS test, targets were presented at 12 degrees to the left or right of center. The mean and trial-to-trial variability of saccade accuracy and latency were examined.

Results: During grip tests, individuals with ASD showed increased force SD across all force levels and at the highest gain level. They also showed reduced ApEn compared to controls across all force and gain levels. During the VGS test, mean saccade amplitude and latency did not differ between groups, but trial-to-trial variability of both saccade amplitude and latency were greater in ASD than in controls. Force SD was associated with age in controls showing a quadratic relationship characterized by age-associated decreases until age 25 in healthy controls and then age-associated increases into middle adulthood. Force SD did not show any age-related differences in ASD. Similarly, increased ApEn was associated with increased age in healthy controls, but not in ASD. Increased age was associated with reduced variability of saccade latencies in both groups, but not saccade amplitude. Neither force SD nor force ApEn were associated with variability of saccade amplitude or latency in either group.

Conclusions: We report deficits in feedback and feedforward processes that are independently affected within individuals with ASD and therefore likely represent distinct neurophysiological processes. Increased force variability and regularity in ASD likely reflects dysfunction of parietal-cerebellar circuits involved in dynamic adjustment of motor commands based on sensory feedback error. Increased variability of saccade accuracy across trials implicates dysfunction of premotor-cerebellar networks that guide movement via internal action representations, while latency variability suggests deficits in cortical-striatal-cerebellar systems involved in regulating timed motor responses. Together, these results document dysfunction of multiple sensorimotor processes that are differentially affected in individuals with ASD and implicate distinct neurophysiological mechanisms.

443.017 *(Poster)* Developmental Trajectories in Coordinated Joint Action and Their Link to Motor Functioning in ASD: Preliminary Results

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Background: Coordinated Joint Action (CJA) takes place when two confederates accomplish a shared goal by coordinating their social-motoric movement in time and space. The ability to mirror, complement and predict other's actions during CJA, requires the successful operation of social-motor capabilities. Though the manifestation of motor deficits in cognitively able (IQ>70) children and adolescents with autism spectrum disorder (ASD) is relatively explored, the development of CJA and the contribution of cognitive and motor functioning to CJA in ASD is yet underexplored.

Objectives: Our study examined developmental trajectories in CJA and their link with ASD severity, cognitive and motor functioning in cognitively able children and adolescents with ASD. Findings regarding the role motor functioning play in the development and performance of CJA in ASD may open a new path for social-motor intervention in the future.

Methods: Study included fifty-six cognitive-able participants with ASD (IQ=95.04, CA=11.8) in two developmental age groups - school-aged children (6-12-years) and adolescents (12-16-years) (*n*=28, each). Background measures included the Autism Diagnostic Observation Schedule (ADOS) and the Wechsler Intelligence Scale for Children - Fifth Edition (WISC-IV). Peer dyads were paired based on IQ and Chronological Age (CA).

Study measures included an observation (the Individual Motor Observation Scale - IMOS) and a parent-report (the Developmental Coordination Disorder Questionnaire - DCDQ) to evaluate motor functioning. In addition, we executed two dyadic CJA tasks - a side-by-side mirroring-walking and a prediction-football task in which participants were instructed to kick and catch a virtual football. The motor measures provided total motor functioning score that was mainly based on gross and fine motor behaviors. CJA performance was measured with total dyadic joint steps and proximity duration in the walking-mirroring task and a total dyadic coordinated movements direction and average reaction time in the football-prediction task.

Results: Results yielded significant group difference between school-aged children and adolescents with ASD in dyadic joint steps and proximity duration during the walking CJA task; and in coordinated movements direction during the football CJA task. In all measures older outperformed younger. Group difference in reaction time during the football-CJA-task was not significant (see Figure1).

A positive correlation was found between three of the CJA categories, CA, and IQ. Motor functioning was correlated positively only with the walking CJA task. This highlight, the developmental improvement in CJA among ASD, and the important contribution of cognitive and motor functioning to social tasks that involve motor coordination (CJA). As expected, negative correlation was found between proximity duration in CJA-walking task and ASD severity, meaning that children with less severe disorder were better in coordinating their movement. Unexpectedly, significant negative correlation was found between ASD severity and football-reaction time, indicating faster reaction in more severely affected children (see table 1).

Conclusions: Findings indicate the maturation of CJA abilities in ASD during the transition from childhood to adolescence and the important contribution of cognitive and motor functioning to CJA performance in ASD. Findings regarding the link between the participants' ASD severity and their reaction time requires further comparison with same-age typically developing sample.

443.018 *(Poster)* Developmental Trajectory of Sensorimotor Integration for Postural Stability in Autism Spectrum Disorder

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Background: Although Autism Spectrum Disorder (ASD) is primarily associated with social communication differences and restricted interests/repetitive behaviors, individuals with ASD also exhibit significant sensorimotor differences. Postural stability is a foundational motor skill that requires integration of input from multiple sensory systems (visual, somatosensory, vestibular) into motor plans. Individuals with ASD show more postural instability during quiet standing compared to typically developing (TD) individuals. When lacking a sensory modality (i.e., eyes closed) or receiving distorted sensory input (e.g., vision without environmental spatial cues), individuals with ASD experience increased postural instability. Despite substantial differences in sensorimotor integration for postural stability in ASD, there has been relatively little work on how these differences change across development from childhood into adulthood.

Objectives: We examined the development of sensorimotor integration and postural stability from middle childhood to early adulthood using the Clinical Test of Sensory Integration in Balance. We examined differences in postural stability between children and adults with ASD and TD and how they change across development. We also examined how postural stability was influenced by changes in visual input. Finally, we used cluster analyses to determine potential developmental stages in postural stability.

Methods: We tested the postural stability of children and young adults with ASD (n=27, M_{age}=12.44, SD_{age}=3.18) or TD (n=41, M_{age}=10.89, SD_{age}=3.50). Participants assumed a comfortable stance on the hard surface of a Biodex BioSway force plate and remained still for 30-second intervals in each of the following conditions: eyes open, eyes closed, and eyes open in a translucent paper sphere (dome) placed on the participant's head. The eyes open condition provides a measure of quiet standing postural stability with all relevant sensory inputs. Eyes closed measures postural stability when participants do not have visual input for maintaining balance and must rely more heavily on proprioceptive (a modality of the somatosensory system) and vestibular input. In the dome condition, participants have visual input, but the input does not include visuospatial cues from the environment that would typically be used to aid in maintaining balance.

Results: A linear mixed-effects model for postural stability (Figure 1) indicated significant main effects of group (F(1,67.90)=10.60, p=.002), age (F(1,68.10)=28.59, p<.001), and condition (F(2,134.60)=44.83, p<.001). Participants with ASD (M=1.33) showed increased postural instability compared to TD participants (M=1.11). Participants showed more instability in the eyes closed (M=1.32) and dome (M=1.35) conditions than the eyes open condition (M=0.91). Postural instability decreased as age increased (b=-0.03). K-means clustering indicated 3 distinct developmental stages of postural stability across group and condition: 7-10 (M=8.83),11-15 (M=12.44), and 16-20 (M=18.00) years with between cluster sum of squares explaining 82.1% of the total variance (Figure 2).

Conclusions: These results indicate that individuals with ASD follow a similar trajectory for the development of postural stability as TD individuals, but exhibit more instability overall. These results also demonstrate that for individuals with ASD, differences in postural stability persist across childhood and into adulthood. These clinically-significant findings can be used for the development of targeted interventions for the unique pattern of sensorimotor problems observed in individuals with ASD.

443.019 *(Poster)* Establishing Measurement Invariance and Modeling Change in Restricted and Repetitive Motor Behaviors from 8-36 Months

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Background: Restrictive and Repetitive Behaviors (RRBs) are a key component of autism spectrum disorder (ASD) symptomology and are detectable in high risk ASD toddlers from an early age. However, RRBs are not unique to ASD. In addition to their association with anxiety and other neurodevelopmental disorders, RRBs have also been observed in typically developing infants (Thelen 1979, 1981) and preschool children (Hoch et al, 2015). Studying the early development of RRBs in both typical and atypical populations may therefore be critical for distinguishing between behaviors that may be typical in early childhood, and those that are predictive of emerging psychopathology.

The ability to examine longitudinal change in RRBs is incumbent upon the assumption that our measure of RRBs captures the same latent construct over time. This refers to longitudinal Measurement Invariance (MI). When non-invariance occurs, items mean something different for different groups and/or ages. For example, parents of very young children may endorse "mouthing objects" more frequently when that behavior is developmentally normative; without accounting for the non-invariance of this item, RRBs would be overestimated in this age group. Thus, accounting for non-invariance is critical when comparing assessment scores across different ages, and diagnostic groups.

Objectives: 1) Test measurement invariance – and adjust for potential non-invariance – in the RBS-EC in a longitudinal sample of low-risk toddlers. 2) Examine longitudinal change in RRBs across toddlerhood.

Methods: RRBs were measured using the RBS-EC, a 34-item parent-report questionnaire that is a downward-extension of the Repetitive Behavior Scale–Revised. The RBS-EC is psychometrically validated on a sample of 17-27-month-old toddlers (Wolff, Boyd, & Elison, 2016), and is intended to capture normative variation in young children. The final sample included responses from parents of 606 low-risk 8- to 36-month-old toddlers. Moderated Nonlinear Factor Analysis (MNLFA, Bauer et al., 2019) was used to generate factor score estimates for RBS-EC subscales while adjusting for non-invariance. Multi-level linear mixed-effects models were used to estimate change in latent subscale scores across development.

Results: Seven items demonstrated differential item functioning (DIF) as a function of age (**Table 1).** Factor score estimates adjusted for DIF were highly correlated with the raw mean estimates from each subscale. However, factor score estimates provided more individual variability for growth curve modelling than raw scores. Longitudinal change varied across subscales (**Figure 1**). While both Repetitive motor and Self-directed behaviors decreased across time, Repetitive motor scores decreased more rapidly ($B_{\text{Repetitive motor}}$ = -0.11, $B_{\text{Self-directed}}$ = -0.06, p's <.001). There was a significant linear and quadratic effect of age on higher-order behaviors, such that behaviors began to decline around 21 months.

Conclusions: MNLFA results suggested that the assumption of MI does not hold for all subscales of the RBS-EC, and that factor score estimates must be adjusted for when comparing RRB scores across different ages. Growth curve analysis of adjusted factor score estimates suggested different trajectories for each subscales of the RBS-EC, suggesting that these reflect separable constructs. Future work examining differences in RRBs across age and/or diagnostic groups should establish MI before comparing trajectories.

443.020 *(Poster)* Evaluating Methods for Assessing Circumscribed Interests in Children with Autism Spectrum Disorder

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Background: Circumscribed Interests (CI), a narrow and intense interest in specific and unique subjects, are a core feature of autism spectrum disorder (ASD; American Psychiatric Association, 2013). The characterization of CIs is important for making diagnostic decisions and intervention development for children with ASD (Boyd et al., 2011). The heterogenous nature of CIs and reliance on parent report of intensity (Li, Fan, Jin, 2018) both introduce challenges in reliably assessing these behaviors (Turner-Brown, Lam, Holtzclaw, Dichter, Bodfish, 2011).

Objectives: This study aims to evaluate existing methods for characterizing CIs. First, to help increase the consistency of how CIs are represented in research, we sought to identify the most efficient yet comprehensive approach for classifying CI into categories. Second, we evaluated the validity of parent ratings of CI intensity, through a comparison to direct attentional allocation.

Methods: Parents of children with ASD and of typically developing (TD) children were asked to submit six examples of their child's highly preferred objects. 221 total CI pictures were coded by two independent coders for alignment with three different published CI categorization schemes (See figure 1; Baron-Cohen & Wheelwright, 1999; Sasson, Turner-Brown, Holtzclaw, Lam, & Bodfish, 2008; South, Ozonoff, & McMahon, 2005). To determine if any of these approaches represented a comprehensive categorization scheme, images that did not align with any of the categories were coded into an "other" category. Next, we examined the convergent validity between parent report of CI object preference and children's gaze allocation to these objects, measured with eye tracking. Parents completed three visual analog scales that evaluated their perception of the intensity/functional impact of the CI. Children in both diagnostic groups were then allotted five seconds to view a series of randomly presented, personalized CI objects presented with a familiar/unfamiliar facial stimulus. Parent ratings and the average amount of time viewing each CI were compared.

Results: Coding results, with an average percent agreement of 93.5%, provided validity for the more comprehensive CI coding scheme published by Baron-Cohen & Wheelwright (1999). Only 13.5% of coded objects did not align with one of the existing categories for this coding scheme; however, both the Sasson (2008) and South (2005) categories, resulted in much higher rates of objects falling into the "other" category (86% and 71.2%; see Figure 1). For aim two, no significant correlations were found between parent ratings and the total time viewing CIs for either diagnostic groups (see Table 1).

Conclusions: This identified the category scheme developed by Sasson & Wheelwright (1999) as the more comprehensive; therefore, it may be the most useful for research using exemplars that are maximally representative of a broad collection of objects. The lack of alignment between attention allocation and parent report of preference indicates that additional research is required to determine the best way to assess the magnitude of CI preference. Additional analyses will examine if an alternative metric of proportion of time viewing the CI to total time might be more conclusive.

443.021 *(Poster)* Examining Specific Aversions and Aggressive Behaviors in Children with Autism Spectrum Disorder

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Background: Sensory aversions in children with autism spectrum disorder (ASD) are prevalent, impairing, and often difficult to address with traditional therapies because of executive-functioning challenges. Similarly, aggressive behaviors are often observed in youth with ASD. Prior studies have shown that sensory profiles—key components of ASD symptom severity—have been associated with poor social-emotional functioning and behavioral problems; however, less is known about potential associations between sensory aversions and self-regulation difficulties, such as aggressive behavior.

Objectives: To examine the prevalence, severity, quality of sensory aversions, as well as the relationship between sensory aversions and aggressive behavior, in a subset of youth from the Simons Simplex Collection (SSC) cohort. The SSC is a national repository of 2,600 families with one child affected by ASD and their unaffected parents and siblings.

Methods: Participants included 407 families from the Simons Simplex Collection at Baylor College of Medicine (n=203, male = 86.2%; mean proband age = 8.7 years [SD = 3.3], range = 4.2-17.8) and the University of Missouri (n= 208; male = 86.7%; mean proband age =9.6 years [SD=3.7], range = 4.0-17.9). Information about recruitment, measures, and procedures related to the SSC can be found in Fischbachand Lord (2010). Sensory sensitivity/aversions were measured using the Autism Diagnosis Interview-Revised (ADI-R) sensory items #72 and #73. The Child Behavior Checklist (CBCL) for ages 6-18 aggression subscale score was used as an index of aggressive behaviors. Descriptive statistics were used to characterize the prevalence and severity of sensory aversions (items #72 and #73). Qualitative analysis was used to categorize different types of aversions. Point-biserial correlations and Spearman correlations were used to assess potential relationships between group status for each aversion (present or absent) and (a) child characteristics (age, ratio IQ scores, CBCL- aggression scores) and (b) severity codings for items #72 and #73, respectively.

Results: At least one type of sensory aversion was reported for 398 participants (97.9%), with an average of between 3 and 4 different categories of aversions noted per participant. The most commonly reported aversions across the full sample were *appliances* (43.2%), *loud sounds* (42.8%), *background sounds* (41.8%), and *foods* (40.1%). Severity codings for ADI-R item #72 (undue general sensitivity to noise) indicated that the largest proportions of children showed definite aversion to noises (44% current, 49% ever). Similar results were observed for item #73 (abnormal, idiosyncratic, negative response to specific sensory stimuli) with 34% exhibiting mild/controllable aversions currently, and 39% having tantrums/exposure avoidance at some point. Results from analyses of associations between sensory aversions and the CBCL aggression subscale are forthcoming.

Conclusions: Sensory aversions affected the vast majority of participants, and severity codings indicated that sizeable portions of children were moderately to significantly impaired by their aversions (codes of 2 or 3 items #72 and #73). An understanding of sensory profiles and how they relate to aggressive presentations may help tailor future behavioral interventions that target maladaptive behavior in individuals with ASD.

443.022 *(Poster)* Exploring Retrospective Sensory School Experiences in Late-Diagnosed Autistic Women.

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Background: Many autistic individuals experience sensory atypicalities that impact daily functioning. In particular, self-report has indicated that sensory differences can have a profound impact at school by inducing anxiety, reducing concentration and causing physical discomfort (Humphrey & Lewis, 2008; Howe & Stagg, 2016). The focus thus far however has been on males. This represents a gap in the literature because the presentation of ASD may differ across sex and gender. For instance, higher levels of social motivation, internalizing behaviours and lifetime sensory scores have been observed in autistic females (Sedgewick et al., 2017; Mandy et al., 2012). School experiences of autistic females may therefore be qualitatively different to that of autistic males. Furthermore, many autistic females remain undiagnosed at school (Mandy et al., 2012). It is these later-diagnosed women who may be most representative of the autism female phenotype- often flying under radar by not conforming to the male model of ASD (Bargiela et al., 2016)

Objectives: The current study therefore explored the school experiences of late-diagnosed autistic females, focusing specifically on the impact of sensory processing differences.

Methods: Sixty females (Mean Age=33.49, SD=9.85) who had received a diagnosis of Autism Spectrum Disorder after finishing school (Mean Age of Diagnosis =27.69, SD=13.85) completed an online questionnaire. Sixty percent of participants had been taught in the UK and a further 26% had been taught in North America. Participants were highly educated with 66% achieving at least a bachelor's degree. An online questionnaire was designed that focused on the type of sensory experiences encountered at school, the potential impacts of these experiences, and strategies used to manage sensory differences. Data were analysed using data-driven thematic analysis.

Results: We found that sensory differences interacted and exacerbated many of the social challenges faced by autistic females at school. Friendships and 'fitting in' were key difficulties for several participants, with 46% reporting bullying at school. Sensory differences could limit the opportunities for socializing, as the stimulating nature of the school hall and playground, often made these spaces inaccessible for participants. Instead, environments such as the library (N=17) were sought as this allowed for a reduction in sensory stimulation. The majority of sensory experiences were negative however and could result in "meltdowns" (N=12) and physical discomfort (N=10). Such responses were reported to result in further teasing by peers (N=8). Finally, sensory differences were associated with heightened anxiety at school (N=26), yet several participants reported masking these experiences until they arrived home (N=5).

Conclusions: Sensory processing differences can have a profound impact on school life. These differences were found to interact with, and exacerbate, several of the difficulties already faced by autistic females at school. Findings suggest that adapting the environment to meet the sensory needs of pupils, or helping individuals manage their sensory differences, may too improve social experiences and mental health at school. Critically, understanding the presentation and impact of sensory differences may also aid in the identification of undiagnosed autistic females at school and further challenge the male conceptualization of ASD

443.023 *(Poster)* Exploring Sensory Reactivity, Mental Health and Behaviour in Autistic Preschoolers

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Background: Research shows that sensory reactivity symptoms are often present in individuals with a diagnosis of autism spectrum disorder (ASD), irrespective of level of functioning. The literature also asserts that autistic individuals are at a significantly higher risk of developing mental health conditions than their neurotypical peers. Whilst some research has investigated individual sensory reactivity constructs within specific diagnoses, particularly with hyper-reactivity/sensory sensitivity and anxiety, little research has been conducted more broadly into the relationship between other sensory reactivity constructs (poor registration/hypo-reactivity and sensation seeking) and the development of other mental health disorders. The current study explores the correlational relationship between sensory reactivity, behaviour and mental health constructs across sample of autistic preschoolers.

Objectives: To examine whether there are relationships between emerging sensory reactivity, behaviour and mental health in autistic preschoolers.

Methods: In total 55 children diagnosed with ASD (ages 3 to 5) took part, clinical diagnosis was confirmed using an ADOS assessment. Sensory measures included the Sensory Profile Second Edition - Parent (SP2), the Sensory Processing Scale Inventory (SPSI) and Sensory Assessment of Neurodevelopmental Disorders (SAND). Mental health was measured using the Behavioural Assessment System for Children Third Edition (BASC3). The SP2, SPSI and SAND provided symptom scores for auditory, visual and tactile, and total scores for sensory seeking, hypo-reactivity and hyper-reactivity. The BASC3 provided symptom scores for hyperactivity, aggression, anxiety, depression, somatization, anger control, bullying, emotional self-control, executive functioning and negative emotionality, and index scores for executive functioning, attention control, behaviour control, emotion control, externalising problems and internalising problems. Bivariate correlational analyses were used to assess the relationship between sensory reactivity, behaviour and mental health.

Results: Significant correlations were found between sensory sensitivity constructs and mental health symptoms, with consensus significance found across all three sensory measures for hyper-reactivity and internalizing problems ($p < .05$), hypo-reactivity and executive functioning ($p < .05$) and sensation seeking and externalizing problems ($p < .05$). Significance was also found between the BASC3 and individual sensory measures across sensory constructs and sensory domains.

Conclusions: Our results provide further support to emerging research suggesting there is a relationship between sensory reactivity and mental health, both at a total construct level and at an individual domain level. Future directions include understanding the causal relationship between sensory reactivity and mental health

443.024 *(Poster)* Identifying Auditory Subtypes of Children with Autism Spectrum Disorder Based on Pitch Processing: A Machine Learning Approach

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Background: Abnormal auditory processing is commonly reported in autism spectrum disorder (ASD) (Tomcheck et al., 2007). Children with ASD have been found to show enhanced neural sensitivity to pitch changes in pure tones compared to typically developing children at the group level (e.g., Ferri et al., 2003; Yu et al., 2015). These evidences have prompted the notion of auditory hyper-sensitivity. However, it is still unclear that whether such enhanced pitch sensitivity reflects behavioral manifestations of auditory sensitivity. Given the considerable heterogeneity of sensory-perception in ASD (Uljarević et al., 2017), it is also necessary to examine the individual variability existing in the observed neurobehavioral abnormality and how it is implicated in sensory symptoms.

Objectives: This study aimed to examine whether abnormal pure tone pitch-related mismatch negativity (MMN) can identify autistic children with hyper- or hypo-sensitivity in the auditory modality with a machine learning approach.

Methods: Sensory Profile (SP; Dunn, 1994) scores and neural sensitivity measure in terms of MMN to pure tone pitch changes were collected from 38 autistic children (mean age = 10 yrs, *SD* = 1 yrs). First, using K-means clustering, behavioral classification of children was obtained along the hyper-sensitivity dimension based on the low-threshold subscale of the SP, as well as along the hypo-sensitivity dimension using the high-threshold subscale. Second, logistic regression with adaptive lasso penalty was applied with the MMN amplitude at nine classic electrode sites as predictors to determine whether neural measures align with the behavioral classification along the hyper- or hypo-sensitivity dimension.

Results: The F3 and C4 electrodes significantly predicted behavioral classification of children along the hypo-sensitivity dimension. Specifically, MMN amplitude reduction at F3 and increment at C4 were associated with the presence of auditory hypo-sensitivity, with a classification accuracy of 71%, sensitivity of 70% and specificity of 72%. No electrode contributed to the classification of children along the hyper-sensitivity dimension.

Conclusions: The neural measures of pitch processing predicted the behavioral manifestation of auditory atypicality to some extent. However, the results also indicated that the alignment between the Sensory Profile and neural measures of sensory abnormality was questionable. Further research is needed with larger sample sizes to examine the validity of the parent-reported assessment for sensory hyper- and hypo-sensitivity. Multi-dimensional evaluations would provide important insights for the subtyping of sensory abnormality in ASD.

Keywords: ASD, Sensory Profile, pitch processing, machine learning

443.025 *(Poster)* Identifying Strengths in Preschool Autistic Children: Using the New Autism Toddler Strengths and Interests Questionnaire-Atsiq

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Background: The enhanced perceptual functioning model proposes a unique profile of perceptual strengths and an association between interests and strengths (Mottron et al. 2006; Samson et al. 2012). This relation is well established in the adolescent and adult autistic population (Jones et al. 2018; Mercier et al. 2000). Recent data suggest that early interests in autistic children could be correlated with perceptive cognitive peaks later in the life trajectory (Mottron, 2017; Ostrolenk et al. 2017). However, perceptual strengths in preschool autistic children are sparsely documented and how they are associated to their interests at that particular stage of development is unknown.

Objectives: 1-To document preschool autistic children's strengths by comparing them to those of typical children using the *Autism Toddler Strengths and Interests Questionnaire* (ATSIQ). 2-To document, according to parents, how interests are associated to strengths in preschool autistic children using the ATSIQ.

Methods: The ATSIQ, a parent-reported questionnaire documenting interests and strengths of preschool autistic children, was completed during a phone interview with 27 parents of autistic children (Mean age = 59.89 months *SD*= 8.21) and 28 parents of age-matched typically developing children (Mean age = 54.86 months *SD*= 16.26; *p*=.156). Two quantitative sections composed of 27 and 12 items are respectively designed to document the nature and frequency of 1-interests and 2-strengths. Most frequent interests (electronics, logos, numbers, letters and plumbing) were reported in a previous publication (Larose et al. 2018). Non-parametric tests (U Mann-Whitney) were performed to compare the frequency of each reported strength between autistic and typical children. The qualitative section of the ATSIQ is composed of 5 open questions allowing the parent to comment on the evolution of his child's most prominent interest. A content analysis was used to evaluate the trajectory of the above-mentioned more frequent interests.

Results: Parents identified three strengths that were significantly more frequent in autistic children in comparison to typical children: Forms, Construction and Manipulation of screens (all *p*'s<.01). No strengths were identified as more frequent in typical children. Four major themes were extracted from the thematic analysis, all of which indicated a positive impact of the use of letters, numbers and electronics (3 of the 5 previously identified frequent interests): 1-skills enhancement, 2-use of varied materials, 3-development of autonomy and 4-development of parallel skills.

Conclusions: The present study is among the first attempt to document specific strengths in preschool autistic children. It also provided information on the evolution of strengths early on in autism development. The use of the ATSIQ, specifically designed to document interests and strengths in preschool autistic children, could improve our understanding of autistic characteristics and how they contribute to learning, skill acquisition and development of expertise in autism.

443.026 *(Poster)* Impaired Spontaneous Mimicry and Elicited Motor Imitation in Autism: Interactions and Associations with Clinical Presentation

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Background: Impaired motor imitation is commonly reported in individuals with autism spectrum disorder (ASD). Given the importance of imitation for facilitating social interactions and learning, imitation impairments in ASD may be associated with decreased social-communicativefunctioning. Motor imitation may occur spontaneously insocialcontexts (e.g., yawning after seeing others yawn) or instructuredcontextsthatprompt, orelicit, imitation (e.g., copying an expert during a training). There is evidence that both spontaneous (Helt et al., 2010) and elicited (Mostofsky et al., 2006) imitation are impaired in ASD. However, no research to date has examined how these two forms of imitation are related to each other and may uniquely inform autism-associated social-communicative deficits within the same cohort of children with ASD.

Objectives: This study aims to: (1) examine, in the same cohort of children with ASD, performance on both spontaneous and elicited motor imitation tasks as compared to typically-developing (TD) children, and (2) examine associations of elicited and spontaneous imitation performance with ASD diagnosis, clinical severity and core clinical features of ASD.

Methods: Forty children, aged 8-12 years, participated (20 ASD, 20 TD). The measure of spontaneousimitationwas the frequency of specific gestures copied (i.e., face-rubbing, arm-scratching, and yawning) during a storytelling taskin which a narrator inconspicuously performed those actions. Elicited imitation was assessed using a one-minute, engaging videogame-like task during which the children were instructed to imitate the dance-like movements of an avatar. Motion tracking data collected with Kinect Xbox cameras was analyzed using a novel Computerized Assessment of Motor Imitation (CAMI) algorithm to assess imitation performance.

ASD severity was assessed using the Autism Diagnostic Observation Schedule (ADOS-2) administered on-site; core clinical features of ASD was assessed using the Social Responsiveness Scale (SRS-2) questionnaire which was collected from parents.

Results: There was no significant association between elicited and spontaneous imitation (R=0.04; p=0.81). A multiple linear regression examining effects of imitation measures on diagnosis (ASD vs TD) revealed that poorer performance in the elicited imitation task (b=-0.70, p=0.001) was a better predictor of ASD diagnosis than spontaneous imitation task performance (b=-0.04, p=0.71).

A multiple linear regression test with ADOS-2 score as the dependent variable revealed that neither elicited (b=0.26, p=0.30) nor spontaneous imitation (b=0.08, p=0.74) were predictive of ASD clinical severity.

A final multiple linear regression test with SRS-2 total score as the dependent variable also showed that elicited imitation (b=-0.55, p<0.001) was a better predictor of social responsiveness than spontaneous imitation (b=-0.09, p=0.53). Follow-up Pearson correlation analyses indicated that, within the sub-scales of SRS-2, elicited imitation performance was associated with both restricted and repetitive behaviors (R=-0.59, p<0.001) and social-communication and interaction impairments (R=-0.53, p<0.001).

Conclusions: Our findings suggest that ASD-associated impairments in spontaneous and elicited imitation are not correlated. Elicited imitation deficits appear more indicative of autism diagnosis and greater symptom severity, although this may be related to the increased precision of assessment with the CAMI algorithm rather than the underlying constructs. The findings warrant further investigation of the comparative and inter-related associations of spontaneous and elicited imitation with aspects of autism presentation.

443.027 *(Poster)* Insistence-on-Sameness Repetitive Behaviors in Young Children with ASD: Age of Emergence, Relationship to Cognitive Level, and Expression in the Daily Routine and Play

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Background: Recent research has shown that restricted and repetitive behaviors (RRBs) reliably occur in young children with ASD, and that different subtypes ("higher order" --Insistence on Sameness (IS) and Restricted Interests--and "lower order" --Motor Stereotypies and Sensory Abnormalities) are fairly distinct in neural substrate, genetics, and developmental course (Lam, Bodfish, and Piven, 2008). Richler et al. (2010) demonstrated that IS behaviors were present in two-year olds at low levels and increased up to four years of age. However, no detailed information currently exists regarding their presence in children under two years of age, or their development and specific manifestations. This study used a younger group (from 17 months) and a more comprehensive list of behaviors than typically sampled.

Objectives: 1) Document ages IS behaviors first appeared in the sample, 2) Examine the relationship between cognitive level and IS, and 3) Provide functional examples, and relative frequency, of IS behaviors in infants, toddlers, and young preschoolers.

Methods: This archival, cross-sectional study used diagnostic evaluation reports/test protocols for 58 children with ASD, ages 17 to 48 months (M_{age}= 2.4 years, SD=1.2, 82% male, 84% White/Non-Hispanic). Instruments.*RRBs*. A new RRB instrument for young children with ASD, the Infant-Toddler Restricted and Repetitive Behavior Inventory (IRRBI), was used. The IRRBI has six scales: Motor Stereotypies, Visual Stereotypies, Repetitive Play, IS (two subscales: Daily Routines and Ritualized Play), Restricted Interests, and Sensory Reactions. Each scale has clusters (of items) based on functional categories. *Cognitive.*The Diagnostic Assessment Scale and the Mullen Scales of Early Development provided VIQ, NVIQ, and FSIQ. Procedure. Two raters coded the evaluation materials for 28 charts using the IRRBI. Mean Cohen's kappa across scales was .58, and .62 for IS. Analyses.Pearson correlations were conducted to examine the association between IS and age and cognitive skills. ANOVAs were conducted to examine the differences in RRBs among five age groups of six-month intervals.

Results: Relationship with Chronologic Age. Age was significantly correlated with both IS subscales (r=.327, p=.014 for Daily Routines; r=.362, p=.006 for Ritualized Play). ANOVAs for mean item endorsement over five increasing age groups showed significant group differences for Daily Routines (F=3.265, p=.019) and Play Routines (F=3.164, p=.021). Relationship with Cognitive Scores. VIQ significantly correlated with Ritualized Play (r=.415, p =.002) but not Daily Routines (r=-.058, p=.674); NVIQ significantly correlated with Total Sameness (r=.413, p =.002) but neither subscale individually. Age of Emergence. Although most types of IS behaviors were more frequent as age increased, Daily Routines first emerged at 21 months. The specific IS behavior identified at this age was related to wanting morning and/or evening care routines the same. Developing one's own idiosyncratic routine with toy or game, a behavior in the Ritualized Play subscale, first emerged at 17 months.

Conclusions: Consistent with previous studies, IS behaviors increased from toddlerhood to preschool age. The relationship with cognitive level is discussed in light of the mixed findings of previous studies. This study contributes novel, detailed information about early IS behaviors, age of emergence, and association with cognitive level.

443.028 *(Poster)* Integration of Visual and Proprioceptive Information in Children with Autism Spectrum Disorder

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Background: Variations in sensory reactivity were recently added to the diagnostic criteria for autism spectrum disorder (ASD), yet limited studies have investigated the role of proprioception and its integration with other sensory modalities in the autism phenotype. The proprioceptive sense plays a critical role in early motor planning and coordination, designating this type of perception as an important facet of typical development. As such, innate alterations in proprioception may implicate downstream developmental variability and contribute to features of ASD involving repetitive behaviors and social communication. Investigation of simultaneous perception of proprioceptive and visual information may provide insight into proprioceptive functioning and multisensory integration in this population.

Objectives: To investigate whether children with ASD utilize and integrate proprioceptive and visual information differently as compared to children with typical development (TD) by exploring weighting of and reliance on visual and proprioceptive cues in a virtual reality (VR) task.

Methods: We evaluated proprioceptive-visual integration with a stimulus that paired movement of the participant's physical hand with the visual presentation of a virtual sheet of dots that moved in the same plane as the hand. While viewing the visual stimulus, participants held a VR controller attached to a sliding rail and moved their hand along the rail. Virtual dot speed was matched to the hand motion speed, and dot direction was either mapped exactly onto the hand movement (congruent condition), or at an angle slightly horizontally offset to the hand motion (incongruent condition). After each trial, the participants reported the perceived direction of the visual motion by adjusting a dial. Four children with ASD aged 9-17 and five IQ and age-matched TD controls have each completed 512 total trials, with six offset angles as well as no-offset trials. We expected that the hand motion would influence the perceived direction of the visual stimulus. We quantified this visual perception change by measuring the difference between the perceived angle (reported by the dial) and the true visual angle.

Results: In both groups, the perceived visual stimulus direction was repulsed away from the hand motion. Mixed design ANOVA reveals a significant main effect of angle on level of repulsion ($F(1,3)=3.35$, $p=0.029$). The magnitude of repulsion correlates positively with the degree of incongruence, with marginally stronger correlation in TD (TD:r=.791; ASD:r=.327). The differences in repulsion between the ASD and TD groups at various incongruent conditions do not reach statistical significance, but appear to trend toward weaker repulsion in ASD when the incongruence brings the visual stimulus toward the central field of vision.

Conclusions: These early results demonstrate that TD and ASD groups may utilize visual and proprioceptive information differently when making perceptual judgments that employs both modalities. Results suggest decreased coupling of visual and proprioceptive information as incongruence increases, an effect that appears marginally stronger in the TD group. Children with ASD may perceive visual and proprioceptive information as more tightly coupled in central visual fields and may integrate competing information differently.

443.029 *(Poster)* Intense Interests in Relation to Later Autism Symptoms and Internalizing Problems in Typically Developing Toddlers and Toddlers Who Develop ASD

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Background: Circumscribed and unusually intense interests represent a core characteristic of autism spectrum disorder (ASD). However, intense interests have historically been omitted from autism assessments early in childhood. There is evidence that young children, both those with and without autism, do show extremely intense interests. Understanding intense interests early in childhood may augment early identification and may have prognostic value.

Objectives:

1. Examine whether interest intensity and peculiarity at 18- and 24-months is associated with autism diagnosis.
2. Investigate longitudinal correlates of early intense interests for children not diagnosed with ASD.

Methods: This study prospectively examined infants at high-familial-risk (HR) and low-familial-risk (LR) for ASD. Participants included HR younger siblings who were diagnosed with ASD at 24 months (HR-ASD, n=43), HR siblings who did not receive an ASD diagnosis (HR-Neg, n=127) and an LR comparison group (LR, n=62). We collected the Intense Interests Inventory (I-3; Elison & Bodfish, 2009), a semi-structured interview that measures intensity and peculiarity of interests (each measured on a 1-5 point scale) at 18- and 24-months of age. We also collected measures of autism symptoms (i.e., SRS) and socio-emotional problems (i.e., CBCL) at 36 months of age.

Results: There was a difference in 24-month interest intensity and peculiarity by diagnostic group, $F_{intensity}(2,228)=7.46$, $p=.001$, $F_{peculiarity}(2,227)=11.68$, $p<.001$ (Table 1). The LR group showed lower intensity interests than HR-Neg and HR-ASD groups (p's<.02), though the HR-Neg and HR-ASD were not significantly different from each other ($p>.05$). For 24-month peculiarity, the HR-ASD group differed from both the HR-Neg and LR groups (p's<.001), but the HR-Neg and LR group did not differ from each other ($p>.05$). At 18 months, there was a diagnostic group difference in interest peculiarity only, $F_{intensity}(2,228)=4.44$, $p=.01$, such that the HR-ASD group showed higher peculiarity scores than the LR group ($p=.01$), but not the HR-Neg group ($p>.05$). We then examined whether differences in interest intensity correlated with later autism and emotional symptoms in the non-diagnosed (i.e., LR and HR-Neg) groups. Intensity of interests at 18 and 24 months were both positively related to social impairments on the SRS at 36 months (p's<.05). Intensity of interests at 24 months was also related to total problems on the CBCL at 36 months ($p=.03$).

Conclusions: Young children, both those with and without ASD, show great variability in intensity and peculiarity of interests. Peculiarity of interests appears to be especially informative for later ASD outcomes. For children who do not go on to develop ASD, early intensity of interests appears to be related to later social difficulties and behavioral problems. It may be that those who show early intense interests are less flexible in their attention, which might be an early marker for psychopathology generally, as well as subclinical autism characteristics.

443.030 *(Poster)* Interventions Using Neurotypical Peers and Siblings to Influence Motor Skills, Physical Activity, and Play in Individuals with Autism Spectrum Disorder: A Review of Literature

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Background: Many individuals with Autism Spectrum Disorder (ASD) experience motor skill development delays or deficits (Fournier et al. 2010). Inadequate motor skills can lead to lower participation in physical activity and more sedentary behavior which can increase the risk of being overweight or obese (Curtin, Jojic, & Bandini, 2014). Research also indicates motor skill development is associated with social skills (MacDonald et al. 2013), language development (McCleery et al, 2013), and cognitive skills (Bedford et al. 2016). Siblings are the most significant members of families after parents. Accordingly, the involvement of neurotypical siblings in the upbringing of individuals with disabilities could have long term positive consequences (Banda, 2015). Peers also play an important role by fostering inclusion in the school setting and creating opportunities for individuals with ASD to practice skills with multiple people. However, few interventions on motor skills, physical activity, and play for children with ASD have been investigated, and our knowledge is even more limited on the effect of peer and sibling involvement.

Objectives: To summarize the existing interventions using neurotypical siblings or peers to influence motor skills, physical activity, and play in individuals with ASD.

Methods: Databases including PubMed, Web of Science, Education Resources Information Center (ERIC), Sports Medicine and Education Index (Previous known as Physical Education Index), and PsycINFO (on ProQuest) were searched for relevant studies published prior to August 2019. Studies that met the following criteria were included: (a) Participants of the studies included neurotypical siblings/peers and participants with ASD; (b) There is interaction between neurotypical siblings/peers and individuals with ASD; (c) Desired outcomes of the studies related to motor, physical activity or play behaviors.

Results: The full search process produced a total of 2671 studies. Of those, 19 studies met the inclusion criteria. Participants were aged between means of 4 to 13 years. Sample size of included studies ranged from 3 to 44, and the ratios of individuals with ASD to their neurotypical siblings or peers ranged from 1:1 to 3:41. 10 out of 19 studies were conducted in a school setting, while the other 9 studies were conducted at home, summer camp, university-based early childhood center, or hospital and health center, etc. 12 out of 19 studies provided pre-training for neurotypical siblings or peers only, both children with ASD and their neurotypical siblings or peers, or parents. Intervention activities included physical education lessons, hide-and-seek, free play, catching, and balance beam, etc. The duration of the included studies varied from 2 to 16 weeks, and each study used varied measures of outcomes. Overall, included studies showed improvements in motor skills, physical activity, and play of participants with ASD.

Conclusions: This review summarized the existing interventions using neurotypical siblings or peers to influence motor skills, physical activity, and play in individuals with ASD. In the future, more sibling- and peer-mediated or guided interventions are needed with motor skills, physical activity, or play behavior as main targeted outcomes.

443.031 *(Poster)* Investigating the Factor Structure of the Childhood Routines Inventory-Revised in the EU-AIMS LEAP Cohort

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Background: The Childhood Routines Inventory-Revised (CRI-R) is a standardised measure of repetitive and ritualistic behaviours. In a large representative sample of over 3000 individuals aged 2-17 years, the CRI-R yielded two factors: Rigidity/insistence on sameness (RIS) and Repetitive sensory and motor behaviours/compulsions (RSMBC). It is not known whether the same factor structure applies to individuals with clinical diagnoses of autism spectrum disorder (ASD).

Objectives: 1) Investigate the factor structure of the CRI-R in children/adolescents with ASD from EU-AIMS LEAP; 2) Examine associations among factors and with clinical correlates.

Methods: Parents of 137 individuals with ASD and 87 comparison individuals (N=78 TD; N=9 ID) aged 6-17 years completed the CRI-R. Principal axis exploratory factor analysis (EFA) was conducted for the ASD sample. The resultant 5-factor solution was then tested with confirmatory factor analysis and compared to the published 2-factor structure, for the ASD group and total sample. Internal consistency was examined. Convergent and discriminant validity were established; the former by comparing factors with the Repetitive Behaviour Scale-Revised (RBS-R) subscales (ASD only), and the latter by comparing cases and controls. In the ASD group, associations with demographic (age, IQ, sex) and clinical variables (Social Responsiveness Scale (SRS), Sensory Experience Questionnaire (SEQ), Strengths and Difficulties Questionnaire (SDQ), DSM-5 ADHD rating scales) were investigated using Spearman's correlation.

Results: EFA yielded a 5-factor solution, which then showed a superior model fit to the 2-factor solution (CFI=0.667, RMSEA=0.086 vs. CFI=0.568, RMSEA=0.095). The factors were interpretable as: “Compulsive/Sameness”, “Food rigidities”, “Restricted/Repetitions”, “Self-directed motor behaviours” (SDMB) and “Aversion to sensory/novelty”, accounting for 47% of the variance. The first two factors comprise the original RIS factor, the last two factors represent the RSMBC factor and Restricted/Repetitions items were split between the two. Internal consistency was demonstrated in the ASD group (alphas ranging 0.83-0.95) and in the TD/ID sample (0.63-0.92). The ASD group scored significantly higher than the TD/ID group on all factors (*d*’s ranging 1.03 (Food rigidities) to 1.40 (Compulsive-Sameness), *p*s<5.69e-12). In the ASD group, correlations with RBS-R subscales ranged from r_s=0.15 (CRI-R Food rigidities–RBS-R Stereotyped behaviour, *p*=.1; Fig1) to r_s=0.73 (CRI-R Compulsive/Sameness–RBS-R Ritualistic-Sameness, *p*<2.2e-16). ASD females scored significantly higher than ASD males on SDMB (*p*=.046, *d*=0.33, other *p*s>.2). In the ASD group, age correlated negatively with Restricted/Repetitions (r_s=-0.30, *p*=.0005) and SDMB (r_s=-0.19, *p*=.031). IQ was not associated with any factors (*p*s>.1). Social communication difficulties (SRS) related to higher scores on all factors (r_s=0.18-0.45, *p*s<.04). Aversion to sensory/novelty and Compulsive/Sameness correlated most highly with sensory sensitivities on the SEQ (r_s=0.71, *p*s<2.2e-16), though all factors were significantly related (r_s=0.37-0.63, *p*s<1.21e-05). Anxiety was most strongly associated with Compulsive/Sameness (r_s=0.55, *p*=9.54e-11), whilst ADHD-hyperactivity-impulsivity was most strongly associated with SDMB (r_s=0.57, p=7.98e-13) and ADHD-inattention with Restricted/Repetitions (r_s=0.30, p=.0006). See Fig1.

Conclusions: Evidence supports a 5-factor structure on the CRI-R in a clinical ASD cohort and shows differing strengths of associations with key clinical correlates, including core ASD and associated symptoms. These factors may facilitate a better understanding of RRB subtypes, both in terms of their clinical profiles and possible neural and genetic substrates.

443.032 *(Poster)* Levels of Physical Activity Among Children with and without Autism Spectrum Disorder between the Ages of 2 and 9 Years

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Background: One of the most widely researched components of health are weight status and physical activity (PA). To date, the majority of PA results have been based on parental report data from the National Survey of Children’s Health. While this provides a national estimate of PA for children with and without ASD, there remains very little objective data examining levels of PA among young children with ASD. The latest PA Guidelines for Americans recommend that preschool aged children (2 to 5 years) engage in active play throughout the day and school aged children (6 to 17 years) engage in at least 60 minutes of moderate to vigorous physical activity (MVPA) each day.

Objectives: The purpose of this study is to examine weight status and levels of PA among children with and without ASD, between the ages of 2 and 9 years.

Methods: 54 children with ASD and 47 neurotypical children were divided by age into 2 groups: preschool (2 to 5 years) and school (6 to 9 years). Height (cm) and weight (kg) were measured and body mass index (BMI) was calculated. BMI percentiles were used to determine weight classification relative to children of the same age and sex. PA was measured objectively for 7 days using Actigraph GT3X+ accelerometers. Wear time was validated manually using parental logs and Actilife 6 data analysis software. Intensities of PA were determined using the Butte (2011) and Evenson (2008) activity cut points for preschool- and school-aged children, respectively. Independent samples t-tests were used for all analyses.

Results: 40.9% and 42.9% of preschool- and school-aged children with ASD were classified as overweight or obese. These estimates are significantly higher compared to 9.1% and 8% of neurotypical children in the same age groups [t(1,95) = 2.580, p = .011, d = .52]. Overall, the mean of all groups exceeded the recommended 60 minutes of MVPA. There were no significant differences in MVPA between children with and without ASD [t(1, 98) = -.174, p = .862]. However, only 37.5% of children with ASD compared to 41.7% of neurotypical children participated in at least 60 minutes of MVPA on most days of the week. Among children with ASD, there were no significant differences in MVPA when comparing children who were of healthy weight and those who were overweight or obese [t(1, 47) = -.543, p = .590].

Conclusions: Despite having significantly higher levels of overweight and obesity, children with ASD engage in similar amounts of objectively measured PA. Accelerometers do not differentiate between purposeful and stereotypical movements, meaning that for children with ASD not all PA has health benefits. Current PA recommendations do not seem sufficient, given the estimated number of young children with ASD who are already overweight or obese. In order to improve and promote positive trajectories of health, PA recommendations may need to be more robust and more specific to age related cohorts as many children with ASD already seem to be meeting the current recommendations.

443.033 *(Poster)* Manual Motor Deficits in Individuals with Autism Spectrum Disorder and Their Unaffected Biological Parents

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Background: Sensorimotor impairments, including feedforward and feedback deficits of manual motor control, are prevalent in individuals with autism spectrum disorder (ASD). Oculomotor impairments also have been documented in unaffected relatives of individuals with ASD. The degrees to which skeletomotor systems are affected in unaffected parents and are familial have not yet been determined.

Objectives: 1) To examine precision manual motor control in individuals with ASD and their biological parents, and 2) to determine whether manual motor impairments are familial.

Methods: We studied 53 probands with ASD and 100 parents of individuals with ASD (ASD parents). Thirty three typically developing (TD) controls were matched with probands on age (5-17 years), and nonverbal IQ. An additional 42 controls were matched with ASD parents on age (29-54 years), sex, and IQ. All participants completed the sustained task across varying force conditions (force task) and a subgroup of these participants (20 probands, 18 TD controls; 49 parents, 31 parent controls) completed the sustained task across varying visual feedback conditions (gain task) to assess motor and visuomotor feedback mechanisms. During the tasks, participants pressed opposing load cells with their thumb and index finger while they viewed a static red/green target bar and a white force bar that moved upwards with increased force. They were instructed to press when the target bar turned green so that the white bar reached the level of the target bar and hold it there as steadily as possible for 8 seconds. We measured the variability of the sustained force and the complexity of the force time series.

Results: During the sustained force task, ASD participants showed greater variability (p=0.03) and reduced complexity (p=0.01) compared to TD controls. Similarly, parents showed increased variability compared to controls during the highest force condition (group x MVC interaction, p=0.05). During the sustained gain task, ASD participants showed increased variability at the highest gain level (p<0.001) and reduced complexity (p<0.001) across conditions compared to TD controls. ASD parents also showed reduced complexity compared to controls when using their nondominant hand (p=0.02). Data collection is complete and analysis of the familiality of sensorimotor issues in ASD is ongoing.

Conclusions: We found that individuals with ASD and their unaffected biological parents show reduced precision manual motor control suggesting that these impairments may be familial. Specifically, individuals with ASD and their parents show a reduced ability to integrate sensory feedback to make corrective motor adjustments to decrease variability. These studies implicate cortico-cerebellar circuits involved in sensory feedback control of precision motor behaviors in the pathophysiology of ASD, and highlight new motor physiological targets useful for characterizing genotype-phenotype relationships in family genetic studies.

443.034 *(Poster)* PTEN Mutation As a Model for Understanding of Restricted and Repetitive Behaviors in Children and Adolescents

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Background: Germline mutations in *PTEN* are associated with abnormalities in white-matter and impaired cognitive abilities among individuals with autism spectrum disorder (ASD), as well as expression of both social impairments and restricted and repetitive pattern of behaviors and interests (RRB) in animal models. However, limited progress has been made in understanding whether *PTEN* mutations are associated with specific phenotypic profiles when compared to idiopathic ASD. This knowledge gap is particularly pronounced in terms of RRB domain. The impairments in specific aspects of executive functioning, heightened rates of anxiety and motor abnormalities have been associated with PTEN loss in both animal models and clinical studies. Given that these processes have been suggested to serve as transdiagnostic mechanisms underpinning Insistence on Sameness (IS), Circumscribed Interests (CI) and Repetitive Motor Behaviors (RMB) RRB domains, *PTEN* mutation offers a unique model for furthering our understanding of the mechanisms involved in the development and maintenance of RRB and therefore has the potential to inform the development of targeted treatments.

Objectives: To (i) characterize RRB profiles in children and adolescents with *PTEN* mutation with no ASD (PTEN-No ASD), *PTEN* mutation with ASD (PTEN-ASD) and idiopathic ASD with macrocephaly but no *PTEN* mutation (macro-ASD) groups and (ii) explore continuities and discontinuities in predictors of distinct RRB domains across these groups.

Methods: Sample included 28 individuals with *PTEN* no ASD (M_{age}= 9.19years, *SD*= 4.91), 43 with *PTEN*-ASD (M_{age}= 11.79 years, *SD*= 5.34) and 33 with macro-ASD (M_{age}= 9.21 years, *SD*= 4.72). The Repetitive Behavior Scale-Revised (RBS-R), the Child Behavior Checklist (CBCL), Behavior Rating Inventory of Executive Function (BRIEF), and the Developmental Coordination Disorder Questionnaire (DCDQ) were completed by parents as measures of RMB, IS and CI (RBS-R), negative valence (CBCL internalizing score), response inhibition and set-shifting (BRIEF) and motor problems (DCDQ). Full Scale IQ (FSIQ) data was also available.

Results: There were significant group effects for RBS-R RMB (*F*= 5.01, *p*= .009) and Circumscribed Interests (*F*= 8.48, *p*< .001) but not for IS (*F*= 1.02, *p*= .37) scores. Post-hoc comparisons showed that *PTEN*-no ASD group had significantly lower RMB and CI scores than both *PTEN*-ASD and Macro-ASD groups, which, in turn, did not significantly differ. Across all three groups higher IS severity was associated with higher CBCL internalizing scores (*r* range: .44-.77) and greater difficulties with set shifting (*r* range: .60-.88). Problems with response inhibition were associated with greater CI severity (*r* range: .35-.78). Motor problems were significantly associated with RMB only in Macro-ASD group (*r*= -.54, *p*< .001) but not in the other two groups. The FSIQ score was significantly associated with RMB across *PTEN*-ASD (*r*= -.57, *p*= .002) and macro-ASD groups (*r*= -.44, *p*= .03) but not in PTEN-No ASD group.

Conclusions: This investigation provides the first preliminary evidence for common and distinct mechanisms influencing RRB domains across *PTEN*-ASD, *PTEN*-no ASD and Macro-ASD groups. These findings have important implications for the design of targeted treatment strategies.

443.035 *(Poster)* Participation in Physical Activity, Sport, and Physical Education Among Canadian Children and Youth on the Autism Spectrum

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Background: A growing body of literature suggests that children and youth on the autism spectrum are less physically active than their neurotypical peers. Insufficient physical activity may have detrimental effects on the physical, mental, and cognitive well-being of this population. However, we still have a limited understanding of the types of physical activity in which children and youth on the autism spectrum participate (e.g., active play, sports, physical education). Further, no large-scale studies have examined physical activity participation in a Canadian sample of children and youth on the autism spectrum.

Objectives: The National Physical Activity Measurement (NPAM) study aims to address the lack of population-level data on physical activity participation among Canadian children and youth with disabilities. The aim of the current sub-analysis was to examine the rate of participation in overall physical activity, as well as two sub-types of physical activity (sport and physical education) among Canadian children and youth on the autism spectrum.

Methods: School-aged children and youth (4-17 years) on the autism spectrum were recruited across Canada through various community and sport/recreation organizations. Parents reported their child's demographic characteristics, along with their rates of participation in physical activity via an online questionnaire. Participants were then mailed a Fitbit Charge HR and instructed to wear it for 28 consecutive days. Descriptive analyses were used to describe participants' level of participation in overall physical activity and the subtypes of sports and physical education. Fitbit analyses are on-going and will provide a direct measure of physical activity.

Results: Data on 255 participants (78% male, 9.4±3.3yrs) on the autism spectrum has been provided thus far. Results demonstrate that the majority (86%) of participants are not engaging in the recommended 60 minutes of moderate-to-vigorous physical activity (MVPA) each day, with the average participant only meeting the recommended dose of MVPA on three days per week. Moreover, overall participation in leisure-time physical activity was generally low, averaging 34±39 minutes per day. In regard to sport participation, fewer than half (48%) of the participants engaged in unorganized sports (i.e., without a coach) in school, while two-thirds (66%) of participants engaged in unorganized sports outside of school. In contrast, higher rates of engagement in organized sports (i.e., with a coach) were reported, with 63% and 85% of participants engaging in and outside of school, respectively. Lastly, time spent in physical education ranged from 0 to 570 minutes per week, with participants engaging in physical education classes for an average of 108±90 minutes per week.

Conclusions: Preliminary findings from this sub-analysis of NPAM data indicate that Canadian children and youth on the autism spectrum are not meeting physical activity guidelines. Participation in unorganized physical activities and sports appear to be particularly low in this population. Next steps include further analyses of this data including an examination of individual (e.g., level of functioning), familial (e.g., SES), and environmental (e.g., neighbourhood amenities) factors that may help to further explain and contextualize the participation levels of children and youth on the autism spectrum.

443.036 *(Poster)* Physical Activity and Screen-Time Among Children with Autism; A Longitudinal Analysis from 9 to 18 Years.

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Background: Children with autism spectrum disorder are at an increased risk of poor health outcomes when compared to neurotypical children (Scharoun, 2017). For example, children with ASD have a higher prevalence of obesity compared to their neurotypical peers (23.05% versus 15.91%) (Healy, 2018). In an effort to understand and ultimately reduce these health disparities, researchers have examined modifiable health behaviors, including physical activity (PA) and screen-time (ST). However, our current understandings of PA and SB are derived primarily from cross sectional studies. There are no known longitudinal studies which have examined these health behaviors in children with ASD across time.

Objectives: The purpose of this study was to examine how time spent in physical activity and screen-time changed over time among children with and without ASD.

Methods: Data were utilized from three different time points (age 9, 13 and 17/18)of a nationally representative longitudinal dataset 'Growing up in Ireland'. Parents and youth reported on demographic variables (e.g., sex, socio-economic status, and support services received), time in PA (days with at least 20 minutes of vigorous PA and days with at least 20 minutes of light PA over the last ten days) and time in ST (hours per weekday spent watching television and hours spent playing videogames). T-tests and robust regression analyses were used to understand the relationship between the matched sample and the variables of interest.

Results: The study included 88 children with ASD and a propensity-score matched sample of 88 neurotypical children, matched based on sex and income at waves 1, 2, and 3. The full sample included 138 males and 38 females. At all time-points (i.e. 9, 13, and 17/18 years of age), children with ASD were significantly less likely to engage in VPA compared to neurotypical children (all p's < .05). From age 9 to age 17/18, VPA decreased for both groups, with a steeper decline among children with ASD (p = .002). More specifically children with ASD most commonly participated in 9+ days of VPA at age 9, 1-2 days at age 13, and 0 days at age 17/18. This compared to neurotypical children who most commonly participated in 9+ days of VPA at age 9 and 13, and 6-8 days of VPA at age 17/18. Regarding light PA, children with ASD and neurotypical children participated in similar levels at aged 9 and 17/18 but were significantly less active at age 13 (p = .0013). Time spent watching TV or playing video-games did not differ between groups at each of the three time-points.

Conclusions: This study, for the first time, examined PA and ST levels from childhood to late adolescence revealing steep declines in VPA among children with ASD. Interventions to reduce the decline in VPA that occurs from childhood to adolescents are urgently needed among this at-risk population.

443.037 *(Poster)* Preferences of Autistic Children for Multi-Sensory Environment Equipment: Patterns of Use and Individual Differences

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Background: Multi-Sensory Environments (MSEs; also called sensory or Snoezelen rooms) are rooms that contain equipment that modifies the sensory environment. They are common in special needs schools and are widely used with autistic children. However, there is no empirical guidance on how to use MSEs with autistic children. Our qualitative research has shown that practitioners believe the benefits of MSEs occur through autistic users being motivated, which can be fostered by using preferred MSE equipment. However, there have been no investigations to date into the equipment preferences of autistic users, including how preference may vary by relevant characteristics such as sensory profile, autistic symptoms, IQ or age.

Objectives: To investigate autistic children's preferences for MSE equipment, and whether equipment preferences vary according to sensory profile, autistic symptoms, IQ or age.

Methods: Forty-one autistic children (8 female) aged 4-12 years (*M*=8 years, *SD*=2.05 years) were each given free use of an MSE for five-minutes. Four key pieces of equipment were available: a bubble tube; touch, sound and light board; fibre optic cabling; and a tactile board. The frequency and duration (seconds) of visits to each piece of equipment was recorded, as well as where each participant chose to visit first. Sensory behaviours performed during the session were coded from videos. IQ and Autism Diagnostic Observation Schedule-2 (Lord et al. 2012) assessments were also completed. Parents completed the Social Communication Questionnaire (Berument et al., 1999) and the Sensory Profile (Dunn, 1999) questionnaire.

Results: Choice of first visit and frequency and duration of visits produced a rank order preference of equipment: (1) bubble tube; (2) touch, sound and light board; (3) fibre optics; (4) tactile board. Greater hypersensitivity and less time spent performing sensory seeking behaviours correlated with more engagement at the tactile board, which requires interaction for stimulation, and less engagement at the bubble tube, which is highly stimulating without active interaction. Higher IQ was associated with more time spent at equipment requiring active interaction for stimulation (i.e. tactile board, and touch, sound and light board) and less time at equipment requiring no interaction (i.e. bubble tube). Age and degree of autistic symptoms did not associate with patterns of use.

Conclusions: This study is the first to investigate the preferences of autistic children for different types of MSE equipment. The strongest preference was for the bubble tube, which offers auditory, visual and tactile stimulation and is commonly used in MSEs (Unwin et al., in prep). The preferences of autistic children were significantly associated with both their sensory and intellectual profiles. It can be suggested that children's sensory needs are influencing patterns of engagement, while greater intellectual ability seems to draw children to equipment that provides greater capacity for intellectual stimulation. The data imply that practitioner consideration of users' sensory and intellectual profiles can help inform how best to use an MSE with autistic children. Further research should directly measure the impact of equipment preference on motivation and capacity to learn.

443.038 *(Poster)* Presence of Symptoms of Attention Deficit/Hyperactivity Disorder Is Correlated with Increases in Restrictive and Repetitive Behaviors in Children Diagnosed with Autism Spectrum Disorder

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Background: Restrictive and Repetitive Behaviors (RRBs) are a core feature of Autism Spectrum Disorder (ASD) and can be extremely impairing for individuals and their families (Richler, Huerta, Bishop, & Lord, 2010). RRBs are also present in other psychiatric, genetic and developmental disorders (Harrop et al., 2015). They have also been shown to predict symptoms of Attention Deficit/Hyperactivity Disorder (ADHD) (Stratis & Lecavalier, 2013). In Fragile X syndrome, over-activity, impulsivity and repetitive behaviors were found to be higher in participants diagnosed with ASD (Crawford et al., 2018). The effect of ADHD symptoms on the type and severity of RRBs in children with ASD has not yet been researched.

Objectives: To determine, whether overactive symptoms of ADHD are correlated with greater severity of RRBs in children with ASD.

Methods: We completed preliminary analysis on previously gathered data from the Simons Simplex Collection and the Boston cohort of the Autism Consortium by analyzing 87 children 3-15 years with ASD. ASD diagnosis was confirmed using the "gold standard" of Autism Diagnostic Observation Schedule-Second Edition (ADOS-2) and Autism Diagnostic Interview-Revised.

ADOS-2 E1 code for Overactivity was used as a proxy for ADHD. Participants in the analysis were put into two groups. Individuals with a code of "2" on E1 were placed into the "More Activity" group (n=43) and those with a code of "0" on E1 were placed in the "Typical Activity" group (n=44).

The ADOS-2 D codes were used to measure RRBs: D1=Unusual sensory interests, (D-sens); D2=Hand/finger mannerisms (D-man) and D3=Unusually repetitive interests/stereotyped behaviors (D-stereo). In addition, the average of the three D codes (D-avg) and the ADOS RRB total score (RRB-tot) were used.

Since the data was not normally distributed, non-parametric statistics were used in the analysis. First, Mann-Whitney-U tests were used to compare if there was a difference in the RRB-tot and D-Avg. Next, we performed chi-squared test to assess the relationship between the coding of overactivity and the rating distribution of the different types the RRBs (D-sens, D-man and D-stereo).

Results: Preliminary analysis found that individuals in the More Activity group had significantly higher RRB-tot scores than those in the Typical Activity group ($p < 0.01$). D-avg was also higher in the More activity group but did not reach significance (P=0.41).

Children in the More Activity group were significantly more likely than those in the Typical Activity group to have elevated D-stereo codes ($p < 0.01$). There were no significant differences for D-sens ($p = 0.11$) or D-man ($p = 0.97$).

Conclusions: This preliminary analysis supports the hypothesis that individuals with ASD with overactive symptoms of ADHD may have greater severity of certain types of RRBs. In our subsequent analysis, we will control for age, IQ and ADOS comparison score and include additional items from the ADOS-2, Child Behavior Checklist and the Behavior and Sensory Interest Questionnaire (BSIQ) to better understand the impact of symptoms of ADHD on individual RRBs. We predict that our original hypothesis will stand in this more specifically directed analysis.

443.039 *(Poster)* Professional Bias in View of Restricted and Focused Interests: Implications for Educational Settings

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Background: In a 2017 study, Koenig & Williams surveyed adults with autism (n = 85) about the personal significance of their restricted or preferred interests. Participants overwhelmingly indicated that they felt teachers should incorporate preferred interests into the classroom, but pointed out a lack of awareness on teachersâ€™ part of the existence, importance, and power of utilizing studentsâ€™ preferred interests. This follow up study explored the relationship between practitionerâ€™s characterization of studentsâ€™ special interests and the positive, negative or neutral utilization of said interests in actual classroom practice. This survey of professional educators (teachers and related service providers) of students with autism (K-8 grade) sought to capture and characterize how their view of preferred interests is associated with their ability or inability to leverage the motivation that studentsâ€™ special interests can potentially provide in classrooms.

Objectives: To determine professional educators attitudes towards restricted or preferred interests that students on the autism spectrum display in the classroom setting.

Methods: A online survey was sent to general and special educators as well as related service providers in a larger urban school district (n= 80). Survey questions included likert scale items as well as open ended responses to two case scenarios of a young (kindergarten) and older (5th grade) student. Each of these scenarios described a focused interest that a child would typically have and descriptors of behaviors that the child exhibited. Descriptive data was collected on the likert responses. The open ended questions were coded by the research team which included a graduate student on the autism spectrum. A priori codes were set that included such items as "not age appropriate", use of interest for "coercion or control", "respect for intrinsic value" of the interest, etc. These codes were classified as positive, or negative codes and a taxonomy of responses was developed. For example, if a teacher described utilizing the interest for social or learning goals, it was a positive rating. Inter-rater reliability of all coded descriptions was established at 85% agreement on the first round of coding.

Results: Only 5% of the educational professionals surveyed found that interests are very helpful when learning content in the classroom as compared to 70% that used interests to soothe or calm the student. When describing interests in given scenarios, negative ratings predominanted regardless of age, years experience, type of professional or gender. Related service providers had higher frequency ratings of positive descriptions for focused interests than classroom teachers.

Conclusions: There is a dissonance between the benefit that the self advocacy community places on focused interests that could be utilized to enhance learning in classrooms and educational professionals view and use of these interests. These attitudes have the potential to negatively impact not only learning but career pathways and enhanced opportunities for socialization. A taxonomy of attitudes was developed based on the results of this survey that can be used for self rating and review of educational practices. These results can assist in guiding educators to examine their own view and alter practices.

443.040 *(Poster)* Prosodic Changes in Noisy Environments: Sensory Sensitivity Scores Predict Interference of Prosodic Control in Autistic and Non-Autistic Adults

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Background: Autism is associated with sensory differences, including hyper- or hypo-sensitivities, and social communication challenges (APA, 2013). Prosodic changes in speech (changes in pitch, stress, rhythm, etc.), play important roles in social communication, as they express the speaker's emotionality and intent (Bryant & Barrett, 2007). Since one's own auditory feedback helps regulate speech prosody (Donath et al., 2002), exposure to ambient noise may disrupt this process (Foxe et al., 2015). As autistic people report difficulties communicating in noisy environments, it is of interest to investigate whether their auditory sensitivities lead to poorer prosodic control in noisy environments.

Objectives: The objectives of this study were to determine whether increased sensory sensitivity is linked to poorer prosodic control in noisy environments, and whether autistic and non-autistic individuals differ in their vocal pitch control in high noise conditions.

Methods: 13 autistic (M_{age}=29.1, *SD*=12.5; M_{IQ}=114.1, *SD*=12.5; M_{AQ}=33.5, *SD*=7.9) and 25 non-autistic adults (M_{age}=21.4, *SD*=8.4; M_{IQ}=97.8, *SD*=11.4; M_{AQ}=15.9, *SD*=5.8) were recruited. Autistic participants provided documentation of an ASD diagnosis. Participants produced vocalizations while exposed to frequency altered feedback (FAF), +/- 100 cent perturbations of their own vocalizations. During half the trials, a multi-speaker babble track was played. The size of the participants' compensatory responses to the FAF was measured. Difference scores were calculated to quantify interference by the babble by subtracting the median response in the babble condition from the median response in the no babble condition for both +100 and -100 perturbation conditions. The Adolescent/Adult Sensory Profile (SP) was used to assess sensory processing patterns across four domains: low registration, sensation seeking, sensory sensitivity, and sensation avoiding.

Results: Interference scores were entered into an ANOVA with group (autistic, non-autistic) and perturbation direction (+/-100) as factors. A direction by group interaction, $F(1,37)=6.446$, $p=.015$, $\eta p^2=.148$, was found as autistic participants experienced greater interference for -100 cents perturbations, while non-autistic participants experienced greater interference for +100 cent perturbations. A hierarchical linear regression was conducted to determine whether group and/or SP scores could predict interference by the babble. Group alone could not account for significant variance. However, when SP scores were added to the model, significant variance in interference scores was accounted for, $F(5,32)=2.625$, $p=.042$, $R^2=.291$. Specifically, the sensory sensitivity sub-scale of the SP was a significant predictor of interference, $t(1)=2.944$, $p=.006$.

Conclusions: Higher sensory sensitivity predicted greater interference by babble noise on auditory feedback control of speech for both autistic and non-autistic participants. One possible explanation is that in noisy environments, the babble captures more of the hypersensitive individual's attention, leaving fewer cognitive resources available to respond to the perturbation. Hypersensitivities to noise are more common in autistic people, which makes interference in noisy environments more problematic for these individuals. Elevated sympathetic responses to noise in autistic people (Chang et al., 2012) may also contribute to the babble's effects on attention. However, autistic people can also be hyposensitive to noise and this heterogeneity in responses to sound may explain the lack of main effect. Future research will explore how Sensory Profile scores are related to perturbation effects.

443.041 *(Poster)* Quantitative Assessment of Motor Movement in Autism during a Functional Dressing Task

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Background: Sensorimotor challenges have been shown to relate to poorer daily living skills in individuals with autism spectrum disorder (ASD) (Jasmin et al., 2009; Travers et al., 2017), even after controlling for key variables like age and IQ (Travers et al., 2017). However, to our knowledge no study has quantitatively and systematically measured motor skills during functional tasks in youth with ASD. This type of information would inform what aspects of movement may be different in ASD and how movement patterns in ASD may affect performance of everyday tasks.

Objectives: 1) To identify group differences in movement kinematics and postural sway during a dynamic dressing task that mimics real-world dressing, and 2) To examine whether whole-body movement during dressing can reliably distinguish youth with ASD from youth with typical development.

Methods: 54 participants with ASD and 34 age-matched participants with typical development (TD) underwent diagnostic testing and completed our Motor Rainsuit Assessment During Dressing (M-RADD) task. In this task, we asked participants to put a clear rain suit (pants and a jacket) over their clothes, and we recorded whole-body kinematics using a Kinect camera. We then calculated various angles of each participants articulated figure segments and used discrete Wavelet transform to clean the time series of each angle. Next, we used dynamic time warping to measure the dissimilarity between various sessions' time series and used these dissimilarities to train and test support vector classifiers using a leave-one-out cross-validation scheme. We compared classification accuracy, to assess the generalizability of the classification paradigm, along two main dimensions, namely (1) all the sessions vs. pre-balance training sessions, and (2) younger participants vs. older participants (<= vs > participants' median age).

Results: Initial analyses found that the dressing task was completed more slowly in the ASD group than the TD group, $t(158) = 6.81$, $p < 0.01$. Classification positive predictive values (PPV=0.81) and true positive rates (TPR=0.81) were significantly higher in younger participants.

Conclusions: The present findings suggest that the group with ASD tended to complete the dressing task significantly more slowly than the group with typical development. Moreover, the classification analyses, suggested that the motor kinematics during the dressing task were able to distinguish between the two groups with high predictive validity, particularly in the younger participants. Future analyses will examine which movements during dressing were the most distinguishable between the two groups, which will help inform how movement differences may impact those with ASD during daily living tasks.

443.042 *(Poster)* Reduced Lateralization of Precision Motor Behavior in Individuals with Autism Spectrum Disorder

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Background: Sensorimotor abnormalities in autism spectrum disorder (ASD) are highly prevalent, associated with core social and communication impairments, and predictive of worse functional outcomes. Despite frequent reports of increased mixed handedness and atypical lateralization of motor brain networks, few studies have compared precision sensorimotor behavior across dominant and nondominant hands or determined how lateralization of precision motor behavior relates to more complex motor coordination and behavior.

Objectives: 1) Characterize dominant and nondominant precision motor behavior in ASD and healthy controls and 2) Determine associations between sensorimotor behavior and performance on standardized tests of motor abilities.

Methods: A precision grip test was administered to individuals with ASD (N = 63, range = 10-34) and age-matched controls (N = 34). Participants viewed two parallel, horizontal bars (FORCE and TARGET) and were instructed to use their thumb and index finger to press opposing load cells to raise the FORCE bar to the level of the TARGET bar at 15% of maximum voluntary contraction (MVC). Force variability (force SD), and regularity (ApEn) were examined. Clinical measures of fine and gross motor behaviors were evaluated using the Bruininks-Oseretsky Test of Motor Proficiency Ed. 2 (BOT). The Annett Hand Preference Questionnaire was administered to quantify the degree of each individual's lateralized dominance.

Results: Individuals with ASD showed reduced grip strength (MVC) compared to controls when using their dominant hand, but not their nondominant hand. Force SD was increased in ASD compared to controls, but did not differ between hand for either group. Across both groups, ApEn was higher for the dominant compared to the non-dominant hand. Individuals with ASD scored lower on all BOT subscales than healthy controls, including Fine Motor Precision, Fine Motor Integration and Manual Dexterity. Annett rated manual laterality did not differ between groups. Greater ApEn and lower force SD were associated with better performance on the BOT Fine Motor Precision subtest for controls but not for individuals with ASD.

Conclusions: Our finding that grip strength is greater for the dominant relative to the nondominant hand in controls but not in ASD suggests reduced cortical lateralization in patients. These results could reflect perturbations of developmental processes affecting peripheral strength, but lateralized effects more likely reflect neurodevelopmental processes involving specialization of left hemisphere motor cortices. We also find that precision visuomotor behavior is strongly related to everyday tests of fine motor control in healthy controls but not individuals with ASD suggesting that distinct motor issues develop relatively independently in patients. Consistent with previous studies, these findings indicate that deficits in motor skill in ASD cannot be explained by deficits in basic motor behavior alone, but point to dysfunction in left hemisphere parietal-premotor networks that support skilled movements.

443.043 *(Poster)* Relations of Restricted & Repetitive Behaviors to Social Skills in Toddlers with Autism

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Background: Adaptive behavior refers to the skills an individual needs in order to operate independently in their daily environments and is often assessed in four domains using the Vineland. Previous work suggests that individuals with autism tend to have the highest deficits in the socialization domain (Sparrow et al., 2005). Studies have also found that deficits in adaptive behavior tend be higher than general intelligence would predict for individuals with autism (e.g., Perry et al., 2009; Yang et al., 2016), and this discrepancy is also most consistently seen with socialization (Liss et al., 2001). Wolff et al. (2014) found that restrictive repetitive behavior (RRB) was strongly negatively correlated with socialization, but not other domains of adaptive behavior, during toddlerhood, suggesting interplay between RRB and social skills early in development. What is yet unclear is whether specific forms of RRB differentially impact aspects of early social function.

Objectives: To further elucidate relations between RRB and socialization ability, we sought to address the following research questions:

1. Are RRB subtypes (insistence on sameness [IS], repetitive sensory motor [RSM], self-injurious behavior [SIB]) differentially associated with socialization scores among children with ASD at 24 and 36 months?
2. What are the specific relations between each RRB subtype and each aspect of socialization (coping skills, play-leisure, interpersonal relationships)?

Methods: We analyzed longitudinal RBS-R (Bodfish et al. 2000) and Vineland II data from 24 (n = 63) and 36-month olds (n = 35) with a diagnosis of ASD from an ongoing study. For RQ1, a two-step hierarchical multiple linear regression was conducted with standard socialization score as the dependent variable. Sex and Mullen Early Learning Composite were entered at step 1 as control variables, followed by RRB subtypes in step 2. To examine RQ2, multiple linear regressions were conducted with RRB subtypes predicting three aspects of socialization.

Results: Hierarchical multiple regression for 24-month olds revealed that sex and IQ did not contribute significantly to the regression model. Each subtype of RRB (IS, RSM, and SIB) uniquely explained a significant amount of variation in average socialization score. For 36-month olds, IQ contributed significantly to the regression model at step 1, but not sex. When IS, RSM, and SIB were introduced in step 2, IQ remained a significant predictor and sex became significant only for SIB. Each subtype uniquely explained a significant amount of variation in average socialization score (Table 1). For our second research question, analyses revealed that all three RRB subtypes were significant predictors of all three socialization aspects, with the exception of SIB with interpersonal relationships at 36 months (Table 2).

Conclusions: Our findings provide evidence that all three RRB subtypes are negatively associated with multiple aspects of socialization, with RSM showing the strongest effect. These relations were evident even when accounting for general cognitive ability. It is plausible that early RRB interferes with the acquisition of social skills, though experimental work is necessary to investigate this possibility.

443.044 *(Poster)* Saccade Adaptation and Autism Spectrum Disorder

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Background: According to the Center for Disease Control and Prevention, 1 in 59 children is affected by Autism Spectrum Disorder (ASD) which is 4 times more common among boys than among girls. ASD is a neuro-developmental disorder, characterized by social interaction difficulties, communication challenges and a tendency to engage in repetitive behavior. In the literature, there is some evidence that eye movement performances in a saccadic adaptation task are reduced in a subgroup of individual with ASD. However, results are not consistent and more research is necessary to show that this could be used as a potential indicator of ASD.

Objectives: In this paper, we will examine the hypothesis that saccadic adaptation performances are reduced in individuals with ASD compared to typically developing. We will also investigate the impact of individuals' age on those performances.

Methods: In this experiment, individuals between the age of 7 and 45 years old served as participants during a saccadic adaptation task. Thirty were diagnosed with Autism Spectrum Disorder (ASD) while sixty-six were typically developing (TD). Pre-adaptation and post-adaptation trials were similar and started with the presentation of a central fixation cross (T0) that participants were instructed to fixate within ± 1.25° between 600 and 1200 ms. After this interval, T0 was turned off and a new target (T1) was presented 20° to either the left or right or 10° to either the top or bottom of the T0 location. Participants were then asked to look at the T1 target as fast as they could. Initiation of the saccade was detected and the T1 target was turned off before the saccade was complete. After 68 pre-adaptation trials, adaptation trials started. They were similar to pre- and post-adaptation trials, but after the initial saccade ended a new target T2 was illuminated 5° closer to the right of the T0 location. The mean amplitude of the first 10 adaptation trials was also compared to the mean amplitude of the last 10 pre-adaptation trials using a t test (single tailed, p = 0.05). A moving average for each age group was computed to determine the differences in amplitude of the eye movement between TD and individuals with ASD.

Results: In a first analysis, we observed that there were no statistically significant differences in adaptation between ASD and TD populations. However, more subjects adapted in the TD population than the ASD population. A secondary analysis show that there may be some differences in the amplitude of the eye movement depending on the subject's age. TD adults adapt faster than ASD, while children and teenager in both groups have difficulty adapting.

Conclusions: Saccadic adaptation may be reduced in individual with ASD. The data presented in this paper clearly show that there is no significant differences in adaptation between individual with ASD and TD in general. However, the data also show that there is a difference in saccadic adaptation performances between the two groups depending on age.

443.045 *(Poster)* Saccadic Eye Movement Abnormalities in ASD and First-Degree Family Members

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Background: Previous studies have identified abnormalities in the accuracy of rapid eye movements (i.e., saccades) in individuals with autism spectrum disorder (ASD) and in first degree relatives of individuals with ASD. Together these findings suggest that impairments in oculomotor control in ASD may be heritable. While previous familiality studies have examined parents separately from their children with ASD, our examination of oculomotor control in family trios (child and biological mother and father) allows for the investigation of parent of origin effects. As the discrete neurophysiological processes that support eye movements have been well defined through single cell recording studies in monkeys and neuroimaging in humans, further investigation into these abnormalities presents an opportunity to gain insight into heritable neurological features associated with ASD.

Objectives: To characterize oculomotor impairments in individuals with ASD and their unaffected biological mothers and fathers.

Methods: Forty-four individuals with ASD (aged 5-22 years), 105 unaffected biological parents, and 73 age-, sex-, and nonverbal IQ-matched typically developing controls (27 matched to ASD participants, 46 matched to parents) completed two oculomotor tasks. During the visually guided saccade task, peripheral stimuli (i.e., white circles) appeared pseudorandomly at $\pm$ 12 or 24 degrees, and participants were instructed to look toward the stimuli as quickly as possible. The latency and accuracy of saccades were measured. During the antisaccade task, targets again were presented at $\pm$ 12 or 24 degrees, and participants were tasked with inhibiting saccades toward the stimuli and making saccades in the opposite direction. The latency and rate of correct antisaccades (i.e., saccades directed away from stimuli) were examined.

Results: Compared to control participants, individuals with ASD exhibited less accurate saccades to 24 degree targets during the visually guided saccade test. Comparisons of ASD parents and controls identified a group x sex x distance interaction in which mothers, but not fathers, of individuals with ASD demonstrated reduced saccade accuracy compared to controls, especially for 24 degree targets. Latencies of visually guided saccades did not differ between individuals with ASD and controls, but parents of individuals with ASD showed reduced latencies relative to controls. Participants with ASD made fewer correct antisaccades than controls, but parents and controls did not differ. No differences in antisaccade latency were seen for probands with ASD or their parents relative to controls.

Conclusions: Reduced saccade accuracy in mothers and their children with ASD implicate alterations in cerebellar mechanisms involved in feedforward movement planning processes in the pathophysiology of ASD. Identification of saccade dysmetria in mothers but not fathers of individuals with ASD suggests that the familiality of this trait may follow a maternal lineage. Our finding that individuals with ASD show a reduced ability to inhibit reactive saccades, but inhibitory control processes were unaffected in parents suggests that higher level cognitive control deficits involving frontostriatal brain circuits may covary with disease state and be specific to individuals with ASD.

443.046 *(Poster)* Self-Rated Executive Function Impairments Among Young Adults with Autism Are Associated with Sensory Processing Experiences.

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Background: Executive functioning (EF) challenges in real world settings are well-documented among children with autism spectrum disorder (ASD). Emerging evidence suggests adults with ASD experience similar difficulties; however, many existing studies have relied upon primarily parent/caregiver report. Therefore, this study examined self-ratings of real-world EF problems among young adults with ASD without intellectual disability and age-matched neurotypical adults. EF challenges, like inflexibility, have been correlated with sensory sensitivity in children with ASD in prior studies, yet these associations have not been evaluated in adults. Thus, we also examined correlations between self-report of both EF difficulties and sensory experiences among adults with ASD.

Objectives: Characterize self-rated real-world EF difficulties experienced by young adults with ASD and their associations with sensory processing.

Methods: Participants consisted of young adults with ASD (n=41; M age=25.60+/-10.28; M IQ=113.49+/-13.86; 32 males) and young neurotypical adults (n=73; M age=24.27+/-7.06; M IQ=117.04+/-11.11; 61 males) who completed psychometrically sound and well-established questionnaires assessing EF (Behavior Rating Inventory of Executive Function-Adult, BRIEF-A) and sensory processing (the Adolescent/Adult Sensory Profile). Analysis of variance was utilized to examine diagnostic group differences in BRIEF-A ratings and interactions between diagnostic group and BRIEF-A scale. Correlational analyses were used to identify associations between BRIEF-A scale ratings and sensory processing domains on the AASP. Where significant associations were identified, these variables were submitted to multiple linear regression analyses with step 1 including control variables of age, sex, and IQ, while step 2 included the additions of the BRIEF-A scales in predicting variance in AASP scores.

Results: Adults with ASD rated themselves as experiencing more EF problems overall than did neurotypical adults (F=58.32, p<.001). When examining the profile of EF difficulties, there was an interaction between BRIEF-A scale and diagnostic group. More specifically, the adults with ASD rated themselves as experiencing particular challenges in shifting/flexibility (M=61.59+/-14.64) and working memory (M=62.93+/-11.88; F=3.78, p=.001). Based on correlational analyses, only two of the BRIEF-A scales were associated with sensory processing in ASD. Follow-up linear regressions demonstrated that after accounting for the effects of age, sex, and IQ, shifting/flexibility challenges were predictive of sensory sensitivity (R^2 change=.28; t=3.25, p=.003) and self-monitoring difficulties were associated with low registration of sensory information (R^2 change=.15; t=2.08, p<.05).

Conclusions: Utilizing self-ratings of EF challenges, we demonstrate comparable EF profiles to those previously documented in autistic adults using parent report. People with ASD rated themselves as having particular difficulties with shifting/flexibility and working memory. Additionally, flexibility problems were correlated with sensory sensitivity while self-monitoring difficulties were associated with low registration of sensory information. These findings strongly support utilizing self-ratings of EF to provide insight into the lived experiences of people with ASD, and establish links between EF and sensory processing in ASD during adulthood for the first time. The shared cognitive and/or neural mechanisms underpinning this relationship should be probed further. EF problems remain an important target for intervention among young adults with ASD.

443.047 *(Poster)* Sensory Processing Patterns in Adults with Autism Spectrum Disorder and Intellectual Disability

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Background: Individuals with ASD often have differences in sensory experience, with some studies reporting atypical sensory behavior in as many as 90% of individuals (Green et al., 2015). While sensory differences are reported to occur across the life span, most of the research has focused on children with few studies addressing sensory processing in adults. The studies on adults typically focus on those without intellectual disabilities (ID) leaving a gap in our understanding of how sensory processing affects daily life in adults with ASD with ID (ASD/ID). Understanding the sensory processing patterns of this group may offer insights regarding strategies to improve participation in daily activities.

Objectives: The objective of this study was to identify patterns of sensory processing in adults with ASD/ID.

Methods: Caregivers of 20 adults with ASD/ID completed the Adolescent/Adult Sensory Profile (AASP) (Brown & Dunn, 2002) as part of a longitudinal study of adults with ASD. The adults with ASD/ID (15 male, 5 female) ranged in age from 30-55 (M = 39.7); all had a full range IQ score < 70 (M = 46; SD = 8.5). The AASP contains 60 items about everyday sensory experiences. Caregivers rated each item based on how frequently behaviors occur. Each item relates to one of four quadrants: low registration, sensory seeking, sensory sensitivity, and sensory avoiding.

Results: Each participant received a raw score for each quadrant in three categories: less than most people, similar to most people, and more than most people. Table 1 shows the number of participants who received a raw score in each quadrant. Participants were similar to most people or more than most people in all quadrants except for sensation seeking. In this quadrant 80% were less than most people. In the low registration and sensation avoiding quadrants, 50% of participants were rated more than most people. Table 2 also shows the mean scores from the AASP standardization study compared with the ASD/ID sample. The ASD/ID sample differed significantly from the AASP standardization group in the sensation seeking quadrant (t=7.65, p<.001).

Conclusions: The results of the study suggest adults with ASD/ID continue to have sensory processing differences and that they may be less sensitive to sensory events and seek out and register less sensory input than most people. According to Dunn's Model of Sensory Processing (1997), this pattern of processing may result in difficulty detecting and responding to sensory stimuli in the environment and less initiation of sensory experiences. This pattern is different than what has been most frequently reported in adults with ASD without ID, where high sensory sensitivity is common (e.g., Clince, Connolly, & Nolan, 2016). The findings of this study highlight the need to understand the distinct sensory needs of adults with ASD/ID and to identify the types of strategies necessary to support participation in daily activities. Given the small sample size and individual variation, further investigation of sensory patterns in adults with ASD/ID is warranted.

443.048 *(Poster)* Sensory Profiles Among Individuals with ASD and ASD+ADHD

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Background: Sensory problems are a hallmark feature of ASD, but have also been found in individuals with ADHD. It is unclear how ADHD symptoms contribute to sensory dysfunction in individuals with ASD. With the possibility of a comorbid diagnosis of ASD and ADHD recognized by the DSM-5, there is a growing need for research in this domain. The present study explored sensory profiles among individuals with ASD without ADHD (ASD group) and individuals with ASD with clinically-significant ADHD symptoms (ASD+ADHD group).

Objectives: To investigate differences in type and severity of sensory problems reported by individuals with ASD and ASD+ADHD.

Methods: Participants included 473 individuals with ASD ages 2-16 (M=6.10, SD=3.22) participating a larger research study. ADHD symptoms were assessed using the CBCL DSM-oriented subscale for ADHD. Participants with clinically-significantly ADHD symptoms were included in the ASD + ADHD group. The ASD group consisted of 370 individuals (80.81% male) and the ASD + ADHD group consisted of 103 individuals (77.67% male). Parents completed the Short Sensory Profile (SSP) and IQ was assessed using various measures. Lower scores on the SSP indicate greater dysfunction while higher scores indicate less sensory dysfunction. A one-way ANCOVA was performed to evaluate group differences on the SSP total score, controlling for age, gender, and IQ. A one-way MANCOVA was conducted to examine group differences on the seven subscales of the SSP, while controlling for age, gender, and IQ. A Bonferroni correction was performed to account for multiple comparisons (a=.0071) and pairwise contrasts were evaluated.

Results: Bivariate Pearson correlations were calculated between the SSP total score and age (r=.129, p=.005) and IQ (r=-.024, p=.610), and a t-test was conducted to evaluate the relationship between gender and SSP total score, t(471)=-2.99, p<.001. The ANCOVA revealed that the ASD and ASD+ADHD groups differed significantly on the SSP total score, $F(1, 472)=53.85$, $p<.001$, with the ASD group obtaining higher total scores on the SSP (M=136.16, SD=24.16), indicating less impairment, than the ASD+ADHD group (M=116.83, SD=22.34). The MANCOVA revealed a statistically significant difference between the groups on the combined dependent variables after accounting for all covariates, $F(7, 462) = 19.72$, $p < .001$, Wilks' $\Lambda = .77$, partial $\eta 2 = .23$. The ASD+ADHD group demonstrated greater sensory dysfunction, on average, than did the ASD group for all subscales. The ASD+ADHD group scored significantly lower, indicating greater impairment, on the underrepsonsivity subscale, $F(1, 468)=120.44$, p<.0001, $h^2=.21$, the auditory filtering subscale, $F(1, 468)=64.38$, p<.0001, $h^2=.12$, and the visual/auditory sensitivity, $F(1, 468)=32.69$, p<.0001, $h^2=.07$.

Conclusions: Greater sensory impairment was reported for the ASD+ADHD group compared to the ASD group across all subscales. ADHD symptoms may exacerbate impairment in individuals with ASD. ADHD symptoms were associated with increased sensation seeking, greater auditory filtering difficulties, and hyper-sensitivity to visual and auditory stimuli. It is possible that the diminished inhibitory control, hyperactivity, and attention difficulties characteristic of ADHD may drive these increased sensory problems.

443.049 *(Poster)* Sensory Profiles As Predictors of Adaptive Behavior in Toddlers with Autism

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Background: Individuals with autism spectrum disorder (ASD) have, on average, atypical responsivity to sensory stimuli that includes hypo- and hyper-responsivity as well as sensory seeking behaviors (Baranek, David, Poe, Stone, & Watson, 2006; Ben-Sasson et al., 2009). Previous work has shown that elevated sensory profiles (i.e. hypo, hyper, and seeking) have been shown to predict later adaptive behavior skills in elementary school aged children with ASD (Williams et al., 2018; doi:10.1016/j.ridd.2018.07.002). What is not yet known is whether these findings generalize to infants and toddlers with ASD.

Objectives: The objective of the current study was to determine whether or not sensory profiles predict adaptive behaviors among high-risk infants and toddlers who are later diagnosed with ASD. We achieve this through a replication and downward extension of methods and procedures described by Williams et al. (2018).

Methods: Data were collected as part of an ongoing longitudinal study of high risk infant siblings. Of the high-risk sibling group (n=391), 90 toddlers went on to receive an ASD diagnosis based on clinical best estimate (HR-ASD). This study analyzed parent report data on sensory responsivity, collected at 12 months of age (Sensory Experiences Questionnaire; SEQ 2.1) and a semi-structured assessment of adaptive behavior collected at 36 months of age (Vineland Adaptive Behavior Scales; Vineland-II) in the HR-ASD group specifically. A series of hierarchical multiple linear regressions were computed using sensory profiles (hyperresponsivity, hyporesponsivity, and sensory seeking) to predict adaptive behaviors (communication, socialization, daily living skills, and motor skills). Other model variables included sex, age at the first point of data collection, household income, maternal education, elapsed time between the first point of data collection and the second point of data collection, and an IQ proxy (Mullen Early Learning Composite; MSEL-ELC).

Results: For toddlers with ASD, the inclusion of hyperresponsivity scores at age 12 months to the base model predicted deficits in communication at age 36 months (. Hyperresponsivity scores on the SEQ () and the MSEL-ELC () were significant predictors in the model. Hyperresponsivity did not predict other domains of adaptive behavior. While Williams et al., (2018) found that a hyporesponsivity model predicted socialization scores, results for our sample did not indicate a significant predictive relation with for the addition of hyporesponsivity scores (total $R^2 = 0.26$). Overall, hyporesponsivity and seeking behaviors at 12 months did not significantly predict adaptive behavior domain scores at 36 months.

Conclusions: Results suggest that the predictive relation of sensory profiles with later adaptive function seen reported in school-age children with ASD partially extend to familial high-risk infants later diagnosed with ASD. In particular, sensory hyperresponsivity in late infancy was strongly related to communication ability at preschool age. These results suggest that early differences in sensory responsivity could have downstream developmental consequences related to language function, though further research is necessary to explore this possibility (Baranek et al., 2018). If a causal link between early sensory responsivity and language acquisition is found, it would have potentially important implications for early intervention.

443.050 *(Poster)* Sleep Problems and Externalizing Behavior in Children with ASD: The Effect of Restricted and Repetitive Behavior

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Background: Restricted and repetitive behavior (RRB) is a core characteristic of autism spectrum disorder (ASD), along with social communication difficulties[1]. Children with ASD often experience co-occurring mental and physical health issues[2]. Studies report that 50-80% of children with ASD[2,3] experience sleep problems (e.g., night-waking, insomnia)[4,5], compared to 20-30% of neurotypical children[6]. Additionally, children with ASD (i.e., between 25-70% [2,7]) often demonstrate behavioral difficulties (e.g., aggression, inattention). There is evidence that sleep problems and behavior problems exacerbate each other; however, the direction of this relationship remains unclear[8-10]. The relationship between RRBs, sleep problems, and externalizing behavior is not well understood. This study measured the relationship between sleep problems, externalizing behaviors, and RRBs in children with ASD.

Objectives:

1. What is the association between sleep problems, externalizing behavior, and RRBs in children with ASD?
2. Do RRBs mediate the relationship between sleep problems and externalizing behavior?
3. When mediated by RRBs, is there a bidirectional relationship between sleep problems and externalizing behavior?

Methods: Seventy children with ASD (mean age (*SD*)= 4.14 years (.92); *range*=2.10-5.70); 46% Latinx) and their parents from a screening clinic sample participated. Parents completed a demographic intake form, the Child Behavior Checklist (CBCL), and Social Responsiveness Scale (SRS). Children were screened for ASD using the Autism Diagnostic Observation Schedule-Second Edition (ADOS-2). Sleep problems and externalizing behavior were derived from the CBCL subscale *T*-scores; RRBs were derived from the mannerisms/RRB subscale *T*-score of the SRS.

Results: Externalizing behavior was negatively correlated with maternal education (p=.007), while age was positively correlated with externalizing behavior (p=.02); partial correlations were conducted controlling for maternal education and age. RRB was positively correlated with sleep problems (p= .005) and externalizing behaviors (p< .001). Sleep problems were positively correlated with externalizing behavior (p<.001). Maternal education and age were covariates in the mediation analyses.

Using PROCESS[11] model 4, mediation analyses were conducted. The overall model was significant, $F(4, 57)= 19.62$, p <.001, R^2= .58. RRBs (M_1) significantly mediated the relationship between sleep problems (X) and externalizing behavior (Y) (b= .10, SE= .04, 95% CI = [.02, .20]). The direct effect between sleep problems and externalizing behaviors was significant (b=.48, SE=.09, $t(62)= 5.14$, p< .001, 95% CI [.29 - .67]).

To explore whether the relationship between sleep problems, externalizing behavior, and RRB is bidirectional, another mediation was conducted, with externalizing behavior as (X), sleep problems as (Y) and RRB as (M_1). The overall model was significant, ($F(4,57)= 10.54$, p <.001, R^2= .43). However, the indirect effect was not significant, (b= .04, SE= .06, 95% CI = [-.08, .14]) suggesting that RRBs did not mediate the relationship between externalizing behavior and sleep problems. The direct effect between sleep problems and externalizing behaviors was significant (b=.65, SE=.12, $t(67)= 5.46$, p< .001, 95% CI [.41 - .89]).

Conclusions: Findings contribute to the growing literature implicating RRBs as a mediator of the relationship between sleep problems and externalizing behavior. This line of research is critical for increasing awareness of sleep problems and externalizing behavior in children with ASD and to develop effective treatment strategies.

443.051 *(Poster)* Sound Sensitivity: How Auditory Hypersensitivty Is Expereinced By Individuals with ASD

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Background:

Auditory hypersensitivity to specific stimuli is demonstrated in children with ASD, and interferes with participation in social, educational and recreational activities. However, more research is needed on the nature of children's responses to sounds in their environments.

Objectives:

Many children with Autism Spectrum Disorders (ASD) experience auditory hypersensitivity. The goal of the current study was to 1) determine how auditory hypersensitivity influences the everyday lives and behaviors of individuals with ASD, and 2) explore the nature of responses to specific sounds including loudness comfort levels.

Methods:

Adolescents with ASD (aged 13-18 years) and their parents were recruited to complete 3 sessions in the lab. Inclusion in the full study required full-scale IQ>85 (Weschler Abbreviated Scale of Intelligence) and normal hearing thresholds (<=25db) confirmed by pure-tone audiometry for each ear. Session 1 included interviews, questionnaires (e.g., the Child Sensory Profile 2 [CSP2], Adolescent/Adult Sensory Profile [ASP], and the Auditory Sensitivity and Child Safety Questionnaire [ASCSQ]). In Sessions 2 and 3, youth were presented with sounds that they reported to be pleasant (Session 2) or aversive (Session 3). Participants were asked to manually adjust the volume and/or pitch of sounds to a comfortable listening level while wearing a wristband measuring physiological signals (e.g., Empatica E4), and to rate the sounds on loudness comfort level using a 4-point Likert scale.

Results:

Preliminary results from Session 1 (n = 5 families, mean age of child 15.4 years) confirmed that all children experienced negative reactions to sound in the last 6 months. Frequency of negative reactions: every day (1/5), a few times/month (2/5), once/month (2/5). The number of specific sounds that trigger the participants ranged from 2-3 sounds to more than 10 sounds. Among sounds that trigger participants' negative reactions, they are described to be loud (4/5), sudden (4/5), shrill (3/5), high-pitched (2/5), and repetitive (2/5). Specific reactions to aversive sounds included being anxious (4/5), irritable (3/5), not responding to name (3/5), yelling and screaming at other children/adult (2/5), and being unaware of surroundings (2/5). Various strategies that were used by parents included blocking or staying away from the source of noises (e.g., earbuds, leaving the environment; 3/5), gradual exposure to aversive sounds (1/5), and no specific strategies (1/5). Despite various strategies, frequency of participant experiencing limited participation in school activities: always (2/5), sometimes (2/5), rarely (1/5); in family activities: always (1/5), frequently (2/5), rarely (1/5), and never (1/5); in community activities: always (1/5), sometimes (2/5), rarely (1/5), never (1/5). When sound hypersensitivity issues compared with other ASD related behaviors, parents described them as one of the most concerning behaviors (1/5), concerning but not the most concerning behaviors (2/5), and not that concerning compared to other behaviors (2/5).

Data collection for Session 2 and 3 is in progress and will be available for the poster.

Conclusions:

Auditory hypersensitivity is an important challenge in ASD. The results of this study will shed new light on the nature of this issue and how it affects families.

443.052 *(Poster)* Swipe Kinematics Differ in Different Aged Children with Autism Spectrum Disorders during Smart-Tablet Gameplay

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Background: Atypical movement patterns in people with autism spectrum disorders (ASD) have been reported (Dowd et al., 2012; Trevarthen and Delafield-Butt, 2013; Cook, 2016). In our previous observation, children with ASD moved slower than typical developing (TD) children in a goal-oriented food-sharing task during smart-tablet gameplay (Lu et al., 2019). However, contradictory results have been noticed in another cohort. Further, it is well known that visual-motor integration skills change dynamically in early childhood, improving remarkably at 4-5 years old (von Hofsten and Rösblad, 1988; Fang et al., 2017). Consequently, this study re-examines the swipe kinematics in different age groups.

Objectives: This study compares the goal-oriented swipe kinematics of ASD and TD children in different age groups, and determines the feasibility of using smart-tablet devices to identify movement signatures in children with ASD.

Methods: Gameplay data from two cohorts were analysed: Cohort 1, a previous study (Anzulewicz et al., 2016), in which 45 TD and 37 ASD children aged 25-79 months took part; in Cohort 2, 316 TD and 202 ASD children aged 30-90 months participated as part of a multi-site trial (Millar et al., 2019). The participants played a food-sharing game on a smart-tablet (iPad mini, Apple Inc.) and their on-screen touch trajectories were recorded. The data were analysed using customised MATLAB scripts. The food-to-target swipes data were mined to yield the duration, travelled distance, minimal distance (distance between the start and end points), distance difference (the difference between the travelled and minimal distances), and average speed (travelled distance divided by duration) of each swipe. The data were then categorised into two age groups: <60 months and ≥60 months, and Mann-Whitney U tests were used to determine kinematic differences between TD and ASD in each age group.

Results: In Cohort 1, ASD moved significantly faster than TD at the younger age (median of 52.65 mm/s vs. 49.70 mm/s) while they moved significantly slower than TD at the older age (median of 46.82 mm/s vs. 81.72 mm/s). The same pattern was observed in Cohort 2, the median value of average speed being 57.81 mm/s in ASD vs. 49.65 mm/s in TD at the younger age, and 65.81 mm/s in ASD vs. 67.00 mm/s in TD at the older age. An analysis on the combined data from the two cohorts yielded the same patterns in the average speed (see details in the attached image).

Conclusions: The kinematic differences between TD and ASD during goal-oriented swipe movements follow different profiles in different age groups; ASD moved faster than TD at the younger age (<60 months) while they moved slower than TD at the older age (≥60 months), suggesting different strategies should be used for different aged children with ASD to compensate the disruption to their sensorimotor control. This study also demonstrates the feasibility of using smart-tablet devices to support the early identification of ASD in the gameplay paradigms.

443.053 *(Poster)* The Body Movement When Persons with ASD Walk through the Narrow Space.

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Background: It is said that persons with Autism Spectrum Disorders (ASD) have awkwardness in walking. Takahashi (2011) reported that persons with ASD diagnosis encounter problems when walking. In his questionnaire survey, many persons with ASD gave an answer like that they sometimes bump into someone when passing by one another. Based on his survey, Takahashi suggested the possibility that people with ASD have difficulty recognizing the positional relation between their body and surrounding objects.

Objectives: This study focuses on the differences of body movement of people between those with and those without ASD when they walk through a narrow walkway. The measurements of this study are as follows: (1) the angle of the trunk rotation and (2) the time taken for each step to go through the walkways of different widths.

Methods: There were 18 participants in this study, and they were divided in to two groups, “control (Non-ASD) group” (N=11, mean age=22.36 years) and “ASD group” (N=7, mean age=29.14 years). This study consisted of three phases; Pre-test, Instruction video, and Post-test. In Pre-test and Post-test, we let participants walk through the narrow walkway (7meters long) with their ordinary speed. There were three walkway conditions with differing widths of narrowness. (1)narrow condition (which is 10% narrower than the width of participants’ back), (2) equivalent condition (which is as wide as the width of participants’ back), and (3) wide condition (which is 10% wider than the width of participants’ back). We recorded video throughout this study.

Results: The ASD group tend to rotate trunk more than necessary when they walk through the narrow space(Figure 1). The rate of change of the time taken for each step was significantly different between control group and ASD group (U=9.0 *p=.27)(Figure 2).

Conclusions: We can say that the pattern of the transition in angle of trunk rotation is irregular in the ASD group, but on the other hand, the pattern of it for the control group is constant. We concluded that typically developed persons require less amount of labor to walk. Moreover, the participants in the ASD group took a longer time than the control group when they walked for each step when they went through the narrow walkway. In the experiment, we instructed the participants to be careful not to touch the obstructions which formed the narrow space when they walked. We thought that persons with ASD tended to focus on not touching the obstructs more than the persons in the control group. So that, in conclusion, we thought that persons with ASD feel difficulty in moving their body correctly in demanding situations, such as when walking in narrow spaces.

443.054 *(Poster)* The Effect of Sensory Processing on Emotion Regulation in Autism Spectrum Disorder and Typical Development

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Background: Emotion regulation is broadly defined as a collection of processes that enable emotion modulation alongside a host of goal-directed behaviours. Difficulties with emotion regulation are prevalent in autism spectrum disorder (ASD) and have been identified as a risk factor for a variety of psychopathologies. Although the underpinnings of emotion dysregulation remain largely unknown in ASD, sensory processing sensitivity is posited to be among the many contributing factors due to feelings of discomfort and distress that are experienced.

Objectives: The primary objective of this study was to investigate the association between sensory processing and emotion regulation abilities in children with ASD and to examine whether this association differs between ASD and typical development (TD).

Methods: Participants (age range 8 to 12 years) consisted of 14 ASD (mean age = 10.35 years; 2 females) and 15 TD individuals (mean age = 9.13 years; 7 females) from an ongoing study. All subjects had IQ scores of $\geq$ 85. Caregivers completed the Short Sensory Profile (SSP) to assess participants' ability to process sensory information and respond to sensory experiences. Emotion regulation was measured with the Emotion Dysregulation Inventory (EDI), a 30-item parent questionnaire validated in ASD samples. Subscales of this questionnaire include Reactivity Short Form (EDI-RS) and Full Reactivity (EDI-FR) indices which assess the degree of intense, poorly regulated negative emotional reactions, as well as the EDI Dysphoria Index (EDI-DI) which evaluates anhedonia and nervousness. T-scores from each subscale were used for analyses.

Results: There was no effect of age, diagnosis, or sex on emotion regulation scores. Linear regression revealed significant associations between total SSP score and the EDI-RS ($F(3, 24) = 13.949$, $p < 0.001$, $R^2 = 0.63$), EDI-FR ($F(3, 24) = 4.767$, $p = 0.018$, $R^2 = 0.37$), and EDI-DI ($F(3, 24) = 2.470$, $p = 0.043$, $R^2 = 0.23$). This pattern of results was largely consistent across SSP sensory modalities. Visual/Auditory Sensitivity significantly predicted scores on the EDI-RS ($p = 0.001$) and EDI-FR ($p = 0.040$). Similarly, Tactile Sensitivity significantly predicted performance on the EDI-RS ($p < 0.001$) and EDI-FR ($p = 0.004$). Underresponsive/Seeks Sensation values were significantly correlated with EDI-RS ($p = 0.002$), EDI-FR ($p = 0.007$), and EDI-DI ($p = 0.009$) subscales. Finally, Taste/Smell Sensitivity ($p = 0.013$), Movement Sensitivity ($p = 0.020$), Low Energy/Weak ($p = 0.009$), and Auditory Filtering ($p = 0.018$) domains were significantly associated with the EDI-RS subscale.

Conclusions: Taken together, the results suggest that greater levels of sensory sensitivity enhance susceptibility to emotion dysregulation irrespective of diagnosis. When replicated in larger samples, these findings may improve the current conceptualization of factors contributing to emotion dysregulation in ASD.

443.055 *(Poster)* The Impact of Sensory Processing Differences on Academic Achievement and Classroom Behaviour for Autistic and Neurotypical Pupils

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Background: In 2017, 70.4% of pupils in the UK achieved a grade C or above in GCSE English or Maths. In contrast, only a third of autistic pupils achieved this 'high pass' grade. Identifying the factors that contribute to variability in academic attainment is vital as it is associated with a range of future outcomes. For neurotypical pupils, intellectual functioning (IQ) has been identified as a powerful predictor of academic success (Deary et al., 2007). However, this association is not consistently found in autism, with many pupils displaying achievement profiles that are not commensurate with IQ (Estes et al., 2011). We hypothesize that sensory atypiclaities may be one factor that impacts upon autistic pupil's academic achievement. Indeed, the typical classroom contains rich sensory inputs that may not be compatible with the sensory needs of pupils, which in turn could impact upon learning (Barrett et al., 2015).

Objectives: The first aim of the current study was to apply hierarchical linear regression to examine if sensory processing differences related to academic achievement and classroom behaviour for autistic and neurotypical pupils. Using model-based cluster analysis, our second aim was to also explore if sensory subtypes could be identified, before examining if these subtypes differed on academic achievement (Aim 3).

Methods: Thirty-six autistic (Mean Age =8.87, SD=1.39) and 28 (Mean Age= 8.36, SD =1.51) neurotypical children between the ages of six and eleven participated in the current study. All autistic pupils attended special education provision whereas all neurotypical children attended mainstream primary schools. The neurotypical group (M= 110.35, SD=14.5) had a significantly greater mean IQ compared to the ASD group (M=83.53, SD=12.60) and therefore analysis was undertaken for each group separately. Children completed the reading and mathematics subscales of the Wechsler Individual Achievement Task, in addition to the Wechsler Abbreviated Scale of Intelligence. Teachers completed the School Companion Sensory Profile (SCSP) and the Connors Teachers Questionnaire.

Results: IQ and SCSP Behaviour Scores, which provide an overall rating of a persons way of acting relating to sensory experiences, accounted for 57.2% of the variance in autistic pupils reading scores. IQ however was found to be the only significant predictor of academic achievement for neurotypical pupils (17% variance explained). Significant positive correlations were also found between sensory differences and classroom behaviour, such that greater sensory differences were related to greater behavioural challenges in the classroom. Using model-based cluster analysis we established the presence of two sensory subtypes within the autistic group, which differed on the severity of differences (Figure 1). Although groups did not differ on academic outcomes, the subtype characterized by greater severity of sensory differences was found to have significantly greater levels of hyperactivity and aggression in the classroom.

Conclusions: Sensory processing differences can significantly impact academic achievement and classroom behaviour for autistic pupils. However, there is considerable heterogeneity in terms of academic achievement and sensory processing differences. A direct link between sensory differences and poor academic achievement is unlikely. Rather variables, such as attention, multisensory integration and anxiety may moderate this relationship.

443.056 *(Poster)* The Interaction of Fine Motor and Structural Language Skills in ASD

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Background: Motor skills are related to language skills in typical development (Iverson, 2019); they may contribute to the development of language skills by, e.g., facilitating opportunities for labelling (Smith & Yu, 2012). Individuals with ASD consistently show impairments in both basic and complex motor skills (Jansiewicz et al., 2006; Dzuik et al., 2007; Bhat et al., 2011; Whyatt & Craig, 2013). Moreover, motor skills predict ASD symptom severity (Bal et al., 2019); motor skills at two years were the best predictor of losing the ASD diagnosis at age four (Sutera et al., 2007). Our team has studied children with documented ASD, who no longer have symptoms in adolescence (Loss of ASD Diagnosis, or LAD; Fein et al 2013). We test whether language development mediates the relationship between motor skill deficits and ASD outcomes and severity.

Objectives: This study assessed group differences in fine motor imitation skills, and tested relationships among *fine motor* skills, *language* skills, and *autism symptomatology* in youth with ASD, LAD. or a history of typical development (TD).

Methods: Participants were children, adolescents, and young adults with ASD (*n*=14), LAD (*n*=14), and TD (*n*=12), ages 8-16, all with FSIQ scores in the typical range; details in Table 1. Measures included assessments of ASD symptomatology, IQ, and language abilities, as well as the NEPSY-II Imitating Hand Positions subtest, a reliable measure of motor imitation.

Results: All scores were in the average range (aside from participants as follows: *n*=2 LAD, *n*=5 ASD, *n*=1 TD) suggesting generally intact motor imitation. ANOVA revealed a significant group difference in fine motor imitation, F=4.58, p=0.01; this group difference was driven by lower scores in the ASD relative to the LAD groups, t=2.48, p=0.02. The LAD/TD and ASD/TD groups did not differ, p's>.05.

Multiple regression analyses revealed that, controlling for IQ, both fine motor imitation (β=-0.30, p<0.05) and core language (β=-0.63, p<0.001) independently predicted total ADOS score. NEPSY fine motor imitation did not predict CELF core language (r=0.21, p=0.22). Contrary to predictions, fine motor skills did not predict core language skills (p=0.51).

Conclusions: Results suggest that individuals who lost the ASD diagnosis by adolescence show significantly better motor imitation skills, compared to their peers with current ASD. Further, those fine motor imitation skills, along with structural language abilities, were associated with ASD symptoms, over and above FSIQ. There was no mediation of motor abilities and language vis a vis ASD symptoms; the two domains were relatively independent. The results of the present study are consistent with the hypothesis that individuals with stronger praxis skills are better at gesture and other nonverbal aspects of communication such as mirroring, contributing to more "typical" scores on the ADOS. Results are also consistent with a less-specific model in which individuals with stronger skills in Domain A are more likely to have stronger skills in Domain B (e.g., the "Matthew effect"). These findings highlight the importance of motor deficits in contributing to core symptoms of ASD. Results need to be extended using a task probing non-social (non-imitative) motor skills.

443.057 *(Poster)* The Relationship between Perceptual Ability and Cognition Changes from the School-Age to Adolescence in Autism.

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Background: Autistic individuals often demonstrate faster and more accurate performance on the Block Design Task (BDT) subtest of the Wechsler Intelligence Scale. Such cognitive peaks have been explained by an optional use of "top-down" flow of information (Caron et al, 2006), resulting in a more local-level analysis, or a "bottom-up" effect of enhanced low-level perceptual information (Muth et al, 2014). Meta-analyses suggest that the autistic local bias leading to superior performance on visuo-spatial tasks is unequally replicated in hierarchical tasks, may vary according to the way *local* and *global* processes are operationalized across tasks, and may originate from perceptual processes in autism (van de Hallen, 2015). Accordingly, although autistic individuals demonstrate a unique lower-level perceptual phenotype, with more efficient processing of luminance-defined stimuli compared to stimuli defined by more complex physical attributes such as texture (Bertone et al., 2005), this perceptual influence is most often never considered when assessing cognitive peaks in autism.

Objectives: This study aimed to assessed visuo-spatial perception in autism while manipulating both the cohesiveness (biasing top-down local and global analysis) and perceptual attributes (biasing bottom-up analysis) of the patterns of a computerized BDT completed by school-aged and adolescent participants.

Methods: Thirty autistic and 30 neurotypical (NT) children and adolescents (7-18 years of age) completed a reversed match-to-sample BDT (Caron et al, 2006) on a touchscreen where they were asked to match a centrally presented target block design with one of four segmented surrounding probes (see Figure 1). Top-down processes were assessed by manipulating the pattern cohesiveness of the block patterns (low-cohesiveness (LC) = block-by block, local-level analysis; high-cohesiveness (HC) = pattern-first, global-level analysis). Bottom-up influences were assessed by manipulating low-level, perceptual attributes of the component block surfaces comprising the block patterns across three conditions: traditional (red/white), high-contrast luminance, (black/white), and texture information (high- vs low-contrast noise) (see Figure 2). Both cognitive (cohesiveness) and perceptual (block attribute) manipulations were assessed for target-probe combinations defined by three matrix sizes: 4 (2 x 2) blocks, 9 (3 x 3) blocks, and 16 (4 x 4) blocks.

Results: While the autism group had significantly faster RTs compared to the NT group at young ages in the 4-block matrix, the NT group improved across age at a faster rate compared to the autism group. In the 16- block condition, the autism group had significantly slower RTs for the LC texture-defined pattern condition (compared to HC patterns) compared to the NT group with increasing age.

Conclusions: For most conditions assessed, manipulating the physical block attributes did not differentially affect performance across age. However, when the reverse-BDT biased a local processing style (LC) and was defined by a large matrix size (16 blocks), the autism and NT groups performance changed with age in a different manner, but only when blocks were texture defined. This suggest that under under high task demands (texture-defined information and 16 blocks), the development of visuo-spatial abilities in autism across age is contingent on the physical attributes defining its local components.

443.058 *(Poster)* The Relationship between Sensory Reactivity Differences, Intolerance of Uncertainty and Anxiety Symptomology in Young Autistic Children

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Background: 60-90% of autistic individuals experience sensory reactivity differences, such as being hyperreactive (e.g. over-sensitive to sounds), hyporeactive (e.g. under-responsive to touch), or seeking (e.g. fascinated by lights). Additionally, over half of autistic children experience co-morbid anxiety. Sensory hyperreactivity has previously been linked to anxiety in autistic children and intolerance of uncertainty (IU) and has been suggested to mediate the relationship. However, little is understood about how sensory reactivity differences relate to IU and specific anxiety symptomology, such as generalised anxiety disorder (GAD). Additionally, research has not yet explored this relationship in young autistic children.

Objectives: This study aimed to elucidate the relationships between sensory reactivity differences, IU and specific anxiety symptomology in autistic children aged 3-5 years.

Methods: Sensory reactivity differences, anxiety and IU were assessed for 54 autistic children (age 3 – 5 years, 13 females, 41 males).

Caregiver reported and observed sensory reactivity differences was measured by the Sensory Processing Scale Inventory (SPSI). Caregiver-reported total anxiety, separation anxiety (SAD), physical injury fears (PIF), social phobia (SOC), obsessive-compulsive disorder (OCD), and GAD was measured by the Preschool Anxiety Scale (PAS). Caregiver reported IU was measured using the Responses to Uncertainty and Low Environmental Structure (RULES) questionnaire. In addition, broader autism traits were assessed using the Autism Spectrum Quotient (AQ).

The relationship between sensory reactivity differences, IU and anxiety was analysed using partial correlation analysis controlling for autism traits. Mediation analysis was then conducted to explore the total, direct and indirect effects between sensory hyperreactivity and anxiety through IU.

Results: Partial correlation analysis (table 1) revealed significant correlations between SPSI sensory hyperreactivity and total anxiety ($r_s = .57$, $p < .001$), SOC ($r_s = .45$, $p = .001$), PIF ($r_s = .44$, $p = .002$), SAD ($r_s = .49$, $p < .001$), OCD ($r_s = .40$, $p = .004$) and GAD ($r_s = .49$, $p < .001$). There were no significant correlations between sensory hyporeactivity or seeking and anxiety ($p > .05$).

Significant correlations were also found between IU and SPSI sensory hyperreactivity ($r_s = .61$, $p < .001$), total anxiety, ($r_s = .70$, $p < .001$), SOC ($r_s = .56$, $p < .001$), PIF ($r_s = .41$, $p < .001$), SAD ($r_s = .65$, $p < .001$), OCD ($r_s = .60$, $p < .001$) and GAD ($r_s = .64$, $p < .001$).

Mediation analysis controlling for AQ (figure 1) indicated that the relationship between sensory hyperreactivity and anxiety is mediated by IU, as the indirect coefficient was significant, (B = .356, SE = .10, LLCI = .1733, ULCI = .5804).

Conclusions: Our results suggest sensory hyperreactivity is related to IU and anxiety in young autistic children, and that the relationship is mediated by IU. Future directions should explore this relationship longitudinally. Understanding the relationship between sensory reactivity, IU and anxiety is important for developing early clinical interventions to improve outcomes for autistic children.

443.059 *(Poster)* The Relationship between Stereotyped Behaviors and Oral Sensitivity in Autism: An Exploration in the ACE Gendaar Cohort

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Background: Autism Spectrum Disorder (ASD) is typified by impaired social communication and restricted, repetitive patterns of behavior and interests (RRBIs; APA, 2013). Disrupted eating patterns (e.g., 'picky' eating, overeating) have also been documented in ASD (Ledford & Gast, 2006; Zheng et al 2017). Because eating offers both gustatory and tactile feedback, the act of eating may serve a self-stimulatory function. Self-stimulation is a common explanation for stereotyped behaviors in ASD, but stereotyped behaviors are often discouraged. This may make a socially-acceptable self-stimulatory behavior especially favorable to autistic individuals. We hypothesize that eating can provide socially-acceptable self-stimulation. Although there is some evidence that RRBIs predict eating disturbances in young autistic females (Bitsika & Sharpley, 2017), this relationship has been under-explored, and to our knowledge remains untested in male-inclusive samples.

Objectives: To explore the possible link between stereotyped behaviors , we test the fit of several models predicting oral sensitivity from stereotyped behaviors in a sex-balanced sample of autistic youth to determine a best-fitting model for this relationship. We theorize that because Oral Sensitivity includes not only avoidance, but also preference, for specific tastes and textures in food, then if there is an association between eating and stimming, heightened oral sensitivity can serve as a measure of sensory-specific eating behavior. We expect that youth who exhibit heightened stereotyped behavior may also exhibit heightened sensitivity to oral taste and texture.

Methods: We examine a sample of 55 (31 male; 8-17y; FSIQ > 70) youth with ASD from Wave 1 of the NIMH ACE Network GENDAAR project. For our analyses, we consider the Stereotypy subscale of the Repetitive Behavior Scale – Revised (RBS-R; Lam & Aman, 2007), and the Oral Sensitivity subscale of the Sensory Profile Caregiver Questionnaire (Dunn, 1999). Higher Stereotypy scores indicate increased stereotyped behaviors; higher Oral Sensitivity scores indicate lower oral sensitivity. We explored the fit of several linear regression models predicting Oral Sensitivity from Stereotypy, including a simple linear regression without covariates, and linear regressions accounting for age, sex, and FSIQ.

Results: In a simple linear regression without covariates, Stereotypy predicts Oral Sensitivity (p=.005, F=8.454, adjusted R^2=.12). A linear regression accounting for Stereotypy, age, gender, and FSIQ maintained significance (p=.02, F=3.205, adjusted R^2=.14), but age and FSIQ were not significant contributors. A final model consisting only of Stereotypy and gender , adjusted R^2=.18). Figure 1 depicts the association between Stereotypy and Oral Sensitivity by sex, in which both sexes demonstrate similar slopes, but girls exhibit greater Oral Sensitivity (indicated by lower scores).

Conclusions: This study suggests that stereotyped behaviors are related to oral sensitivity in both sexes. This lends some support to the theory that eating behaviors in ASD may be related to RRBIs. Given the exploratory nature of our results, additional research in an independent sample should be conducted to further test whether eating can serve a self-stimulatory function in ASD. Such work could help explain the heightened incidence of overeating in ASD, and inform interventions for disordered eating in autistic individuals.

443.060 *(Poster)* Understanding Levels of Motor Skill Competence Among Children with ASD

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Background: Children with ASD experience a host of health disparities, including higher rates of obesity and lower levels of physical activity (PA). Participation in PA plays an integral role in the prevention of obesity and maintenance of a healthy weight. However, for a child to participate meaningfully in PA they must first have the requisite motor skills to do so. To develop interventions that will promote positive trajectories of PA and health for children with ASD, we first must determine their current levels of motor skill competence.

Objectives: Therefore, purpose of this research was to examine levels of motor skill competence among 6 to 9 year old children with ASD using the Test of Gross Motor Development (TGMD-3).

Methods: The primary group of 28 children with ASD (23 boys; 7.95 ± 1.22 years) were individually-matched to 2 comparison groups of neurotypical children on different aspects of development. The first comparison group was matched on sex (21 boys) and age (7.97 ± 1.29), while the second group was matched on sex (22 boys) and level of locomotor skill competence. All children were assessed on the TGMD-3, a criterion referenced assessment that examines the performance of locomotor and ball skills. Multiple performance criteria for each skill allow children to receive credit for any aspect of the movement they are able to perform; scoring is based on 46 and 54 possible performance criteria for the locomotor and ball skills subtests, respectively.

Results: Children with ASD demonstrated significantly lower levels of motor skill competence on both the locomotor [$t(1,52) = -4.879$, $p = .000$, $d = 1.34$] and ball skills [$t(1,52) = -7.845$, $p = .000$, $d = 2.15$] subtests of the TGMD-3 compared to neurotypical children of the same age. To match the second comparison group on the raw score of the locomotor skill subtest of the TGMD-3 [$t(1, 52) = -.558$, $p = .580$, $d = .15$], the children were between the age of 3 and 7 years. Despite being significantly older, children with ASD and the developmentally matched comparison group had similar levels of competence on the ball skills subtest [$t(1,52) = -1.370$, $p = .177$, $d = .37$].

Conclusions: By the age of 10, the majority of neurotypical children perform the fundamental motor skills included in the TGMD-3 with competence and confidence. Having a greater repertoire of motor skills affords children additional opportunities for PA participation across a greater variety of activities. Regardless of disability motor skill competency in young children does not naturally develop, it must be taught, practiced, and reinforced. The results of this research suggest children with ASD are not acquiring the same level of motor skill competence and may not have the same access to opportunities for learning as neurotypical children. It is during these formative years when it is developmentally and age-appropriate for children with ASD to be learning these skills. Without intervention, children with ASD will not acquire sufficient levels of motor skill competence that will afford them an opportunity for lifelong participation.

443.061 *(Poster)* Usefulness of the Sensory Profile As a Biomarker for Autism Spectrum Disorder

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Background: Sensory abnormalities are common symptoms in patients with autism spectrum disorder (ASD) and can cause various behavioral problems in daily life. Sensory abnormalities have been evaluated in several studies using the Sensory Profile (SP), a commonly used questionnaire. However, few studies have focused on the relationships among sensory abnormalities and the difference in age-dependent prevalence, intellectual quotient (IQ) or characteristics of ASD, such as social communication.

Objectives: The aim of this study was to evaluate the prevalence of sensory abnormalities in children with ASD using the SP and compare them with those in typically developing (TD) children. We analyzed the relationship depending on age, IQ, and characteristics of ASD. We further examined whether the SP could be used as a biomarker for ASD.

Methods: A total of 252 children with ASD aged 4 to 17 years and 94 TD children aged 4 to 17 years were recruited for this study. ASD diagnosis was made according to the Diagnostic and Statistical Manual of Mental Disorders Fifth Edition criteria and confirmed using the Autism Diagnostic Observation Schedule Second Edition (ADOS-2) in 138 participants. The severities of autistic characteristics were divided into mild (autism spectrum) and moderate to severe (autism) according to ADOS-2 scores. IQ were divided into normal, border, moderate delay, and severe delay. The Japanese version of the SP, which was evaluated by the guardians and consists of six sensory processing subdomains (i.e., auditory, visual), and four quadrant scores (i.e., avoidance, sensitivity), was used to evaluate sensory abnormalities using the age appropriate cut-off values. Behavioral problems were measured using the Child Behavior Checklist (CBCL). The relationship between sensory abnormalities and behavioral problems was analyzed using linear regression analysis. To test the specificity and sensitivity of the measured SP as a biomarker of ASD, receiver-operating characteristic curve analysis was performed. Statistical analysis was performed using SPSS version 23.0 (IBM Corp., Tokyo, Japan). This study was approved by the Internal Review Board in Osaka University Hospital.

Results: Children with ASD had a remarkably higher prevalence of sensory abnormalities in short SP total score (ASD: 43.8%, TD: 9.8%; $p<0.05$) and higher CBCL total scores compared to that in TD children (ASD: 66.19±9.4, TD: 49.9±7.8; $p<0.05$). Furthermore, children with ASD with low IQ and severe characteristics of ASD showed a higher prevalence of sensory abnormalities ($p<0.05$). The prevalence of sensory abnormalities showed no differences regarding age in children with ASD. The sensitivity and avoiding quadrant scores and boys exhibited higher CBCL total scores ($p<0.01$, $p=0.02$, and $p<0.01$, respectively). The three or more abnormal sensory modalities can predict for ASD with high area under the curve (0.88, 95% CI = 0.84-0.92, sensitivity = 69%, specificity = 95%).

Conclusions: The number of abnormal sensory modalities could be used as a predictive biomarker for ASD. This suggests that sensory abnormalities in children with ASD may not arise from a single sensory pathway, but may involve multiple sensory processing pathways. Evaluating sensory abnormalities and managing them adequately may improve their social adaptation in patients with ASD.

Service Delivery/Systems of Care

PANEL SESSION — **SERVICE DELIVERY/SYSTEMS OF CARE**

220 - Take a Seat at the Table: Engaging Community Stakeholders to Guide Intervention Adaptation for Youth with Autism

Panel Chair: Jill Locke, *Speech & Hearing Sciences, University of Washington, Seattle, WA*

Discussant: David Mandell, *Center for Mental Health, University of Pennsylvania, Philadelphia, PA*

Conducting research in community settings creates opportunities to build capacity in existing service systems to ensure intervention supports are readily accessible, relatively low-cost, and sustainable. However, interventions for children with autism often are not successfully implemented in real-world contexts, in part because they often are not adapted in the context of implementation, which results in poor intervention-setting fit, defined as the interactions among the context, intervention characteristics, and intended end-users or practitioners. Collaboration and partnership with community stakeholders in the adaptation process is a methodological paradigm shift in the ways in which interventions are typically designed and has the potential to improve intervention usability and implementation. We will present data from four studies that use established methods from the fields of user-centered design and implementation science to offer end-users an active role in intervention and implementation strategy adaptation to ensure practical relevance and contextual appropriateness. The four studies engage multiple stakeholders (e.g., parents, providers, agency leaders) to adapt a: 1) pediatric integrated mental health care model for youth with autism; 2) disruptive behavior intervention for school-aged children with autism; 3) parent-coaching implementation strategy for young children with autism; and 4) leader-level implementation strategy to support schools use autism interventions.

220.001 *(Panel)* Caregiver Insights to Inform Co-Creation of Integrated Mental Health Care for Children with Autism

N. A. Stadnick[1], *K. Martinez*[2], *G. A. Aarons*[1] *and L. Brookman-Frazee*[3,4,5], *(1)University of California, San Diego, La Jolla, CA, (2)Clinical Psychology, San Diego State University / University of California, San Diego Joint Doctoral Program in Clinical Psychology, San Diego, CA, (3)Psychiatry, University of California, San Diego, La Jolla, CA, (4)Child and Adolescent Services Research Center, San Diego, CA, (5)Autism Discovery Institute, Rady Children's Hospital-San Diego, San Diego, CA*

Background: Children with autism spectrum disorder (ASD) have a variety of unmet healthcare needs including access to needed specialty care. Access to and successful linkage to mental health care is particularly important for children with ASD to address the high rates of co-occurring psychiatric conditions that they may experience (Leyfer et al., 2006; Simonoff et al., 2008). Leveraging integrated care approaches, such as primary care providers collaborating with families to identify concerns and facilitate connection to specialty services, hold promise to address this healthcare need. Strategic and community-partnered methods are needed to tailor service coordination and delivery models to enhance linkage to mental health services for children with ASD. One such method is co-creation, defined as the collaborative mobilization and exchange of knowledge by and between stakeholders to improve health service delivery and experiences (Greenhalgh et al., 2016; Osborne et al., 2016). As part of a larger program of ASD implementation research (Stadnick et al., 2019), this study highlights one example of the co-creation process undertaken with caregivers of children with ASD.

Objectives: The purpose of this exploratory qualitative study was to understand the experiences of caregivers accessing mental health services for their child with ASD. The objective of gathering caregiver insights is to guide co-creation targets of tailored integrated mental health care for children with ASD.

Methods: Participants were eight mothers of children with a documented ASD diagnosis who received primary care at one of three health care organizations in Southern California. Caregivers were invited to participate in a focus group or individual interview. The semi-structured interview guide inquired about the following: 1) the mental health needs of children with ASD, 2) comfort discussing mental health in primary care appointments, 3) current primary care procedures for mental health screening and linkage and 4) needed adaptations to current procedures for children with ASD. A deductive approach to data analysis using rapid qualitative analytic methods was employed (Hamilton, 2018).

Results: Qualitative results highlighted three primary themes based on caregiver perspectives: 1) limited discussion about mental health and largely initiated by caregivers, 2) uncertainty about mental health referral options, which is complicated by the child's ASD diagnosis and 3) limited follow up with the family or mental health providers after referral. Caregivers provided several recommendations to guide co-creation of tailored integrated care practices for ASD. Recommendations included: routine mental health screening in primary care; encouraging primary care providers to initiate discussions about mental health, informational brochures about mental health and mental health services; follow-up contact with the family after mental health needs identified.

Conclusions: Caregiver insights provide targeted guidance towards tailoring integrated mental health care practices for children with ASD. Many of the recommendations shared by caregivers are actionable and feasible to implement. Next steps will be to align caregiver perspectives with the perspectives of primary care providers that were concurrently collected to produce an integrated mental health care model for ASD and test it in an upcoming pilot feasibility study.

220.002 *(Panel)* Iterative Redesign of a Behavioral Skills Training Program for Use in Educational Settings

J. Locke[1] *and K. Bearss*[2]*, (1)Speech & Hearing Sciences, University of Washington, Seattle, WA, (2)Psychiatry and Behavioral Sciences, University of Washington, Seattle, WA*

Background: Children with autism engage in disruptive behavior at a rate higher than their typically-developing peers in schools.Teachers endorse disruptive behavior as a considerable concern for students with autism, which is compounded by the lack of adequate resources for behavior management in the classroom. Considering schools are the most accessed service system for children with autism, there is a dire need to improve community-viable, empirically supported interventions targeting disruptive behavior for children with autism in schools. RUBI is a proven-efficacious intervention that addresses disruptive behavior in children with autism. Over the past decade, the RUBI Autism Network developed and systematically tested a low-intensity (11-session) manualized intervention for children ages 3 to 14 with autism and co-occurring disruptive behavior. RUBI is a weekly, one-hour outpatient treatment based on principles of applied behavior analysis, where therapists train parents to assess the function of their child's behavior (e.g., to get attention, gain access to a tangible items, escape demands) and use a range of behavioral strategies, which leads to reductions in child disruptive behavior. Although RUBI is an empirically supported intervention for children with autism and co-occurring disruptive behavior, adaptations are needed for its use in schools.

Objectives: The goal of this presentation is to introduce a novel methodological approach to redesign a proven-efficacious intervention, RUBI, for use in community settings. We use the Discover, Design/Build, Test (DDBT), a user-centered design and implementation science framework to enhance the usability, contextual fit, uptake, and effective implementation of an intervention, to guide assessment of the implementation context (elementary schools) and iteratively redesign the RUBI intervention to improve usability and implementation (feasibility, acceptability, appropriateness).

Methods: Forty school staff (general and special education teachers, paraprofessionals, school counselors, administrators, etc.) that support children with autism in general and special education classrooms from 20 partner elementary schools were included in this study. In the first stage, we use a day-long observation and retrospective think-aloud interview protocol to identify the contextual constraints and work processes relevant to the management of disruptive behavior in the classroom. In the second stage, we use an in-depth intervention demonstration of RUBI paired with behavioral rehearsal, a prospective think-aloud interview protocol, and structured assessment methods to identify targets for RUBI redesign (adaptation or pruning needs related to RUBI content and structure). In the third phase, we engage in collaborative redesign feedback sessions to iteratively adapt RUBI content and procedures, and we measure the usability, feasibility, acceptability, and appropriateness of the redesigned RUBI intervention.

Results: Data collection is ongoing and will be completed in January 2020. Conventional content analysis, in which meaning is derived from the content of verbal communications, but no a priori codes are identified prior to reviewing transcripts, will be used to code qualitative data. Quantitative ratings (usability, feasibility, acceptability, appropriateness) of RUBI will be interpreted using measures of central tendency to identify targets for RUBI redesign.

Conclusions: The use of a user-centered design and implementation science approach to redesign a proven-efficacious intervention may provide greater usefulness and usability in community contexts.

220.003 *(Panel)* Engaging Multiple Stakeholder Groups to Develop Strategies to Support the Implementation of Parent Coaching in Early Intervention.

M. Pellecchia[1]*, R. Beidas*[1]*, C. Cannuscio*[1] *and A. C. Stahmer*[2]*, (1)University of Pennsylvania, Philadelphia, PA, (2)Psychiatry and Behavioral Sciences, University of California at Davis MIND Institute, Sacramento, CA*

Background: Parent-mediated early intervention (EI) for young children with autism spectrum disorder (ASD) improves child and family outcomes. Parent coaching is a critical component of parent-mediated interventions. However, recent evaluations of community-based EI providers' use of evidence-based intervention techniques indicate that they infrequently implement parent-coaching strategies during usual practice, especially in under-resourced settings. The reasons for this implementation gap are unclear, but are likely multi-layered and complex. An in-depth understanding of the challenges to using parent coaching is necessary to inform the development of strategies to improve their implementation in publicly-funded early intervention settings.

Objectives: This study sought to learn about experiences with and perspectives toward using parent coaching from stakeholders across multiple levels of involvement (i.e., parents, providers, and agency leaders) within a publicly funded early intervention system to inform the development of strategies to improve parent coaching implementation.

Methods: Semi-structured interviews were conducted with 20 stakeholders (5 parents, 10 providers, and 5 agency leaders) which probed for information about respondents' experiences using evidence-based parent coaching strategies, and barriers and facilitators to using each strategy. Transcripts were analyzed iteratively based upon an integrated approach incorporating both inductive and deductive features.

Results: Common themes are consistent with constructs described in the Consolidated Framework for Implementation Research (CFIR: Damschroder et al., 2009) including: 1) providers' preferences (e.g., prefer a child-directed approach), beliefs (e.g., perception that some parents are not ready for coaching), and self-efficacy (e.g., lack of confidence in their ability to coach parents); 2) family characteristics (e.g., parent expectations for treatment); 3) intervention setting (e.g., chaotic homes), and 4) organizational factors (e.g., inconsistent approach across providers within agencies).

Conclusions: This study is one of the first to provide first-hand perspectives regarding community providers' use of parent coaching across multiple groups of stakeholders. Findings highlight the unique challenges to implementing parent coaching within publicly funded service systems and the complexity of these implementation challenges as they relate to different stakeholder groups. These findings will inform the development of implementation strategies tailored to meet the needs of each stakeholder group including developing easy-to-use educational materials for parents, creating a learning collaborative among providers to foster collaboration and improve consistency in treatment approach, and working with agency leaders to develop a formal implementation blueprint to guide the implementation of parent coaching. Implications and recommendations for strategies to improve the implementation of parent coaching within similar publicly-funded service systems will be discussed.

220.004 *(Panel)* Special Education Leaders' Feedback to Inform Adaptation of the Leadership and Organizational Change for Implementation Intervention

J. Suhrheinrich[1]*, M. Melgarejo*[1]*, B. Ventenilla*[2] *and G. A. Aarons*[3]*, (1)San Diego State University, San Diego, CA, (2)Special Education, San Diego State Universtiy, San Diego, CA, (3)University of California, San Diego, La Jolla, CA*

Background: Although evidence-based practices (EBP) for children with autism spectrum disorder (ASD) exist, current methods for selecting, implementing and sustaining these practices in school settings are not effective.Implementation leadership has been identified as a critical factor supporting use and sustainment of EBP across service sectors, including services for students with ASD (Aarons, Ehrhart, Farahnak, & Sklar, 2014; Lyon et al., 2018). The Leadership and Organizational Change for Implementation (LOCI) intervention provides targeted training to first-level leaders, those who supervise and support direct service providers, in leadership development, while building alignment and support for organizational change across all levels of leadership (Aarons, Ehrhart, Farahnak, & Hurlburt, 2015). Although school principals have been the primary focus of leadership in educational research, school-based services for children with ASD involve a team of individuals involved in leading and managing providers. Specialized staff (i.e Autism Specialist, Behavior Specialist) are first-level leaders (Priestland & Hanig, 2005) providing clinical guidance to direct service providers and are well-poised to influence adoption of new programs.

Objectives: The purpose of this exploratory mixed-methods study was to identify which leaders and what leader actions were key in the implementation process of school-based interventions for students with ASD. A second objective was to use these data to inform adaptations to the LOCI intervention to fit the special education service context.

Methods: Participants were recruited in partnership with the California Autism Professional Training and Information Network. Data were collected from survey participants (n=340) across organizational levels of special education services, including high-level administrators (n=19) (Special Education Director, District-level Administrator), specialized staff/first-level leaders (Autism Specialist, Behavior Specialist, Program Specialist, Mentor Teacher), principals (n=15), teachers and other direct service providers (n=153), and mental health providers (n=33; school psychologist, MFT). A subset of 12 survey questions regarding identification, selection, resource allocation, and training of educational programs for students with ASD were selected from a larger survey. Focus group participants (n=30) were specialized staff/first-level leaders in school-based services for students with ASD. Coded data from one set of questions focused on gathering feedback on the LOCI protocol were selected from the full focus group transcripts.

Results: Survey results indicated specialized staff/first-level leaders are critical in implementation of interventions for students with ASD as compared to high-level administrators, school site principals, teachers, and mental health providers. First-level leaders were most frequently identified as having the most impact on "identifying new educational programs for ASD for possible implementation" (56.8%) and "choosing which new educational intervention(s) for children with ASD will be implemented" (48.3%). Qualitative results highlighted three themes: 1) reduction in initial LOCI training time; 2) inclusion of leaders at multiple levels, but job titles of participants may vary by district size; 3) clear goals supported by all team members and accompanying timelines.

Conclusions: Findings will advance our understanding of the complex leadership structure within special education services and influence the adaptation of a leadership intervention to support the implementation and sustainment of EBP for ASD in schools.

PANEL SESSION — **SERVICE DELIVERY/SYSTEMS OF CARE**

221 - Understanding Stakeholder Perspectives Towards Evidence-Based Practices for ASD in Publicly-Funded Systems of Care

Panel Chair: Brooke Ingersoll, *Psychology, Michigan State University, East Lansing, MI*

Discussant: Melanie Pellecchia, *University of Pennsylvania, Philadelphia, PA*

Implementation science highlights the importance of stakeholder perspectives in the successful implementation of evidence-based practices (EBPs) in community settings. This panel describes research examining key stakeholder perspectives regarding the use of EBPs for youth with ASD in publicly-funded intervention systems, with a focus on barriers and facilitators that influence their implementation. The first two studies present data from two stakeholder groups on the use of family training practices within the same Medicaid-funded community mental health system: (1) ABA providers' perceptions of barriers and facilitators to the use of family training with their clients with ASD and (2) parent perspectives of engagement in current family training practices and attitudes toward evidence-based parent-mediated intervention (PMI) models. The third study examines the concordance between therapist and caregiver ratings of therapist use of EBPs in publicly-funded mental health programs. Finally, the fourth study examines agency trainer and therapist perspectives on a staff training model to support the use of an evidence-based PMI for toddlers in the Part C early intervention system. Dr. Melanie Pellecchia (discussant) will draw on her expertise on the implementation of EBPs in publicly-funded systems and make recommendations for strategies that can inform dissemination and implementation efforts, particularly for diverse families.

221.001 *(Panel)* A Mixed Methods Investigation of Barriers and Facilitators to Providers' Use of Parent Training with Medicaid-Enrolled Families of Individuals with Autism

D. Straiton *and B. R. Ingersoll, Psychology, Michigan State University, East Lansing, MI*

Background: Recommendations for best practice in the treatment of children with autism spectrum disorder (ASD) stress the importance of interventions such as parent training, in which caregivers are involved in implementing intervention strategies to teach their child skills. Many traditionally underserved (e.g., racial or ethnic minority, language minority, low socioeconomic status) families of children with ASD experience barriers that obstruct their access to and participation in autism-related services. Parent training has the potential to mitigate many of these barriers.

Objectives: This project examined barriers and facilitators endorsed by community providers who work with Medicaid-enrolled families of individuals with ASD under age 21. We sought to examine the relationship between parent training extensiveness (a measure of frequency and quality) and barriers and facilitators at the family-, provider-, and organization-levels.

Methods: This study utilized a convergent QUAN + qual mixed-method design. Ninety-seven applied behavior analysis (ABA) providers completed a survey regarding their parent training practices with Medicaid-enrolled clients with ASD. The relationship between parent training extensiveness (calculated by z-scoring the values for parent training frequency and quality and then summing both z-scores) and a number of provider demographic, training, and caseload variables were examined. Hierarchical linear regression was used to examine to what extent providers' perceptions of barriers and facilitators to their use of parent training predicted parent training extensiveness, after controlling for significantly associated provider demographic and training variables. Thematic analysis was used to analyze follow-up interviews from 13 providers.

Results: Results indicated that a) the number of providers' training experiences regarding parent training (r = .33, p = .001) and years of experience in working with children with ASD (r_s = .24, p = .02) were associated with parent training extensiveness; b) the final hierarchical linear regression model in which barriers predicted parent training extensiveness was significant [$F(5,86) = 7.32$, $p < .001$)] and explained 30% of variance, with family-level barriers explaining unique variance, β = -.23, t = -2.29, p = .03 (see Table 2); c) thematic analysis yielded the following themes for barriers: limited family engagement and interest, family stressors and/or cultural differences from the provider, logistical barriers (e.g., transportation in rural areas), lack of agency support or agency norms regarding parent training, and limited provider training about parent training (pre-service and in-service); d) no facilitators uniquely predicted parent training extensiveness; and e) thematic analysis yielded the following themes for facilitators: high family engagement and interest, logistical facilitators, agency support and norms regarding parent training, and training providers about parent training.

Conclusions: Taken together, these results indicate that providers perceive family-level barriers to be particularly challenging, over and above provider- and organization-level barriers. Providers perceived Medicaid-enrolled families as difficult to engage and/or uninterested in participating in parent training. Providers also noted having few pre-service and in-service training experiences that adequately prepared them to use parent training. Results suggest that implementation efforts to increase the use of parent training in community settings should address providers' perceptions of family-level barriers and foster high-quality training opportunities regarding parent training.

221.002 *(Panel)* Family Training Under the Medicaid Autism Benefit: Understanding Caregiver Perspectives on Engagement

K. Casagrande *and B. R. Ingersoll, Psychology, Michigan State University, East Lansing, MI*

Background: Parent-mediated intervention (PMI), in which providers coach parents to use intervention strategies with their child, is considered best practice in family training for children with ASD. Parents value PMI and view it as an unmet need, but families receiving services through Medicaid are significantly underrepresented in this research. These families have much to gain from PMI, as it can increase the accessibility, intensity, and effectiveness of evidence-based services in a system with limited resources. However, previous research on family training in a Medicaid setting suggests providers' perceptions of high family-level barriers limit their use of PMI strategies.

Objectives: In the context of a larger community-engaged project on family training during Medicaid-funded Applied Behavior Analysis (ABA), our goal is to better understand: 1) caregivers' perceptions of PMI as part of their child's current ABA; 2) caregivers' motivation to participate in PMI; and 3) the influence of barriers and facilitators on their motivation to participate.

Methods: Caregivers (N=203; 63% White; 82% Mothers; 32% ≤ High school education) of children with ASD (Age in years: M=8.86, SD=4.16; 52% White) receiving Medicaid-funded ABA services (Years of ABA: M=1.97, SD=1.39; Hours per week: M=14.60, SD=9.11; 53% Center-based) completed a survey. Caregivers were shown a one-page flyer describing evidence-based PMI and asked how similar this was to their current ABA family training support, as well as their motivation to participate in PMI using a validated measure. Caregivers also reported factors that could affect motivation to participate using validated measures of family-centered care, daily stress, external barriers to treatment, therapeutic alliance, and beliefs about the relevance and effectiveness of PMI. Semi-structured follow-up interviews (N=16) provided additional context for quantitative findings.

Results: Families reported high motivation to participate in PMI (M=4.26/5, SD=0.83); this was unrelated to parent, child, or service characteristics (r_{pb} p's≥.195), but was related to satisfaction with current involvement in ABA (r_{pb}=0.216, p=0.005) and perceived similarity of PMI with current ABA family support services (r_{pb}=0.169, p=0.033). After controlling for those factors, family-centered care explained a significant amount of variance in motivation to participate in PMI (ΔR^2=0.041, p=0.010). Furthermore, while therapeutic alliance (ΔR^2=0.063, p=0.001) and attitudes about PMI (ΔR^2=0.382, p=<0.001) explained additional variance in the model, daily stress and external barriers to treatment did not (ΔR^2=0.025, p=0.124; see Table 1). Interviews found that most caregivers valued the coaching and feedback components of PMI, but shared that current ABA family support services, which were primarily progress monitoring, were not worth the burden of participation. However, caregivers were willing to prioritize involvement in PMI specifically despite the burden.

Conclusions: Previous research on provider perspectives within this Medicaid system found high perceived family-level barriers to engagement. However, parents themselves reported relatively few barriers and high motivation to participate in PMI. Parents also reported that their current ABA family training experiences were not consistent with evidence-based PMI. The difference in perspective between parents and providers within this system may be related to caregivers' limited perceived value in current family training services, rather than a lack of motivation to participate overall.

221.003 *(Panel)* Comparing Therapist and Caregiver Perceptions of Therapists' Evidence Based Strategy Use in Children's Mental Health Services

C. Chlebowski[1,2], *T. Lind*[3], *W. Ganger*[2] *and L. Brookman-Frazee*[2,4,5], *(1)University of California San Diego, La Jolla, CA, (2)Child and Adolescent Services Research Center, San Diego, CA, (3)University of California, San Diego, La Jolla, CA, (4)Psychiatry, University of California, San Diego, La Jolla, CA, (5)Autism Discovery Institute, Rady Children's Hospital-San Diego, San Diego, CA*

Background: There are increased calls for therapists to implement evidence based practices (EBP) in children's publicly-funded mental health (MH) services. For children with autism spectrum disorder (ASD), caregiver participation plays an important role in effective delivery of EBPs. Limited work has examined concordance between therapist and caregivers in perceptions of therapist in-session EBP strategy delivery in children's MH treatment.

Objectives: The current study 1) compares therapist and caregiver ratings of therapist EBP strategy delivery in publicly-funded psychotherapy sessions, 2) examines the impact of therapist EBP training on therapist-caregiver rating concordance, and 3) examines child, therapist, and treatment factors impacting therapist-caregiver agreement.

Methods: Participants included a subset of 146 therapists and 158 caregivers of children with ASD aged 5-13 years drawn from a community effectiveness trial of AIM HI ("An Individualized Mental Health Intervention for ASD") conducted in publicly-funded outpatient and school-based MH programs. Ratings of therapist in-session EBP strategy delivery were collected from therapists and caregivers using the ASD EBP Therapist Strategies Questionnaire following 6 months of either AIM HI training or delivery of usual care. Agreement of therapist and caregiver perceptions of therapist EBP strategy use was examined using standardized difference scores and q-correlations. Linear mixed models were used to assess the impact of AIM HI therapist training and predictors of therapist-caregiver agreement.

Results: Therapist self-ratings of Caregiver-Directed ($t(41.44)=-5.85$ $p<.001$) and Child-Directed ($t(156)=-2.21$, $p<.05$) strategies differed by training condition with trained therapists reporting significantly higher EBP strategy use. Caregiver ratings followed the same pattern with higher rated EBP strategy use for both Caregiver-Directed ($t(38.22)=-5.06$ $p<.001$) and Child-Directed ($t(34.69)=-2.844$, $p<.01$) strategies for therapists who received AIM HI training.

The mean q-correlation between therapist and caregiver ratings for all intervention strategies was 0.31 (SD = 0.31), indicating that ratings covaried in a predictable, linear fashion. The mean standardized difference score was .00 (SD = 2.42), indicating that therapists and caregivers did not disagree on the overall rating of in-session EBP strategy use.

In multivariate models examining training group, child, caregiver, therapist or treatment characteristics predicting agreement, children who had at least one co-occurring mental health disorder had lower therapist-caregiver agreement (q-correlation: B = -.20, SE = .10, $p < .05$) and higher disagreement (standardized difference: B = -.20, SE = .10, $p < .05$), with therapists reporting lower strategy use than caregivers. Therapist with a self-identified ASD specialty reported more in-session strategy use than caregivers, with higher rates of disagreement (standardized difference: B = .97, SE = .26, $p < .01$). Other child characteristics (ethnicity, cognitive level, baseline behavior problems), caregiver characteristics (education, preferred language); and session treatment characteristics (session structure, treatment continuity, pursuit of skills in session) were not significantly associated with agreement.

Conclusions: Therapist EBP training was associated with higher ratings of therapist EBP strategy use from both therapists and caregivers suggesting that EBP training may impact therapist in-session behaviors. Ratings between therapists and caregivers suggested low levels of disagreement of overall therapist in-session EBP strategy use. Future study will explore the relationship between rating concordance and client outcomes.

221.004 *(Panel)* Community Provider Perspectives on Project Impact for Toddlers Training and Implementation in Early Intervention Settings

J. A. Ko[1], *S. R. Rieth*[2], *K. S. Dickson*[1], *R. Haine-Schlagel*[1], *A. C. Stahmer*[3] *and L. Brookman-Frazee*[1,4,5], *(1)Child and Adolescent Services Research Center, San Diego, CA, (2)San Diego State University, San Diego, CA, (3)Psychiatry and Behavioral Sciences, University of California at Davis MIND Institute, Sacramento, CA, (4)Psychiatry, University of California, San Diego, La Jolla, CA, (5)Autism Discovery Institute, Rady Children's Hospital-San Diego, San Diego, CA*

Background: Community provider perceptions of evidence-based interventions (EBIs) are critical to the utility, feasibility, and adoption of these interventions in community settings (Borntrager et al., 2009). However, there has been limited examination of EBIs in community settings and the perspectives of therapists being trained to deliver EBIs have largely not been examined. Project ImPACT for Toddlers (PI for T; Stahmer et al., 2016; Ingersoll & Dvortscak, 2019) is a parent-mediated EBI for very young children with social communication challenges. A community trial of PI for T demonstrates preliminary evidence of gains in positive parent-child interaction and children's social and communication skills (Stahmer et al., 2019); however, more information is needed regarding provider perspectives on the intervention and training process to promote sustainment of the practice over time in the community.

Objectives: This study utilized qualitative interviews and quantitative survey results to examine agency trainer and therapist perspectives on training in PI for T and their experiences delivering the program to families in the community.

Methods: Participants were recruited from 12 community agencies providing early intervention services. A train-the-trainer training model was utilized, where leaders (designated as agency trainers) were first trained in the PI for T intervention, and then trained therapists at their agencies. Agency trainers (n = 14) were 21% Hispanic/Latinx; Therapists (n = 24) were 29% Hispanic/Latinx. A total of 29% of agency trainers and 33% of therapists had a special education credential. Training in PI for T took place over approximately six months and consisted of didactic teaching of PI for T curriculum, in-person practice and feedback, and ongoing coaching and fidelity monitoring. Three months following training, agency trainers and therapists completed a feedback survey (1=strongly disagree to 5=strongly agree) and were invited to participate in an interview about their experiences with the training process and delivering the PI for T intervention. Qualitative data were coded using an iterative grounded theory approach (Glaser & Strauss, 1967) and transcripts from interviews were coded and analyzed using QSR-NVivo 2.0.

Results: Quantitative results indicated high acceptability and appropriateness of training (M=3.84, SD=.61 and M=3.45, SD=.97, respectively), as well as moderate intervention feasibility (M=3.14, SD=.92) and sustainment (M=3.01; SD=.87). Interview results indicated both agency trainers and therapists reported the acceptability and appropriateness of the training model, and indicated the group-based model of training, comprehensive materials, and agency support served as primary facilitators of these outcomes. Agency policies and time were key barriers. Interview data also supported the feasibility, acceptability, and utility of the intervention approach in community settings, particularly the focus on parents. Family characteristics/fit with the family was identified as both a barrier and facilitator to feasibility.

Conclusions: Results indicate that community providers support the training and use of the PI for T intervention in their practice. Continued efforts to disseminate EBIs for children with autism in the community will be improved by particular attention to key barriers and facilitators identified here.

POSTER SESSION — SERVICE DELIVERY/SYSTEMS OF CARE
444 - Service Delivery/Systems of Care Posters

444.001 *(Poster)* A Pilot Study Examining Implementation Strategies for the Autism Support Checklist

B. O'Hagan[1]*, C. Bays-Muchmore*[2]*, P. Sonikar*[1]*, A. Friedman*[1]*, L. Bartolotti*[1]*, S. King*[1] *and M. Augustyn*[1]*, (1)Developmental and Behavioral Pediatrics, Boston Medical Center, Boston, MA, (2)The Autism Program, Boston Medical Center, Boston, MA*

Background: Individuals with Autism Spectrum Disorder (ASD) have higher rates of various medical conditions and are higher utilizers of the healthcare system[1–4]. Despite higher usage, patients with ASD and their families report lower satisfaction with care recieved[5–8]. This may be partly due to the unique unmet needs in the typical hospital environment[9–11]. In an effort to address this, the Autism Friendly Initiative (AFI) at Boston Medical Center (BMC) implemented the Autism Support Checklist (ASC), a questionnaire derived from the Autism-Specific Care Plans[12] that summarizes a patient's communication, sensory, and safety/behavioral needs. This information is then entered into the patient's Electronic Health Record (EHR) for clinicians and staff to access.

Objectives: The goal of this study is to (1) evaluate two implementation strategies (i.e., high-intensity and low-intensity trainings), (2) determine the acceptability of the ASC, and (3) collect patients' caregivers' feedback.

Methods: We looked for upcoming appointments in February-August 2019 for patients who had ASCs in their EHR and randomly assigned their clinicians (n = 23) to one of two groups; (1) low intensity group (received an email about ASC) and (2) high intensity group (received an email and in-person training about ASC). After the appointment, clinicians completed a brief online survey. We also collected data from 17 patient caregivers through a phone survey after their appointments. Both clinician and caregiver surveys included quantitative and qualitative items. Responses were analyzed using Fisher's exact tests.

Results: 71% of clinicians reported reading the ASC in full and among these clinicians, 70% reported finding it useful. In terms of potential barriers to ASC, 43% of clinicians reported "lack of time", 14% reported "information is irrelevant", 14% reported "information is too long", and 17% reported "unsure where to locate". 18% of clinicians reported changing their behavior because of the ASC. There is a trend in which high-intensity group clinicians were more likely than low-intensity group clinicians to report reading the ASC in full ($p = 0.068$) and lack of time as a potential barrier for using the ASC ($p = 0.10$). There was no significant difference between the responses of the clinicians in the high-intensity group and the low-intensity group. Patient caregivers reported similarly positive outcomes across both clinician groups regarding clinicians' ability to communicate with the patient and address their sensory needs.

Conclusions: In this pilot study, the ASC was generally well-received by clinicians, and there is preliminary evidence suggesting that an active training component may be helpful in increasing clinician engagement. However, the active training component does not translate to an increased likelihood that the clinician will rate the ASC as more helpful or report behavior change. Further research is needed to explore other potential implementation strategies for the ASC and its longitudinal impact and effectiveness on improving care delivery and patient/family-related outcomes.

444.002 *(Poster)* A Spatial Analysis of Service Lag to Early Intensive Behavioral Intervention

A. F. Dimian*, J. Wolff, F. J. Symons and J. Simacek, University of Minnesota, Minneapolis, MN*

Background: Early intensive behavioral intervention (EIBI) is one of the most common evidence based early intervention approaches to increase adaptive behavior among children with autism spectrum disorder (ASD). Despite emphasis on intervening early following identification and diagnosis, significant barriers can interfere with timely service access. Among the most common barriers (e.g., waitlists, service provider shortages), geography has been relatively unexamined. More specifically, geographic location is a known but not widely investigated barrier to both receiving a timely diagnosis and starting or sustaining ASD treatment efforts. Previous research suggests that there is limited access to care for autism-related services in non-metropolitan/ rural areas (Mandell et al., 2005; Thomas, Ellis, McLaurin, Daniels, & Morrissey, 2007).

Objectives: The purpose of this study was to assess the relation between geographical distribution and starting EIBI services.

Methods: A cohort of children ages 3-5 years old (n=667) with ASD residing in Minnesota between 2008 and 2010 were identified through Minnesota's Medicaid Management Information System. We compared metro and non-metro residence using Kaplan- Meier product limit estimates of survival and Chi- square analyses. The distribution of service providers and the average time lag to EIBI was also assessed utilizing geographical information system (GIS).

Results: Approximately 70% of children in this study experienced a time lag to EIBI services, with an average lag of approximately 9 months (range= 0-45 months). Average time lag ranged from 0 to 28 months. The average age to start EIBI services was 4.70 years (SD=1.24 years). In the metro area, the average start age was 4.79 years. In the non-metro area, children started EIBI at a younger age, 4.50 years, on average. The Kaplan-Meier median time to starting EIBI per the survival functions for the whole sample was 5 months. The children who resided in the metro area, median time lag was 6 months and for the children who resided in the non-metro areas, median time lag was 4 months. At 12 months, the probability of 'survival' (i.e., starting EIBI) was approximately 18% for the non- metro children and 35% for the metro children. Overall, the survival curves showed that non-metro children experienced less time lag to starting EIBI over time.

Conclusions: Overall, sample sizes and number of service providers varied by county with most of the children residing in the metropolitan/urban areas. There was a statistically significant mean difference between metro and non-metro time lag to service estimates with the non-metro areas having overall shorter time lags. Notably, we also found that the average age at start of EIBI was 5 years regardless of urban or rural residency. This represents a systematic time lag that runs counter to the theoretical basis of early intervention for ASD. With the increase in ASD prevalence, resources and service provision are critical for meeting the needs of children and families early on and throughout the lifespan. Research focusing on socio-cultural factors – including where one happens to live –has the potential to significantly inform both clinical practice and public health policy.

444.003 *(Poster)* An Exploration of a Community-Based Autism Intervention Implemented within Part-C Services

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Background: While fidelity is often held to high standards for research projects, procedural fidelity in community and educational settings is variable (e.g., Stahmer et al., 2015) if measured at all. There is a pressing need to bridge research and practice in systematic ways. In 2015, the Minnesota Department of Education (MDE) received a State Personnel Development Grant (SPDG) from the Office of Special Education Programs (Grant number: H323A150010) with the goals of improving early ASD identification, enhancing intervention, and preparing for transitions out of Part C services. The Early Social Interaction (ESI) intervention (Wetherby et al., 2014) is being conducted through the Autism Navigator, a collection of web-based courses and tools developed by the Florida State University Autism Institute to bridge the gap between science and community practice using a highly interactive web platform with extensive video footage to illustrate effective evidence-based practice for both early identification and intervention.

Objectives: The goal of this exploratory study was to determine the feasibility of implementing ESI in a community setting using the Autism Navigator online training.

Methods: Five Minnesota districts are implementing this project, three in the Twin Cities metro area and two greater Minnesota districts added in 2017. Early intervention providers in these districts have completed the 30-hour Autism Navigator training and participate in monthly webinars and annual training events. Data has been collected through year four of five for the SPDG project, with the final data collection deadline scheduled for March 1, 2020. A sample of 19 Part C providers have completed self-ratings of fidelity completed across sessions with 31 children identified with ASD and their families and 76 providers have completed an annual survey asking about their use of the intervention strategies.

Results: Average self-ratings of fidelity for the first four years have been 30.2% (n = 34), 61.6% (n = 63), 71.6% (n = 73), and 71.0% (n = 63). External observations of fidelity were completed for a minimum of 20% of providers in years two through four. The mean year three external fidelity rating was 48% (range of 20% to 75%), compared to a mean self-rating of 51% for the same visits (range of 0% to 75%), while the mean year four external fidelity rating was 65% (range of 30% to 85%), compared to a mean self-rating of 69% for the same visits (range of 55% to 85%) with an overall inter-rater agreement of 85%. Quantitative and qualitative survey data across all five years of the project will be presented as well.

Conclusions: Results of this exploratory professional development project provide preliminary evidence to support the use of online training, supplemented with in-person and web-based follow-up, to implement community evidence-based early autism intervention. The use of systematic self-ratings of fidelity may be an important and feasible tool for improving community practices and outcomes for young children with ASD receiving Part-C services.

444.004 *(Poster)* Assessing the Ability of the Infant-Toddler Checklist to Identify Developmental Concerns in a Low-Income, Ethnically Diverse Population

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Background: While screening tools exist to identify communication delays prior to 18 months, there is a need to better understand whether these tools can accurately identify developmental concerns in younger, ethnically diverse children. One such tool is the Communication and Symbolic Behavior Scales Developmental Profile Infant-Toddler Checklist (ITC), a broadband communication screening tool that has successfully identified autism spectrum disorder (ASD), language delay, and developmental delay among children ages 9 to 24 months.

Objectives: This study aims to answer the following question: in a low-income, ethnically diverse population, can the ITC predict developmental and communication concerns earlier than more commonly used screeners?

Methods: The setting for this study is an urban primary pediatric care clinic that serves a culturally and linguistically diverse population. Children were screened per clinic standard of care with the Parents' Evaluation of Developmental Status (PEDS) at 12 and 15 month well child visits and the Modified Checklist for Autism in Toddlers, Revised with Follow Up (M-CHAT-R/F) at 18 and 24 month well child visits. As part of this study, parents and guardians of children between the ages of 11 and 20 months received additional screening with the ITC. Results on the ITC were compared to subsequent results on the PEDS and the M-CHAT-R/F. Of those who screened positive, research staff performed chart reviews through 24 months of age. The following data were abstracted from the child's medical record: screening results from the PEDS and the M-CHAT-R/F; developmental diagnoses; referrals for developmental services; and notation of parental and provider concerns. Preliminary data were analyzed descriptively. Once all participants have reached 24 months and charts can be fully abstracted, the kappa statistic will be used to measure agreement between the ITC and the PEDS, the M-CHAT-R/F, and parental concern.

Results: 300 children were screened using the ITC; 56% were Black or African American, 23% were Hispanic, 49% were male, and 16% of parents/guardians preferred a language other than English. 98 children (33%) scored above the cut off for developmental concern on the ITC. Of these 98, we obtained permission to access the charts of 92 children. Of these 92, 66 (73%) were screened with either the PEDS or the M-CHAT-R/F at the closest proximal well child visit; 15 screened positive and 51 screened negative. 26 had no documentation of routine screening. ITC positive screening results were discordant with M-CHAT-R/F and PEDS results in 77% of proximal screens.

Conclusions: Preliminary results show a higher positive screen rate on the ITC than previous studies. This finding is likely due to the higher risk and younger age of participants in this study. The ITC appeared to identify new concerns, not revealed by the clinic's standard screening tools. Findings suggest that broadband screening may lead to earlier diagnosis of ASD and other communication delays. However, it is also possible that the tool over-identifies developmental concerns among typically developing very young, low-income children. Ongoing chart review and analysis will assess the potential advantage of this screener for identifying ASD.

444.005 *(Poster)* Autism Alertness in Dutch Physicians Screening in the Child General Population: Effects of an Online Course

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Background: Signalling autism is a significant task of Youth and Family Centre (YFC) physicians performing preventative health care in the Netherlands by screening the child general population from birth to adolescence. Knowledge about screening for Autism Spectrum Disorder (ASD) in preventative health care practitioners is limited and little is known about the lasting effect of ASD education.

Objectives: To evaluate the effect of an online course on the level of ASD knowledge, psychiatric stigma, perceived competence and referrals in YFC physicians.

Methods: Physicians followed the online course 'Detection of Autism Spectrum Disorders in Children aged 4-6 Years by Youth and Family Center Physicians' consisting of three Live Online Learning (LOL) sessions. We assessed ASD knowledge and competence signalling ASD before, directly after and at six months follow up using questionnaires. Psychiatric stigma was measured using the Community Attitudes towards the Mentally Ill (CAMI) questionnaire, before the course and at six months follow up. Participants were asked to register referrals two months before the course and at follow up.

Results: Results showed an increase in general ($F(2, 154) = 8.93$, $p < .001$) and specific ($F(2, 154) = 23.92$, $p < .001$) ASD knowledge after the course. Physician specific ASD knowledge mean scores remained higher ($p = .01$) at follow up ($M = 6.46$, $SD = 1.65$) compared to pre-course means ($M = 5.87$, $SD = 1.65$). Psychiatric stigma amongst YFC physicians did not change as a result of the course. Perceived competence related to the detection of ASD ($F(1.56, 120.27) = 141.41$, $p < .001$) was higher after the course than at the start, and mean scores remained higher ($p < .001$) at follow up ($M = 36.95$, $SD = 4.08$) than before the course ($M = 29.05$, $SD = 5.56$). We found no effect of the course on the number of potential ASD referrals.

Conclusions: This study shows that an educational online course has long-term effects on autism knowledge and especially perceived competence of Youth and Family Centre physicians. Education on the early signs of ASD, communication and municipal referral options should have adequate attention in primary care settings.

444.006 *(Poster)* Autism Parent Training in a Developing Country: A Public/Non-Governmental Organization (NGO) Partnership.

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Background: Multidisciplinary support services for autism spectrum disorder are minimal in the public service and often inaccessible due to the high cost privately. Repeated advocacy efforts have also failed to impact significantly the public service provisions. The stark reality is that many families do not access basic services like speech therapy and occupational therapy. Many children do not receive adequate access to school placements.

Early detection and intervention is the way forward but in a developing country, impacting service provision is limited by resource challenges regarding funding, management, political will, infrastructure limitations, and limited human resources.

This project accessed funding from a NGO to train professionals within the public health system to provide parent training modules to parents in their service regions.

Objectives: We studied the impact of a NGO sponsored training in providing training to parents of children with ASD.

Methods: In March 2016, December 2016 and November 2017, a local Rotary Club, a Child Health Department of a tertiary institution, a Community Paediatric team in a Regional Health Authority (RHA) and a foreign university autism research and treatment centre came together to host autism parent training modules. Selected professionals from all five Regional Health Authorities in the country were invited to be trained. Parents from various public clinics were invited to attend. Eight modules were completed. Professionals trained then offered training to parents in their respective regions.

Results: Within twenty four months subsequent to the initial training, sixty percent of the RHAs held some form of parent training for local families.

In one RHA, a child psychiatry team and a community paediatric team collaborated to provide parent training during afternoon sessions within working hours in a local health centre. Materials were provided through the RHA print centre. Light refreshments were sponsored by a drug company. Eight training sessions were carried out during the twenty four month period. On average thirty parents were invited for the training but the average attendance rate was 60% of parents invited. Initial feedback indicated that parents found the training beneficial. Data regarding the outcome after training is to be collected.

In another RHA, training was carried out in a local health centre for small groups of parents. A medical officer teamed up with nurses in the health centre to provide the training.

In another RHA, an initial large group parent training session was carried out. A further six parent training sessions were carried out over the next two years.

Training was also provided in the context of clinical consultations in paediatric follow up clinics.

Conclusions: In keeping with the United Nations mandate for upgrading services for Autism this Public/NGO partnership has improved capacity by training parents. Given the constraints, financial and otherwise, this type of partnership is a way forward in developing countries. While the partnership has bolstered capacity, further supports and strategies beyond provision of initial training is necessary to achieve sustainable improvements in care.

444.007 *(Poster)* Autism Services Research Funding: Trends across a Decade

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Background: The autism field's substantial, prolonged emphasis on biology and putative risk factors, as well as the subsequent NIH funding targeted to these issues, has come at the expense of areas such as treatment and services that have the capacity to more rapidly improve the lives of many individuals with autism spectrum disorder (ASD) and their families. Recently, a shift has occurred highlighting this issue both in the media and by funding agencies. In fact, the NIH has identified the development and delivery of evidence-based services as an area in need of resource growth. However, with the exception of knowing the broad fact that, since 2008 service research funding averaged <10% of total autism-related funds, little is known about the patterns of services funding, the issues addressed by the services specific funding or the products from that funding.

Objectives: Therefore, the objective of this study was to conduct a detailed analysis of trends in services research funding for ASD using data on NIH-funded projects to understand funding patterns and issues addressed by funded projects and to identify future areas of research.

Methods: Given that NIH funds the majority of ASD research, we examined data on federal funding for ASD services research via NIH RePORTER from 2008-2018; 135 projects met criteria for review. Data collected included, but was not limited to, administering institute/center, cost per year, services category of focus, population of interest, symptom focus, setting and intervention agents, linked publications, and US state.

Results: The number of services projects funded was highest in 2018 (*N*=26); however, the 10-year trend was inconsistent and did not show a linear increase across time. Spending has increased from $4.43 to 22.99 million, though this may be proportionate to funding overall. Most projects focused on treatment development/efficacy/evaluation (~51%), with policy research (~8%) least prevalent. Trends in total spending mirrored these results, with few resources going to policy (~6% of overall funds). Notably, ~50% of projects came out of just three states, and there was no funding for services research in 21 states. Research most often took place in universities/medical centers. Encouraging results were found in regard to intervention agent, symptom targets, and age range studied. Analyses of trends across time and services categories, as well as a detailed review of linked publications are in process.

Conclusions: Few services projects related to ASD were funded in the last decade and most were treatment studies in university/medical center settings, which often fail to address important factors relevant to providing services in community settings. Thus, more attention to implementation and dissemination is needed. Further, the limited representation of states holds important implications for generalization of results, as each state service system is unique. This is further complicated by the lack of attention to policy in ASD services research, which has recently received attention as a potential, powerful mediator between research and practice.

444.008 *(Poster)* Autism, Poverty and Family Financial Hardship

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Background: Families of children with ASD face several financial challenges due to complex service needs and high out of pocket expenditures. Families living in poverty are especially vulnerable due to high demands on family resources, reduced earnings and disconnection from services and supports. As of 2016, an estimated one-third of children with ASD are living in poverty. Despite this, we know little about the characteristics, financial hardships and use of financial supports among households of children with ASD. Gaining such an information can help to inform policies aimed at promoting economic well-being of children with ASD and their families.

Objectives: This report explored family financial hardship among families of children with ASD (ages 3-17 years) and their participation in safety net programs. We addressed the following three aims: 1) to present levels of family financial hardship among households of children with autism, 2) to describe the types of safety-net programs low-income households of children with autism report using, and 3) to report levels of family financial hardship among low-income households of children with autism that do and do not receive safety-net benefits.

Methods: We analyzed data from the combined 2016 and 2017 National Survey of Children's Health (NSCH). Our sample included 1,679 children, ages 3-17 years, whose parents reported a current diagnosis of autism. We compared findings to households of children with other special healthcare needs (SHCN), but no autism (N=13,959) and to all other households of children (N=61,940). We used descriptive analysis to generate national point estimates across several domains of family financial hardship including household poverty, family out-of-pocket expenses, and material hardship (which included: difficulty paying for basics like food or housing; unable to afford adequate food; difficulty paying a child's medical bills; and reducing work hours to care for their child). We also assessed household receipt of the following four safety net programs: Temporary Assistance to Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the National School Lunch Program (NSLP).

Results: Over half (56%) of children with ASD lived in low-income households. Children with ASD from low-income households tended to have poorer health and higher levels of autism severity than their peers from higher-income households. Two-thirds of parents of children with ASD reported experiencing at least one type of material hardship. Material hardship was higher among parents of black and Hispanic children with autism and younger children (ages 3-5 years). Out-of-pocket expenses were lower among children with ASD from lower-income households and those that received Medicaid. Over one-fourth (30%) of children from households under 200% of the FPL were disconnected from all safety net programs.

Conclusions: The high proportion of households of TAY with ASD that participate in safety-net programs, coupled with high rates of material hardship among this population, warrants the further investigation of antipoverty programs and ASD.

444.009 *(Poster)* Autism-Friendly Language and Literacy Library Program: Development and Evaluation of an Online Package for Librarians

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Background: Learning to read with understanding is essential for participation in education, the workforce, and society. Concerningly, up to 65% of students on the autism spectrum show impairments in reading (e.g., Johnels et al., 2019). Literacy development commences before children begin school providing an opportunity for early supports prior to the onset of challenges. Public libraries provide a free avenue for many families during this time to support children's skill development through access to multimedia, reading materials, and early language and literacy sessions. However, families of children on the spectrum report accessing these resources less often than families of children without autism (e.g., Simpson et al., 2019). They also report barriers to access including challenging sensory environments, difficulties engaging their child, and concerns about their children's challenging behaviours (Prendergast, 2016; Simpson et al., 2019).

Objectives: We aimed to develop an online training package for librarians to support implementation of autism friendly library sessions. This included evaluation of the effectiveness of training in increasing autism knowledge and self-efficacy to include children on the autism spectrum in library activities as well as social validation.

Methods: A mixed methods approach was used across three phases. Phase 1 included development and evaluation of face-to-face delivery of training with 22 (20 females, 2 males) librarians including quantitative evaluation of changes in autism knowledge and confidence in including children on the spectrum (adapted from the Autism Inclusion Questionnaire, Segall & Campbell, 2007), and social validity of the training (adapted from the Intervention Rating Profile, Martens et al., 1985). Phase 2 included implementation in libraries and qualitative evaluation of the utility and implementation of training through interviews conducted with five female librarians. Phase 3 included translation to an online module which was completed by 22 female librarians and evaluation of autism knowledge, confidence, and social validity of the training in response to the online delivery of content.

Results: In Phase 1 statistically significant changes in knowledge and confidence were found following training. Phase 2 provided insight into implementation in practice including increased confidence in providing a more supportive environment and valuing library sessions as literacy learning experiences. Phase 3 showed the initial feasibility and effectiveness of the online translation of training including increases in knowledge and confidence. Across phases the training was rated as socially valid by participants with feedback for fine-tuning such as including example scripts incorporated from Phases 1-2 into the Phase 3 online translation.

Conclusions: The use of a mixed methods approach to the development and refinement of training provides a model for future development of knowledge translation tools to disseminate research into community practice. Our research provides the first proof-of-concept of the online training package to support participation of children on the spectrum through changes in librarian practice. The next stage is to evaluate the implementation of learned strategies by librarians and the impact on child access and outcomes including development of emergent literacy skills relative to comparison groups not accessing library services to ultimately support better literacy outcomes for this population.

444.010 *(Poster)* Autistic Adult Services Availability and User Experiences in the EU: Results from the Autism Spectrum Disorder in the European Union (ASDEU) Survey on Residential, Employment, Education, Financial and Social Services

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Background: The research base for autism in adulthood is underdeveloped and there is very little knowledge regarding autistic adult services practices and delivery.

Objectives: The overall objective was to improve understanding of current services practices for autistic adults and opportunities for improvement as part of the Autism Spectrum Disorder in the European Union (ASDEU) project comprised of 20 partners in 14 European Union (EU) states. This study's specific objective was to examine autistic adult services availability and user experiences based on an ASDEU survey of residential, employment, education, financial and social services.

Methods: ASDEU survey questions included services availability, user preferences, waiting times and alignment of user experiences with published guidelines regarding residential, employment, education, financial and social services provision for autistic adults. Separate survey versions were created for autistic adults, carers of autistic adults and professionals in adult services. The survey was translated into 11 languages and distributed in 2017 by ASDEU partners via electronic media hosted by ASD organizations and in-country adult services facilities. For this study, distributions of responses from all three respondent groups regarding features of each type of service were analyzed separately; responses from the carer group for analysis were stratified on level of independence of the autistic adult under care.

Results: 1,842 persons responded to the survey: 631 autistic adults (66% female; 52% 26-35 years old), 526 carers of autistic adults (autistic adults were 27% female; 54% 18-25 years old), 685 professionals in adult services (80% female; 52% in non-medical services). There were from 100 to 590 responders per country from Denmark, Finland, France, Iceland, Italy, Poland, Spain and UK; and 50-60% of responders were in communities of 20,000-1 million inhabitants. The top choices by autistic adults or carers (10%-42% of responders) for services best suiting their current needs were: residential - 'help in own home', 'full time residential facility'; employment - 'job mentors'; education - 'support in regular education setting'; financial - 'supplementary income if not fully employed', 'supported employment', 'full pension (if cannot work)'; social - 'behavior training for individual', 'peer-to-peer matching', 'peer-to-non-peer matching', 'life skills training'. The top choices of professionals (29-75% of responders) for services most needed were: residential - 'day center', 'help at college'; employment - 'job mentors', 'employer programs'; education - 'support in regular education setting', 'day school'; financial - 'supported employment'; social - 'life skills training'. Median waiting times for specific services were generally <1 month or 1-3 months, except for residential services which could be up to 6 months. Most professionals were uninformed of waiting times ($\geq$ 50%: 'don't know'). Seven of the 9 recommended residential services features were experienced by <50% of carers or adults.

Conclusions: Variation in services experiences and perceptions reported by autistic adults, carers of high or low independence autistic adults, or adult services professionals underscores the need to query all groups for a complete picture of community services availability and needs. The results reveal areas for improvement in autistic adult services delivery in the EU to achieve recommended standards.

444.011 *(Poster)* Capturing the Autistic Experience: Self-Advocates Develop Self-Assessment Tools to Inform Autism Diagnosis across the Gender Spectrum

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Background: Current gold standard tools for identifying and studying autism are critiqued for their lack of specificity and sensitivity, especially in autistic people who are older, have higher IQs, and are not cisgender boys (e.g., Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015). For example, evidence from an epidemiological study indicates that girls are diagnosed later than boys, particularly girls without intellectual disability (Shattuck et al., 2009). Information from autistic people about their own experience of autism represents an untapped resource for enhancing clinical and research tools for diagnosis and phenotyping. To fully capture the inner experience of autism, however, autistic people need to define the questions asked, as well as the answers given.

Objectives: Leverage a collaborative team of autistic self-advocates, clinicians and researchers to develop an ADOS-2, Module 4 participant feedback questionnaire and a self-report autism trait questionnaire to capture the inner experiences of autistic people.

Methods: As part of an NIMH Autism Center of Excellence Network study of gender in autism, and using participatory research techniques, autistic self-advocates partnered with autism researchers and clinicians to develop and collect self-report measures on two autism evaluation tools. These are:

- A participant feedback questionnaire to capture the inner experience of people receiving the ADOS-2, Module 4, in order to inform ADOS findings. Feedback will also be collected after the research appointment about participants' experience in the study overall.
- A self-report autism trait questionnaire constructed with items identified by an iterative process consisting of: environmental scanning of writings by autistic people validated by the autistic community as touchstones; condensing those descriptions into themes; generating an item list from those themes; and revising the items through a two-stage Delphi procedure, adapted for the diverse Delphi panel of autistic experts (e.g., speaking and non-speaking, full gender spectrum).

Results: The development of the ADOS feedback questionnaire has identified important issues such as the level of effort expended to participate in the ADOS interview and whether any of the participant's comments had been previously rehearsed or practiced. The questionnaire has also expanded to assess both the positive and negative experiences autistic people encounter in assessment and research. The self-report autism trait questionnaire, based on the environmental scan, addresses aspects of the autistic experience that are not captured with current diagnostic tools, such as "autistic inertia" and experiences of "camouflaging." The involvement of the autistic Delphi experts and autistic lead researchers was crucial in revealing the challenge of developing self-report questionnaires of autistic traits that are non-stigmatizing and truly assess autism without making comparisons to an implicit neurotypical standard. The process further revealed the challenge of disentangling autistic traits from trauma and bias.

Conclusions: Participatory research techniques with autistic researchers as co-investigators leading researchers and clinicians in the development of new assessment tools yields measures which introduce previously unrecognized components of the autistic experience. The development of these promising new tools illustrates the necessity of enabling autistic experts to lead research efforts in order to drive meaningful lines of inquiry and obtain valid, important, and exciting findings that arise from that work.

444.012 *(Poster)* Comparing Social Capital Among Parents of Low-Resource Children on the Autism Spectrum during Key Life Stages

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Background: Low resource caregivers with children with autism spectrum disorder (ASD) experience difficulties accessing services post-diagnosis and during key life events (e.g., school transitions; Nuske,et al 2018). Disparities may relate to levels of social and cultural capital, i.e., resources within social networks that provide advantages (Lin 2001). Family and community supporters can provide additional resources and professionals can provide access to services. Cultural capital is the dominant social assets that one possesses (e.g., education) that promote social mobility. It also includes non-dominant cultural resources and social assets found in communities of color, e.g., aspirational capital (ability to maintain dreams for the future; Yosso 2005).

Objectives: Describe community cultural capital, network density, network size and role in a sample of low-resource caregivers with children with ASD and explore cross sectional variation in community cultural and social capital across key life stages.

Methods: Participants were recruited for two behavioral intervention RCTs across four Autism Intervention Research Network on Behavioral Health (AIR-B) sites: Los Angeles, CA; Sacramento, CA; Philadelphia, PA; and Rochester, NY. Participants included primary caregivers of children (2-14 years) with ASD (n=249) who were largely female (90%), and ethnically diverse (41% Hispanic; 23% Black; 5% Asian; 29% other non-white), with mean age of 36.8 years. Families fell below the federal poverty level standards, with 83% of caregivers at an average household income of under $50,000. Families identified up to ten supporters of their child and their connections with one another. We used a multi-dimensional community capital survey to capture Cultural Wealth (Yosso, 2005), Motherhood Capital (Lo, 2016), and Black Cultural Capital (Carter, 2003). Caregivers were grouped into four different categories by child's age/grade, including "infant/toddler" (n=17; age 0-3); "pre-school/kindergarten" (n=146); "elementary" (n=49; 1-5 grade); and "middle school" (n=37; 6-8 grade).

Results: Caregivers reported high levels of non-dominant community cultural capital, excepting social capital. Caregivers of color reported higher levels of all non-dominant forms of community capital, except navigational and familial forms. Few network members had weekly or more contact with one another. White caregivers had greater professional density that caregivers of color (24% vs. 14%) Contact density was lowest during the early childhood stage (5%) and highest during elementary stage (10%). Mean network size was lowest during middle school (5.03) and highest during early childhood (5.53). Weekly connections bridging family/community supporters and professionals were sparse across all life stages (overall 2%).

Conclusions: Low resource caregivers identified cultural resources (e.g., aspirations for the future). This study provided confirmation that caregivers of color rely on nondominant forms of cultural capital while parenting their child with autism. However, access to key social capital is lacking, creating a systemic barrier. The disparity in professional densities between caregivers of color and white caregivers suggest key barriers that require further investigation. Future interventions should use asset-based tactics to build on the community capital strengths of caregivers. Strategies to build connections that bridge home, community and professional contexts will allow for increased access to key resources to better support children with ASD across all life stages.

444.013 *(Poster)* Critical Time Points When Accessing Diagnosis and Early Treatment Among Children with ASD: A Comparison between Immigrant Children and Children of US-Born Parents

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Background: The number of children diagnosed with Autism Spectrum Disorder (ASD) has grown at a striking rate. Numerous researches have shown that early detection, treatment and services are crucial in advancing outcomes and reducing symptoms. Center for Disease Control's report on ASD was based on 11 states, which does not include the State of Illinois (Biao et al., 2018). As one of the top immigrants receiving states, Illinois hosts approximately 1.8 million immigrants (US Census Bureau. 2017). Little is known about the timeline or critical time points of their experiences as they seek diagnosis and therapy compared to children with ASD of non-immigrant parents.

Objectives: This paper sought to compare the timeline of diagnosis and early therapy access between immigrant families and US born families of children with ASD in the state of Illinois.

Methods: A survey was developed based on previous studies on access to diagnosis and treatment. 213 parents of children with ASD who were under the age of 18 at the time of data collection completed the survey. Among them, 21 were immigrant parents. Using immigrant vs US-born as the grouping variable, we conducted independent sample t-test comparing children's age (in months) when parents first noticed something different in their child, when parents first talked to a doctor or clinician about their concerns, when child gets their diagnosis, and when child first received any kinds of therapy services.

Results: Comparing immigrant children with ASD's timeline for diagnosis and treatment with children with ASD of US born parents, we found no significant differences in all critical time points except marginally significant differences in children's first access to any kinds of therapy (t=1.148, *p*=0.058). Children of US born parents' first access to therapy earlier (M=37.7, SD=28.1) than children of immigrant parents (M=46,1 SD=41.6). When only children who requires substantial support were included (N=74), children of immigrant parents (N=12) were significantly older for all four critical time points compared to children of US born parents (N=52). Specifically, immigrant parents first notice something different when their children were significantly older (M=29.3, SD=25.4) compared to the other group (M=16.5, SD=10.3, t=1.63, *p*=0.000). Immigrant parents also brought up their concern to a doctor or clinician when their children were much older (M=34.6, SD=33.9) compared to US born counterparts (M=18.9, SD=13.2, t=1.58, *p*=0.001). Children of immigrant families also had later diagnosis (M=52.9, SD=42) compared to children of US born parents (M=40.1, SD=22, t=0.944, *p*=0.005). Similarly, children of immigrant families also accessed any kinds of therapy at an older age (M=54.2, SD=51.3) compared to children of US born parents (M=26.7, SD=15, t=1.84, *p*=0.000).

Conclusions: It is alarming that children of immigrant families who requires substantial support had a significantly delayed timeline at every single critical time points as their parents seek diagnosis and therapy. Our findings underscore the importance of targeting immigrant families of children with ASD with more profound functional limitations to facilitate early detection and access to treatment. Awareness campaigns and screening events should take measures to improve outreach to immigrant families.

444.014 *(Poster)* Developing the Autistic Satisfaction with Care Holistic Interview Using the Delphi Method.

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Background: Autistic adults may need residential care as they transition into old age, as in the non-autistic population. Very little is known about the needs of older autistic adults in residential care, and how to support them within residential care services. Care homes for older people play a central role in their social, physical and psychological quality of life, and it is important to identify and understand what factors can contribute to wellbeing for autistic adults, who may have specific and unidentified needs. One obstacle to research in this field is a lack of appropriate tools to capture the experience of older autistic adults in residential care settings.

Objectives: To create a new research tool to investigate the experiences of autistic adults living in residential care services. We aimed to incorporate community derived priorities and questions, using a Delphi method to design the interview-based research tool.

Methods: Twenty-six UK-based experts in autism, ageing, and residential care including autistic adults, their family members, service providers, clinicians, and academics were recruited as expert panellists for the Delphi study. All participants completed the two-round Delphi process, which involved identifying and prioritising key areas of interest, generating and providing feedback on interview content.

Results: Four areas of interest and high priority for older adults living in residential care were identified and rated as important by > 70% of respondents, and used to design the research tool: (1) Daily life, including daily routine, spending time with others, hobbies and interests; (2) The home environment, including comfort of the surroundings, safety and privacy, and the sensory environment; (3) Independence and advocacy, including supporting autonomy, flexibility, and advocacy; and (4) Health and wellbeing, including physical health, food, fitness and hygiene. To allow for inclusion of all priority topics, four linked interviews were designed, each covering one topic. Subsequent interview questions were generated by expert panellists, and refined to create the final interview schedule. This co-creation process gave rise to the Autistic Satisfaction with Care Holistic Interview (ASCHI), an open-access interview schedule designed to be used with autistic adults in residential care homes.

Conclusions: To identify and support the needs of older autistic adults in residential care, it is essential to first understand their experiences. Co-creating this research tool to facilitate future research is an essential step in the process. A participatory research paradigm was used to ensure areas of enquiry were defined by the autism community. The ASCHI is an open-access tool that can be used in future studies to explore the experiences of older autistic adults in residential care, and help shape future research, practice and policy. With appropriate validation, it could also be developed for use in service evaluations. More broadly, our Delphi method could be replicated by teams developing new measures for use with under-researched populations.

444.015 *(Poster)* Early Intervention Effects on Gesture Use in Children with ASD: A National Query of SLPs

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Background: Gesture development, use, and repertoire differ in young children with ASD than in those with typical development (Manwaring et al., 2018 and Watson et al., 2013). Gestures play a fundamental role in social interaction and are an important intervention outcome in early ASD interventions. However, which interventions are most effective at improving gestures for the purpose of social interaction remains unclear. Naturalistic Developmental Behavioral Interventions (NDBI's, Schreibman et al., 2015) frequently incorporate gestures into their teaching targets and outcomes. For example, Ingersoll (2010) studied the impact of object and gesture imitation on language use in children with ASD and found that teaching gestural imitation alongside object imitation lead to higher rates of language use than object imitation alone. Even within the scope of NDBIs, techniques used to teach gestures, measurement, and how gestures are prioritized within the intervention context vary. Further, Speech Language Pathologists (SLP) are often the first professionals to intervene with children with ASD and prioritize communication objects. However, very little is understood regarding how SLPs address gestures in early interventions. Therefore, the purpose of this study is to survey practicing SLPs to determine which methods are most frequently used to teach gestures to young children with ASD and if those methods are considered NDBIs.

Objectives: To survey practicing SLPs to determine which intervention methods are most frequently used to teach deictic gestures to young children with ASD.

Methods: First, a comprehensive literature review was completed to determine intervention strategies that result in increased gesture production. Next, a survey was distributed nationwide through ASHA, SLP message boards, and social media sites to ask SLPs about their training and experiences with deictic gestures. Specifically, the survey asks how often SLPs teach gestures, in what contexts gestures are taught, which methods are used (i.e. NDBIs, direct strategies, caregiver coaching), and how effectively SLPs feel their intervention improves gestures.

Results: Preliminary analyses were conducted with 85 participants. Participants were provided with a comprehensive list of 25 intervention techniques and packages, some of which are considered effective according to the National Autism Center (NAC) Standards Report, and others are not. They were asked to identify all strategies they use to target deictic gestures. Twenty-five percent of the sample reported they had specific training in deictic gestures. Seventy-two percent reported they received specific training on social communication in ASD. Regarding intervention strategies, descriptive analyses revealed modeling as the most frequently implemented strategy, followed by prompting, following child's lead, naturalistic teaching, and PECS. Twelve percent of the sample reported they do not target gestures in interventions. All 25 intervention strategies were endorsed by at least two respondents.

Conclusions: Results indicated that SLPs are implementing a wide range of intervention strategies to teach deictic gestures. Among the top five endorsed categories, prompting and naturalistic teaching are deemed established treatments according to the NAC. All but PECS are captured within the NDBI framework. The large variance in findings emphasizes the need for targeted pre-professional and inservice training experiences targeting knowledge and interventions for deictic gestures.

444.016 *(Poster)* Employment Policy for Working Age Youth and Adults with ASD

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Background: Over half of transition-age youth with autism (TAY-ASD) are disconnected from employment in the first two years after high school. The 2014 Workforce Innovation and Opportunity Act (WIOA) encourages earlier provision of Vocational Rehabilitation (VR) services to support youth with disabilities during the school-to-work transition. Approximately half of TAY-ASD who use VR services are secondary students at VR application. However, no published research examines prevalence and correlates of the VR services students with autism may receive during high school and their association with successful employment outcomes. Understanding VR service utilization and associated outcomes during the critical period of transition to adulthood is important for informing effective policies.

Objectives: Determine prevalence and correlates of VR service utilization and employment outcomes for TAY-ASD who entered VR as students, compared to non-student TAY-ASD and adults with ASD.

Methods: We analyzed the federal Rehabilitation Services Administration database for VR cases closed in FFY 2015-2017. Analysis included 18,773 TAY-ASD (ages 16-21) who entered VR as students; 12,710 TAY-ASD Non-students; and 12,611 Adult ASD Non-students (ages 22-39), who received VR services. We used binary analyses and logistic regression to examine the types of services utilized, association of demographic and impairment characteristics with services received, and the relationship between employment outcomes and receipt of key VR services (VR counseling and guidance, job search, job placement, short-term on-the-job supports).

Results: TAY-ASD Students received similar patterns of VR services as TAY-ASD and Adult Non-students; although TAY-ASD Students less frequently received key job-related services (job search, job placement, on-the-job supports) than TAY-ASD or Adult Non-students ($p<.001$). One-fourth of TAY-ASD Students received no key services. Approximately 26% of TAY-ASD Students who received no key VR services achieved employment at VR exit, compared to 87% of those who received all four key services. Adults with ASD had higher odds of receiving on-the job supports (OR=1.09), job placement (OR=1.1) and job search (OR=1.35), compared to TAY-ASD Students. The odds of TAY-ASD Students being employed at VR exit increased as the cost of services increased (OR=1.59). TAY-ASD Students who received job placement (OR=2.25) or on-the-job supports (OR=2.95) had the highest odds of achieving employment. Odds of employment were lower for TAY-ASD Students who were female (OR=.77), Hispanic (OR=.81), received SSI or SSDI at the time of exit (OR=.75), with less than high school education or a special education certificate at exit (OR=.88) or a "most significant disability" (OR=.76). TAY-ASD Students were less likely to be employed with every three-month increase in receipt of VR services (OR=.97).

Conclusions: TAY-ASD Students were less likely to receive key VR services or to exit VR with a job, than TAY-ASD or Adult Non-students. However, receiving key VR services was influential for increasing employment of TAY-ASD Students. States should focus on providing key VR services that support employment outcomes for TAY-ASD Students and optimize their transition into adulthood. Future research should continue to delineate the effectiveness of specific VR services for students and youth on the spectrum and determine how their service needs change across the lifespan.

444.017 *(Poster)* Enhancing Community Participation through Better Understanding of Families, Recreation Providers and Therapists.

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Background: Although programming related to education and therapeutic gains is a central focus on ASD care, integration into community activities is an essential for reducing potential safety risks such as drowning and to increase community acceptance. This study examines the similarities and difference from 3 perspectives and provides strategies for successful implementation of community-based programming to reduce risk of drowning and to increase engagement of families in typical recreational activities.

Objectives: The purpose of this study was to identify perceived barriers to community-based recreation and to provide strategies for improving access to community-based programming; specifically swimming instruction.

Methods: Combination of descriptive research design through electronic survey to identify naturally occurring perceptions. Structured interviews with a constant comparative analysis to explore family perspectives on community participation were also used.

Participants included community recreation providers (n=25), therapists with a caseload of at least 75% children (n=85) and parents (n=12). Participants were recruited through various listservs via email and personal contacts as a convenience sample.

Online Qualtrics survey was created by researchers to administer to participants via email and Facebook. Questions were developed based on researcher's past knowledge on community participation and analysis of previous research. Structured interview for families was developed review of content experts and families.

Researchers used SPSS for analysis of data and identified commonly perceived barriers as well as the level of importance of community participation. Thematic analysis of an open-ended question from the survey and interviews was also conducted.

Results:

Community recreation providers identify lack of training/preparation and constraints such as lack of staff and limited space/time results in barriers to inclusion. Forty-six percent of providers indicate a preference for hands-on training and 50% indicate preference for training by someone with “expertise”. Furthermore, respondents also indicated they would like more training through educational resources (23.08%) as well as additional staff or volunteers on site (23.08%).

Therapy providers identified financial burden and transportation as perceived barriers. Less than 10% of all providers indicate they “always” (1-5 Likert scale) refer, provide information on community activities, provide information on transportation options or provide a list of funding options.

Families consistently report concerns regarding the training of recreation providers and access to services that are receptive to their child’s needs. Availability of programming that supports the unique needs of children is not regularly available. Family well-being is enhanced when offered opportunities to participate in community activities.

Conclusions: Community participation is an essential component of care for children and youth with ASD and their families. For programming to be successful and for families to feel comfortable and accepted, training by experts is needed to increase competence and comfort of providers. Community participation can potentially lead to reduced safety risks and increased feelings of acceptance and social opportunity for both children and families.

444.018 *(Poster)* Enhancing Providers’ Delivery of Feedback about an Autism Spectrum Disorder Diagnostic Evaluation

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Background: Serving children with ASD is a significant public health concern (CDC, 2014). Up to 25% of children with ASD do not receive any services (Karp et al., 2018), and time to initiate recommended services is often lengthy. The manner in which clinicians deliver an ASD diagnosis after an evaluation may impact caregiver’s subsequent implementation of services. To date, only one study has examined a training on delivering an ASD diagnosis and found it increased trainees’ flexibility, attentiveness, and responsivity (Kawamura et al., 2016). To address this gap, the SPIRIT toolkit was recently developed for and piloted with psychologists at a regional children’s hospital to help them individualize communication with families during an ASD diagnostic evaluation (DX; Haine-Schlagel et al., 2019).

Objectives: To pilot SPIRIT for different provider types within a community agency, including examining: (1) providers’ perceptions of acceptability, appropriateness, usefulness, and utilization using mixed-method data; and (2) whether toolkit perceptions differed by provider characteristics.

Methods: 80 attendees at one of two trainings at the San Diego Regional Center for the Developmentally Disabled included: 1) psychologists who provide DXs; 2) service coordinators (SCs) who meet with families following a diagnostic evaluation; and 3) managers. Approximately 1-2 months later, attendees were sent a mixed-method feedback survey; 49 attendees (61.3%) responded. Respondents were 55.1% SCs, 24.5% psychologists, 4.1% managers, and 16.3% unknown. All respondents who reported gender were female. Average age was 40.2 (SD=11.4) and years in current position averaged 7.3 (SD=10.1). Close-ended responses (1-strongly disagree to 5-strongly agree) were analyzed descriptively using SPSS; open-ended responses were coded using an open-coding process (Haine-Schlagel et al., 2013). Bivariate correlations and independent t-tests were conducted to compare toolkit perceptions by provider characteristics.

Results: For objective 1, the training was considered acceptable (M=4.27; SD=.90; 87.8% agree-or-strongly-agree) and useful (M=4.05; SD=.80; 74.4% agree-or-strongly-agree). Open-ended responses were consistent; the training served as a useful reminder to tailor communication with families. The toolkit was considered an appropriate fit for agency mission and population served (M=4.29; SD=.70; 89.7% agree-or-strongly-agree). Many respondents reported using at least one tool in the last month (M=3.63; SD=1.15; 68.4% agree-or-strongly-agree) and planning to use at least one tool in the next month (M=3.90; SD=.87; 72.5% agree-or-strongly-agree). Some respondents reported improvements in communication with other providers and families due to the toolkit. For objective 2, provider age was significantly correlated with toolkit appropriateness (r=.345; *p*=.039) and marginally correlated with training acceptability (r=.300; *p*=.072). Psychologists reported significantly higher perceptions of toolkit appropriateness than SCs (psychologist M=4.63; SC M=4.12; *p*=.042). Time in position was not associated with any perceptions.
Conclusions: Mixed-method data indicate a toolkit designed to improve and individualize providers' communication to families following an ASD DX is acceptable, appropriate, and useful across provider types. Given SPIRIT was initially designed for psychologists, it is not surprising that they considered it more appropriate than SCs. Future efforts will be focused on increasing the intensity of the training and enhancing its appropriateness for service coordinators and other providers who help families process DX feedback and recommendations.

444.019 *(Poster)* Establishment of Operating Standards for Support Services for Children with Autism Spectrum Disorders in LMIC: Vietnam As a Case Example

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Background:
Evidence-based intervention (EBI) as well as evidence-based assessments for ASD can be complex, both within a particular method but also in regards to the coordination across methods and providers for a particular child. To guide agencies and their services towards use and appropriate implementation of services such as these, "operating standards" are essential. Operating standards are guidelines that structure service provision to focus on and implement accepted standards of care believed to be most effective (Manghani, 2011).
Objectives:
The purpose of the present study was to develop a set of operating standards for ASD services for the Southeast Asian LMIC Vietnam, and to conduct a preliminary evaluation of the standards. In addition, the study can provide a model that may help guide development of ASD operating standards in other LMIC.
Methods:
This project involved three phases, each with separate research procedures. The first phase involved drafting an initial set of operating standards. The second phase of this project involved evaluation and modification of these initial standards by professionals (e.g., teachers; psychologists) and experts (university faculty) in Vietnam involved in ASD service provision, research and training. The third phase involved evaluation and finalization of the revised standards by a different set of experts in the ASD field.
Results:
A set of 9 standards was established including: (1) Legality indicates that an agency must be registered under some governmental authority, which can include sanctioned professional associations, or national, provincial, or district departments of education; (2) Ethics focus on agency ethics such as putting the benefit and well-being of family and children as the highest priority; (3) Human Resources structures the qualifications for each position with the agency; (4) Intervention Approach emphasizes that practice activities should be "empirically-based" practice, and that agencies should only use approaches recommended by the scientific community; (5) Intervention Process focuses on the sequence of procedures that a child would go through at the agency; (6) Intervention Plan describes what targets and activities to achieve the targets should be included in intervention plans; (7) Periodic Training describes the regular trainings that both the agency staff as well as the child's caregivers should receive; (8) Facilities recommends the minimum space for each child, and types of functional rooms that a center should have; (9) Recommended Standards has several components that are recommended but not required.
Conclusions:
After a long study with the application of a variety of research methods on the appropriate target population, a set of standards was developed for tested, disseminated widely, and incorporated into the policies of related governmental organizations and units. Almost every professional agreed that the standards were necessary, appropriate and scientific, suggesting that the standards are feasible, but there are still concerns about the application in practice.

444.020 *(Poster)* Evaluating Possible Disparities in School-Provided Services for Students with ASD: A Systematic Review

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Background: School districts are required to provide for students' educational and associated needs (United States, Congress, & Senate, 2003) and schools are the primary service provider for children with ASD (Brookman-Frazee et al., 2009). However, there are equity concerns regarding possible differences in the amount or type of school-provided services across subgroups of children with ASD. For example, Hispanic children with ASD are less likely than White children to receive in-school behavioral health services (Locke, et al., 2017) and children diagnosed with ASD at older (versus younger) ages have lower school-based therapy use (Zuckerman, Lindly, & Chavez, 2017). This highlights a need for systematic examination of differences and potential disparities in school-provided services received by students with ASD.
Objectives: To characterize differences and potential disparities in amount or type of school-provided services received by students with ASD and to identify related factors.

Methods: Selected keywords and inclusion criteria were used to identify relevant articles through two electronic databases, ERIC and PsycINFO (1990-2019), resulting in 540 articles. Articles were screened based on the following study criteria: 1) Conducted in U.S. or Canada, 2) Published in a peer-reviewed journal, 3) Included participants diagnosed with ASD from preschool to transition-age, 4) Examined school-based services, and 5) Included sub-groups within ASD participants. Articles were screened by two reviewers and discrepancies were resolved through discussion, resulting in 36 eligible articles. A codebook was collaboratively developed and iteratively refined by all six reviewers. Articles were independently coded by three reviewers, with discrepancies resolved through consensus discussions.

Results: Preliminary evaluation indicates several key findings. Articles used quantitative (n=36) and mixed (n=1) methodology. Studies involved youth ages 3-6 (n=20), 6-11 (n=27), 12-14 (n=20), 15-18 (n=20), 19-22 (n=6), and 3 studies did not specify age. Aspects of school services examined included type of service (e.g., behavior supports and mental health services; n=28), service characteristics (e.g., intensity and parental involvement; n=15), quality of service (e.g., satisfaction and staff knowledge; n=6), and other (n=1). Factors examined as related to school services included child clinical characteristics (e.g., ASD severity level and adaptive functioning; n=26), family demographics (e.g., education level and SES; n=16), child demographics (e.g., ethnicity/race and age; n=13), family characteristics (e.g., parental stress; n=8), program characteristics (e.g., program fidelity and cost of services; n=6), and other (n=1). Differences in services received by related factors were coded and analyzed for frequency of service differences by associated factors. For example, one study linked higher ASD severity with receipt of more occupational, physical, social skills, and speech therapy, and another study indicated students with ASD in families with incomes under $50,000 had greater odds of receiving services at school. A summary of relationships between specific service categories and related factor categories will be presented.

Conclusions: Outcomes will advance our understanding of factors related to access, scope and intensity of school-provided services for youth with ASD and may inform critical areas for program evaluation to ensure service equity.

444.021 *(Poster)* Evaluating Registration Location on Sample Quality and Survey Completion of Participants in the SPARK Study

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Background: Simons Powering Autism Research for Knowledge (SPARK) is a research study developed by the Simons Foundation, aimed at advancing the understanding of how genetics contribute to autism. The UM-NSU Center for Autism (UM-NSU CARD) is one of the 31-sites participating in the recruitment of individuals into SPARK. Participant registration includes providing a sample of saliva for genetic analysis. The UM-NSU CARD SPARK-site offers registration opportunities across 3 locations including (1) registering offsite via a web-based registration and saliva collection kit sent by mail; (2) onsite at a UM-NSU CARD hosted registration event; and (3) home-based consultation whereby a UM research visits a participant at home to assist in completing registration process. Following registration, participants are prompted via email, to provide more detailed information clinical history via questionnaires on a web-portal.

Objectives: The purpose of this study is to examine the quality of genetic samples and subsequent survey completion rates across three location options that UM-NSU CARD utilizes for SPARK participant registration.

Methods: We reviewed the registration location, genetic sample quality, and subsequent survey completion among 624 affiliated UM-NSU CARD SPARK registrants who completed the study from 3/2018 and 2/2019. The sample consisted of 222 (37%) individuals with ASD, and 402 (33%) biological parents. The categorization of the three registration locations as follows: offsite, onsite, and home-consultation. For this sample, 248 (39.7%) registrations occurred offsite, 311 (49.8%) onsite, and 65 (10.4%) via home-consultation. Sample quality was evaluated as pass or fail, based upon laboratory analysis of its utility for genetic analysis. For this sample, 558 (90.1%) passed quality analysis. The survey completion was deemed completed if subsequent questionnaires were completed entirely. Not-completed and partially-completed surveys were categorized as not-completed. For this sample, 306 (49%) completed surveys.

Results: Regarding the sample quality, pass rates for registrations occurring via home-consultation (98.5%) was significantly better than pass rates for offsite (87.7%) or onsite (90%). There was no difference in the quality pass rate by participant status (i.e., ASD or biological parent). In terms of the survey completion rates, offsite registrants had significantly higher completion (64.5%) then both onsite (42.8%), and home consultation (20%).

Conclusions: Based on this sample, the location of registration has implications for both the quality of the obtained genetic sample and the subsequent completion of surveys. Providing one on one support via home consultation may foster a better quality of the sample collected. However, home-consultation and onsite registration do not result in optimal levels of subsequent survey completion. It will be important for future researchers to examine ways to improve survey completion following home-consultation and onsite registrations, as well as ways to foster improved sample quality of those participants registering offsite.

444.022 *(Poster)* Evaluating the Efficacy of Home Visits on Participant Enrollment in SPARK

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Background: Simons Powering Autism Research for Knowledge (SPARK) is a research initiative designed to accelerate our understanding of the causes of autism. SPARK enrolls any individual with an autism diagnosis, their biological parents, and siblings. SPARK aims to identify ASD genetic risk factors and has sequenced DNA from 39,981 individuals with ASD. 25,691 of the sequenced samples were collected through the 31 clinical sites. Although saliva collection can be completed autonomously from home, 8 sites offered home visits, wherein study team members visit families' homes to complete registration, consent and saliva collection.

Objectives: Assess the impact of home visits on SPARK recruitment and enrollment; evaluate the most common and successful home visit strategies; share effective home visit practices with sites who offer home visits, and those who seek to implement them.

Methods: CHOP surveyed the SPARK Network to identify sites employing home visits. Eight sites conduct home visits: CHOP, MU Thompson, MUSC, UM-CARD, Rush, UIOWAKKI and UCSD/ SARRC. Sites were asked to describe successful visit strategies, data regarding frequency, duration and number of visits performed. SPARK Central provided data regarding saliva kit failure rates for each site. Saliva kit data was analyzed to determine failure rate differences in capture method.

Results: Of the 8 sites, 3 primarily used phone calls to schedule visits. Four used phone calls and emails, and 6 sites scheduled home visits during in-person interactions. All sites indicated that home visits required 2-3 hours of staff time, including scheduling, driving, visit completion and follow-up. The number of home visits completed since March 1, 2019 varied per site, with a minimum of 8 and a maximum of 98. Six sites offered visits during evenings/weekends, while all 8 sites set their own limitations on allowable distance. Feedback from families was positive, with participants referring others for these visits, highlighting the additional support for saliva collection, opportunity to ask questions and convenience of completing the kits at home.

SPARK Central data revealed that 29 of 31 sites perform "onsite" collection (study team assisted saliva sample collection). Of these 29 sites, 23 (and all 8 home visit sites) experienced lower saliva kit failure rates for samples collected onsite as compared with kits completed without.

Conclusions: Regardless of home visit volume, all sites surveyed observed a decrease in saliva kit failure rate with assistance, as compared with kits completed by families independently. This suggests that sites already performing home visits should increase home visits, while sites not using home visits should strongly consider their use. Two sites indicated that their rural surrounding communities limit their number of home visits, while 2 sites cited staff availability as a limiting factor. Sites who frequently perform home visits should consider collaborating in order to produce home visit SOPs for the network. Increasing awareness of home visits amongst families may also lead to an increase in overall SPARK participation. A questionnaire assessing families' thoughts on home visits may support a concerted effort to increase resources needed to make home visits a regular component of SPARK enrollment.

444.023 *(Poster)* Evaluation of an Information Support Program for Parents Accessing Services within an Individualized Funding Model: The Autism Ontario Service Navigation Program

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Background: Ontario is Canada's most populous province (population 14 million) with approximately 135,000 people on the spectrum. In April 2019, Ontario's provincial Ministry of Child Community and Social Services (MCCSS) began transitioning from an autism centre-based funding model to an individualized funding model (or, direct funding model) for providing autism services to children and youth. Individualized funding models are promoted as a means to increase choice within publicly funded systems by providing families with self-directed budgets to purchase eligible services according to their preference. Other jurisdictions previously implementing such models for autism service delivery have provided examples to learn from, including Australia and the Canadian provinces of Alberta and British Columbia. Among the greatest concerns with this model has been providing adequate information to families to enable equitable access to budgets and support informed choices. To support families' informational needs within the individualized funding-based Ontario Autism Program (OAP), the MCCSS funded Autism Ontario to develop and implement the OAP Service Navigation Program (SNP).

Objectives: To describe early experience implementing the SNP by reporting results of an ongoing program evaluation.

Methods: Development of the SNP, including training of regional service navigators, was informed by a jurisdictional scan and a framework for providing information in individualized funding programs. Among other responsibilities (e.g., direct parent support, outreach activities), service navigators provided Childhood Budget Workshops to promote access and use of funds. Results below include second quarter (Q2) program evaluation highlights, and a survey of 133 parents who attended 34 Childhood Budget Workshops in September 2019. Further results (to Q4) will be available by the conference.

Results: In its first 6 months, the program's reach was actively extended through: connections made by the program's 18 regional service navigators with over 300 community agencies, online campaigns (e.g., Facebook ads, newsletters), and translation of promotional materials to 14 languages (beyond standard French language services). In Q2, service navigators had 1165 unique family contacts, and number of service navigation requests (1392) increased 245% from Q1. In the Childhood Budget Workshop survey, participants generally found workshops useful (98%; n=51), although not everyone necessarily felt better equipped to complete paperwork to access the program and manage funds (88%; n=49). Regarding barriers to managing funds, 50% felt they did not know what services their child needs, 33% did not know where to access services, and 34% did not know how to begin accessing services (n=42). Future program elements to be evaluated include a goal setting process, and peer-to-peer mentorship.

Conclusions: Childhood Budget Workshop survey findings are consistent with findings from other jurisdictions regarding the significant knowledge gaps within many families, which represent barriers to equitable access and informed use of self-directed budgets to purchase services. This highlights the importance and need for a robust informational service like the SNP in Ontario. The Q4 program evaluation results, including future Childhood Budget Workshop surveys, will be useful to policy makers in jurisdictions that provide or are considering providing informational services for families within an individualized funding model.

444.024 *(Poster)* Examining Access to Teacch Services across North Carolina

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Background: The UNC TEACCH Autism Program was established in 1972 with approximately 7 regional centers allocated across the state of North Carolina in order to provide access to services for families with autism. North Carolina is comprised of 100 counties, 80 of which are considered rural and ~40 underserved. Recently, the state was ranked 44/51 for access to mental health services (MHA, 2019). Further, in comparison to other children with special health care needs, families of children with autism are more likely to report unmet need for care and financial difficulties (Thomas et al, 2012; Parish, Thomas et al, 2012a&b). As such, it is unknown how well families from rural or underserved demographics access autism services. Additional barriers to care such as language have also been noted in the literature (Zuckerman, et. al., 2014).

Objectives: Our primary aim was to examine access to TEACCH services across the state. Our objectives were: First, to determine the proportion of counties served through regional TEACCH centers across the state. Second, to examine the impact of underserved county status on accessing services. Lastly, to identify additional previously documented demographic barriers to accessing TEACCH services including race and language spoken.

Methods: Data included 4080 families accessing TEACCH services from 2016-2018 through all seven regional clinics for treatment, evaluation or consultation. Counties were classified as underserved based the definition of Health Professional Shortage Areas (HPSAs) which are designations that indicate health care provider shortages in primary care, dental health; or mental health. Proportion of counties accessing TEACCH services was calculated followed by proportion of underserved counties. Next, proportion of language spoken in the home, race and ethnicity were calculated based on underserved county status. Further analyses will further explore percentage of cases in underserved counties accessing services by modality (e.g. treatment, evaluation).

Results: In terms of counties served, 99/100 counties were reached from 2016-2018. 41 counties were determined to be underserved based on the HPSA definition; 40/41 underserved counties accessed TEACCH services. 799 (19.6 %) families from an underserved county accessed TEACCH services. Language reported was 75.3% English N= 3059; 5.6% Spanish N= 228. Other notable languages included 7 Arabic speaking families; 4 Russian; 2 French. Families from underserved counties were 92% English and 3.6% Spanish speaking. Distribution of race and ethnicity from underserved counties was 70% white, 16% Black/AA, and 8.5% indicated Hispanic ethnicity.

Conclusions: Our results indicated that families from almost every county (including underserved counties) in NC access TEACCH services. Distribution of language spoken and ethnicity is comparable to state-wide demographics suggesting that North Carolinians are accessing TEACCH services equally regardless of ethnicity or language barriers. This suggests that families with ASD in North Carolina may experience less disparate access to care than previously reported. Further analyses will explore differences based on type of service accessed and trends over time.

Objectives:

Methods:

Results:

Conclusions:

444.025 *(Poster)* Expanding Autism Knowledge and Access in Early Childhood Community-Based Settings

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Background: Early childhood care providers ("care providers"; e.g., teachers, mental health consultants) play a critical role in the process of identifying children with Autism Spectrum Disorder (ASD) and connecting families to resources. While children are increasingly being routinely screened for developmental concerns in early childhood education (ECE) settings, care providers continue to report limited knowledge about ASD, including diagnostic considerations and resource navigation. Moreover, care providers report interest in better engaging parents in the referral process.

Objectives: To determine the feasibility of ASD-focused trainings for care providers in community-based settings and to evaluate changes in care provider knowledge about ASD. An additional objective is to strengthen and synergize partnerships between a large pediatric hospital and community agencies that work with young children to ensure that efforts to increase timely ASD identification and connections to care are co-created and sustainable.

Methods: Project activities include developing and piloting a standardized, replicable set of ASD trainings for care providers to increase knowledge about ASD, engage parents in care, and navigate local services. Informal training development was conducted with stakeholders including staff at ECE organizations across Washington, DC. A day-long community leader in-person training was then conducted. Baseline and post-training data were collected. Measurements included attendance, satisfaction, impressions of the training, suggestions for improvement, knowledge of ASD (Maternal Autism Knowledge Questionnaire; MAKQ, Kuhn & Carter, 2006), and impressions of impact on knowledge and confidence. Fifty-six community providers attended the day long training including family/community engagement specialists (N=13), mental health clinicians (N=10), early childhood educators/special educators (N=8), care coordinators (N=8) and others.

Results: Most participants felt that the training was well-organized (95.7% Agree/Strongly Agree), the trainers were effective (95.7% Agree/Strongly Agree), topics covered were relevant to their work with children and families (93.6% Agree/Strongly Agree), materials provided were useful (87.0% Agree/Strongly Agree), and they were satisfied with the knowledge gained from the training (93.3% Agree/Strongly Agree). Qualitative analyses of open-ended responses indicated that participants most enjoyed learning about resources and hearing from a parent panel. Participants expressed discontent with the length of the training and noted that there was too much information provided at once. All participants felt Somewhat (51.1%) or Very Prepared (48.9%) to share the information learned with others at their community sites. There was a significant increase in ASD knowledge (MAKQ; $t(42)=-4.22$, $p<0.001$). Further, participants rated increased confidence in engaging parents in conversations about their child's development and ASD concerns ($t(40)=-5.55$, $p<0.001$) and in supporting parents in navigating ASD concerns ($t(40)=-6.99$, $p<0.001$). Participants also rated increased knowledge and skills in recognizing atypical development ($t(40)=-2.56$, $p=0.014$) and in helping families connect with ASD resources ($t(40)=-4.74$, $p<0.001$).

Conclusions: This project contributes to efforts to increase engagement in ASD services for families of young children served in community settings. Participants are currently co-leading trainings within their community sites with a trainer from this study team and continued data collection is in process. Findings from this pilot will be used to inform larger scale community implementation programs to better support ECE providers.

444.026 *(Poster)* Facilitating EBP Implementation in Community-Based ASD Agencies: Clinical Effectiveness of the ACT SMART Implementation Toolkit

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Background:

Autism spectrum disorder (ASD)—the pervasive, lifelong neuro-developmental disorder, characterized by impaired social communication and repetitive behavior and/or restricted interests—affects 1.5% of the population in the U.S. (Xu et al., 2018). Evidence-based practices (EBPs) for ASD lead to improvements in the core deficits of ASD, as well as social, behavioral and adaptive functioning (Wong et al., 2015). Unfortunately though, the utilization of EBPs is varied in ASD community-based organizations (ASD-CBOs). The ACT SMART Toolkit (Drahota, Meza, & Martinez, 2014), is a comprehensive, web-based interface developed to guide implementation teams through phases of EBP implementation (e.g. needs assessment, adoption, planning). A pilot study was conducted testing the feasibility, acceptability, utility, and fidelity of the toolkit, with the overall aim of facilitating the implementation of EBPs in ASD-CBOs.

Objectives: Assess preliminary effectiveness of the ACT SMART Toolkit within ASD-CBOs to increase use of video-modeling.

Methods: Six Southern California ASD-CBOs meeting eligibility criteria (social and/or research collaborations with other agencies/researchers/collaborative groups; efforts to receive additional staff training; interest in implementing new EBPs) participated in the pilot study. ASD-CBOs provided: Applied Behavior Analysis (ABA; *n*=4), ABA and mental health (*n*=1), and Speech and Language Pathology services (*n*=1). All six agencies reported a need for one of the three EBPs selected for the ACT SMART Toolkit pilot study (i.e. social narratives, video modeling, self-management) during agency recruitment. Once the pilot study began, all six agencies selected video modeling to be implemented at their agency, with five completing all phases of the ACT SMART Toolkit, and one agency selecting not to adopt an EBP. Supervisors and direct providers at each participating agency completed an agency assessment, including the ASD-SIS (Pickard et al., 2018), at pre- and post-pilot to report the utilization of various interventions, including video modeling.

Results: Effect sizes (Hedges g) were calculated for the agencies that completed the pilot, in order to examine clinically meaningful changes in reported utilization of video-modeling from pre- to post-pilot. Results indicate a medium effect size (0.52) for supervisor-reported use of video-modeling and a large effect size (0.88) for supervisor-report of direct provider's use of video modeling. Results indicate a large effect size (0.94) for direct provider-reported use of video modeling.

Conclusions: Due to the low number of participating agencies in this study, the researchers did not expect to find statistically significant differences in reported use of video modeling from pre- and post-pilot. Effect sizes were used to calculate a more accurate estimate of the magnitude of the effect of the ACT SMART Implementation Toolkit (Ferguson, 2009) on use of video-modeling.

Overall, effect sizes indicate clinical significance between pre- and post-pilot in the reported utilization of video-modeling. These findings signal that the ACT SMART Toolkit yields behavioral changes in provision of EBPs as reported by supervisors and direct providers. Importantly, this is the first implementation toolkit designed specifically for ASD-CBOs; as a result, these findings indicate the ACT SMART Toolkit may be an effective strategy to facilitate the uptake of EBPs in ASD-CBOs.

444.027 *(Poster)* Factors Associated with Service Utilization Among Low-Resourced Families of Children with ASD

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Background: Engaging children with autism spectrum disorder (ASD) in early intervention improves child and family outcomes. Family involvement and engagement in service access is critical; however, families face many challenges navigating the complex ASD service systems. These challenges are exacerbated among low-resource families. Psychoeducation and supportive interventions can assist them in accessing services, although barriers to participation still exist (e.g., childcare, transportation, buy-in). Service utilization and barriers were studied within the context of Mind the Gap (MTG), a flexible, caregiver-focused intervention for families of young children with ASD, designed to increase service access for young children with a new ASD diagnosis. This study reports initial level of service access for low income families of children with ASD.

Objectives: The goals of this study are to describe service use and potential barriers to service use in a sample of underrepresented families recruited for participation in the Mind the Gap RCT at the point of recruitment.

Methods: Participants were recruited across four Autism Intervention Research Network on Behavioral Health (AIR-B) sites: Los Angeles, CA; Sacramento, CA; Philadelphia, PA; and Rochester, NY. Participants included primary caregivers of children ages 2-7 years who were diagnosed with ASD within the last year (n=121). Inclusion criteria were: 1) child not receiving any autism-specific services; 2) family's annual household income at or below 185% of the federal poverty level; and 3) participating caregiver speaking English, Spanish or Korean. Participating caregivers were largely female (90%), and ethnically diverse (37% Hispanic or Latinx; 30% African American or Black), with an average age of 34.4 years. The mean age of the children was 4.2 years; most were male (75%). Most caregivers (81%) had an average income of less than $50,000 a year. Families completed a Service Access form, aimed at quantifying the type, frequency and length of early intervention services at intake.

Results: At baseline, 112 caregivers completed the Service Access form. 24% reported no services, with the average number of services being 1.89, primarily delivered in schools (1.29). The most commonly received service was speech and language therapy (65%), followed by occupational therapy (50%). Most services were child-directed services, with few, if any parent-directed services reported. Only 5% of families reported ever having attended a parent support group, 1% reported receiving any form of parent training, and none reported receiving any parent advocacy or counseling support. Number of services received was examined by primary language, race/ethnicity, and family income. A Wilcoxson Rank sum test revealed that only primary language was significant ($p<.05$), with non-English speaking families receiving fewer services (1.4) than English speaking families (2.1).

Conclusions: Low income, racially diverse families access fewer early intervention services for their children outside the school setting. Even with a focus on the importance of parent-implemented intervention for all children with developmental delays, fewer than 5% of families report any type of support services. Primary language limits service access even further.

444.028 *(Poster)* Factors Inhibiting the Detection of Toddlers with ASD Among the Bedouin Population in Southern Israel

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Background: One of the main challenges of ASD is the difficulty in achieving early diagnosis. Early detection and diagnosis are a precondition for early and efficient intervention. The Bedouin population in Israel is distinct in terms of religion, culture, and language. These characteristics influence their perception of health and illness and their patterns of using health services. The number of Bedouin children who are diagnosed with ASD is estimated at 1/1000. Apparently, this rate is an underestimation of the true situation.

Objectives: This research examines the stakeholders, processes, and forces, both overt and hidden, which influence the process of detection and diagnosis of children with ASD among the Bedouin population in the Negev.

Methods: A Qualitative Research: In-depth interviews were conducted with eighteen health policymakers and managers of health institutions that engage in diagnosis and treatment of ASD, as well as three focus groups including nurses from the Maternal and Child Health Centers (MCHC) and pediatricians in primary care clinics that provide services to the Bedouin population.

The environmental-ecological-social system model of Bronfenbrenner (1979) served as a theoretical framework for mapping factors delaying the detection of ASD in children that emerged from interviews and focus groups. Factors were grouped into themes that served for the creation of ecological maps that describe the factors delaying the detection of ASD in Bedouin children. These maps show the influential connections between the themes, the ecological environment levels, and the content.

Results: The delaying factors in the Macro-environment (policymakers), were found to be the lack of a clear policy, lack of a budget policy, lack of tools and standards and lack of a policy for professional training.

The delaying factors in the Mezo-environment (service providers), were found to be lack of professional qualifications of service providers, problematic inter-institutional communication, lack of available appointments, lack of cultural and language accessibility, and fear of lawsuits.

The delaying factors in the Micro-environment (Bedouin population), as described by the interviewees, were fear of exposure and stigma, lack of awareness to developmental problems.

The lack of policy theme was found to have central influence on other themes. Other correlations were found between all levels of the ecological environment, e.g. between the following themes of the Macro-environment: lack of clear policy, lack of tools and standards, and lack of training policy. Correlations were found with the Mezo-environment, influencing the professional qualifications of the service providers and the inter-institutional communication that was found to be tied to the lack of available appointments. The lack of professional qualification theme at the Mezo-environment was found to be correlated with the theme of lack of knowledge and parental awareness of developmental delays at the Micro-environment.

Conclusions: To decrease ASD diagnosis gaps among Bedouin toddlers, it is necessary to determine a clear policy of detection and diagnosis procedures for all service providers engaged in prevention, detection and diagnosis of autism in toddlers. This will force service providers to specialize and create a more professional environment for ASD detection.

444.029 *(Poster)* Family Outcomes Using a Culturally Grounded Model of ASD Intervention with Latinx Families

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Background: Despite improvement in early identification of autism spectrum disorder (ASD), differences in ASD rates among racial and ethnic minority children have persisted (Baio et al., 2018). Research shows that Latinx children are diagnosed later than their white counterparts and receive fewer intervention services. Several factors influence the access to services and the diagnosis of ASD for Latinx children (Lopez, 2014). These factors include socio-cultural individual, family, healthcare systems, educational systems, and community systems (Lopez, 2014). Numerous studies have explored the importance of early diagnosis and early intervention. However, there is a significant gap of research focused on culture in early intervention. Parents Taking Action (PTA), is a culturally informed psychoeducation program for Latinx families of children with ASD. PTA utilizes a promotora de salud model, whereby Latina mothers of children with ASD deliver information about ASD, child development, advocacy, evidenced-based practices, and teach parents skills to enhance their children's social communication to Latina mothers of children with recent ASD diagnoses.

Objectives: 1) Increase the understanding of ASD among Latinx families. 2) Address the need for culturally informed interventions. Present a promotora model of ASD intervention delivery combined with bicultural/bilingual pivotal response training.

Methods: Ten Latina mothers were recruited for this pilot study. Recruitment criteria was: Latin American descent, mother of a child with ASD or at-risk for ASD between 1 and 8 years of age. All mothers were offered the Parents Taking Action (PTA) program from two trained *promotoras* community health workers. PTA included 14 sessions of 2 hour in-home didactic psychoeducation. Mothers also received 4 one-hour sessions of pivotal response training (PRT) from bilingual/bicultural coaches in their homes. Children were present for the PRT sessions. The attrition rate was 30%, thus the data represented here are from the seven mothers who completed pre and posttests (See Table 1 for sample demographics). A questionnaire regarding child, parent, and family outcomes was provided before and after the intervention program. We focus on the Family Outcome Survey, which addresses five family outcomes that are prioritized in early intervention programming. Lastly, focus groups (English and Spanish) to assess experience in the intervention were conducted after all participants completed assessments.

Results: Paired samples t-tests showed significant increases in three family outcomes (understanding child's rights and needs, know your rights and advocate for your child, have a support system) and the overall total score on the Family Outcome Survey (Table 2) from pre to post test. Qualitative analysis of focus group transcripts, available for 4 mothers, illuminated positive influence of promotoras who shared the experience of being Latina and raising a child with ASD.

Conclusions: The promotora model of ASD intervention delivery combined with bicultural/bilingual pivotal response training addresses the factors that influence Latinx families of children with ASD. Family outcomes were positively influenced with this culturally informed model of intervention. Further, mothers felt a sense of support that was unique to the shared experience with promotoras. Further implications and limitations will be discussed.

444.030 *(Poster)* Functional Outcome in a Highly Specialized Unit in Autism Spectrum Disorders (URTEA)

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Background: URTEA provides comprehensive care tailored individually to children and adolescents with Autism Spectrum Disorder (ASD) who also have comorbid psychiatric disorders or severe behavioural problems which impact severely on their functioning despite previous interventions in communitarian mental health facilities. The multidisciplinary team provides treatment in close collaboration with all communitarian resources involved.A recurrent finding in those individuals is the pronounced discrepancy in cognitive ability and impairment in functioning. Factors related to functioning are receiving recent attention in research[1] but it is still unclear which individual characteristics or components of the intervention predict better functional outcomes.

Objectives: The main aim of the study is to examine the characteristics of those children and adolescent with ASD associated to more improvement in functioning as measured with the DD-CGAS after intervention in URTEA.

Methods: All children and adolescents seen in the URTEA between January 2018 and August 2019 were included. The local IRB approved the use of their retrospective clinical and sociodemographical data. All participants (n=58) fulfilled DSM-5 criteria for ASD. The assessment of basal and post-discharge functioning was obtained with the Spanish version of the Developmental Disability Children's Global Assessment Scale in Autism (DD-CGAS).

All tests were 2-tailed, and all statistical analyses were carried out with SPSS 18.0. Continuous variables were normally distributed. Differences between groups were examined with the Student's t-test. The level of statistical significance was set at <0.05

Results: 58 participants were included, 84.5% male, mean age 12.78 (SD 3.01), IQ=80.33 (15.55). They were referred to our unit from outpatient care (63.7%), inpatient units (20.6%) and day hospitals (15.5%). Most of the sample (46.6%) attended mainstream schools with support and 32.7% special educational centers or educational health units. 20.7% were not attending to any school. 37.8% associated intellectual disability and psychiatric comorbidity was the rule (77.6%).

After one year treatment in URTEA, all participants improved their functioning significatively (t= -8.34, p=0,000), specially ASD individuals without associated intellectual disability (t=-3.45, p=0.001) and older than 12 years of age (t= -2.05, p=0,045).

A trend towards greater improvement was found in those with psychiatric comorbidities compared to those without any comorbid disorder, but this difference was not statically significant (t=1.62, p=0.090). No differences were found attending to sex (t=-3.99, p=0.779)

Regarding intervention factors, better functioning outcomes were present in those who participate in psychotherapeutic groups (t=1.78, p=0.04) and those who were advised to attend schools specifically for children with learning disabilities (t= -2.69, p=0.01). No significative differences were found taking into account psychopharmacological interventions.

Conclusions: Our findings show improvements in all children and adolescents seen in URTEA, after they have failed to improve in previous communitarian interventions. Those with high functioning ASD seem to benefit more, as there is a narrow margin for improvement in those severely affected. Comorbid psychiatric disorders associated to ASD pose a challenge to regular services and the specialized approach seems to contribute to better outcomes. Our results suggest that reduced or adapted demands in special needs schools could ameliorate functioning in those populations.

444.031 *(Poster)* Healthcare Experiences of Autistic Adults at a Specialized Primary Care Center

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Background: Transitioning from pediatric to adult healthcare systems is challenging for many autistic individuals due to a variety of interpersonal and systematic barriers. These barriers to care often result in poor satisfaction with healthcare among autistic adults, relative to the general population. The Center for Autism Services and Transition (CAST) at The Ohio State University is a patient-centered primary care model aiming to remove many barriers to care for autistic adults. For example, CAST patients may receive modifications to the standard patient workflow (e.g., bypass the waiting room due to sensory sensitivity) and are seen by physicians with extensive experience working with the autistic adult population.

Objectives: The objective of this study is to compare the self-reported satisfaction with healthcare of CAST patients to autistic and non-autistic adult population comparison groups.

Methods: We compared results from a cross-sectional online survey of adult CAST patients to published self-report data from United States-based samples of autistic and non-autistic adults (Nicolaidis et al., 2013). Approximately 53% of the non-autistic adult population comparison group had at least one other self-reported disability. Satisfaction with healthcare provision was quantified using 8 items validated by Nicolaidis et al. (2013), where respondents rate the extent to which their healthcare provider: (1) gave them time ask all of their questions; (2) addressed their feelings/emotions; (3) involved them in healthcare decisions; (4) ensured understanding of needed steps for health management; (5) helped them deal with feelings of uncertainty; (6) understood what they were trying to communicate; (7) communicated in a way they understood; and (8) could be trusted to take care of their needs. All items were rated on a 5-point Likert scale, where higher scores indicated greater satisfaction. We performed preliminary independent samples t-tests to compare the satisfaction of N=16 CAST patients (50% female) to the autistic adult (N=209; 59% female) and non-autistic adult (N=228; 66% female) comparison groups at the item-level.

Results: On average, CAST patients reported levels of satisfaction 0.91 points (SD=0.14) higher than the autistic adult comparison group and 0.58 points (SD=0.20) higher than the non-autistic adult population comparison group. CAST patients' satisfaction with care was significantly higher than the autistic adult comparison group for all items (all $p<0.001$). CAST patients also rated their satisfaction with care significantly higher (all $p<0.01$) than the non-autistic adult comparison group, except for one item; CAST patients and non-autistic adults reported similar perceptions about the extent to which healthcare professionals understood what they were trying to communicate ($p=0.11$).

Conclusions: Preliminary findings reveal CAST patients have higher satisfaction with healthcare than a comparison group of autistic adults and similar or higher satisfaction with healthcare than a non-autistic adult comparison group. These early findings provide robust support for patient satisfaction with CAST, which will be important for disseminating this model of care delivery beyond the local level.

444.032 *(Poster)* Healthcare Utilization Patterns of Patients with Autism Spectrum Disorders (ASD)

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Background: Individuals with Autism Spectrum Disorder (ASD) have reported higher rates of various medical conditions, care utilization, and costs[2–6]. However, despite higher usage rates, patients with ASD and their families reported lower satisfaction due to unmet communication, sensory, and behavioral needs that were incompatible with a typical hospital enviroment[7–11].

Objectives: This study aims to examine utilization patterns of pediatric and adult patients with ASD at Boston Medical Center (BMC).

Methods: Data were retrieved from the clinical data warehouse of Boston Medical Center (BMC). Our sample data included BMC patients who were (1) coded to have relevant ICD-9 or ICD-10 codes at least once within the past ten years, and (2) seen in 2017. The ICD-9 and ICD-10 codes deemed relevant to include for identifying our sample are listed in Table 1 and Table 2. The final sample included 1,787 unique pediatric (≤22 years old) and 304 unique adult (≥23 years old) patients. Descriptive statistics were used to analyze utilization patterns by department.

Results: 1,787 unique pediatric patients generated 8,000 encounters (92% outpatient, 6% emergency, 1% inpatient, 2% other) and 304 unique adult patients generated 1,953 encounters (86% outpatient, 10% emergency, 2% inpatient, 2% other) in 2017. "Other" includes: observation, pre-admit, pre-clinic, recurring, and same day care visits. For these pediatric patients, the top five most frequently visited departments are: (1) Pediatrics Specialties Clinic (e.g., Developmental Behavioral Pediatrics, Pediatric Neurology), (2) Pediatric Primary Care Clinic, (3) Child Psychiatry, (4) Pediatric Emergency Department (ED), and (5) Otolaryngology. For these adult patients, the top five most frequently visited departments are: (1) Psychiatric Clinic, (2) Adult ED, (3) Primary Care, (4) Social Service Office, and (5) Family Medicine.

The ED was one of the most visited departments for all patients (#4 for pediatric and #2 for adult patients). In 2017, 317 pediatric patients (507 encounters) and 74 adult patients (185 encounters) were seen in the BMC ED. The most common reason for pediatric ED encounters was reported behavioral crises, comprising 70 (24.5%) of cases. For adult patients, this number is 18 (17%), making it the second most common reason after body aches/heart problems.

Conclusions: Patients with ASD are regularly seen across departments throughout BMC, suggesting that strategies to improve their experiences should be implemented on a hospital-wide level. The number of adult patients is disproportionately low, which may be due to underdiagnosis or underreporting of ASD in adults. Alternatively, it is possible that autism diagnoses are not always accurately reported in the Electronic Health Record (EHR). Lastly, behavioral crises were among the most common reasons for ED encounters, suggesting a need for additional staff training to address behavioral health needs within the ASD community.

444.033 *(Poster)* Implementing a Nation-Wide Continuous Support System for People with ASD and Their Relatives in Russia: Current Problems and Perceived Barriers

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Background: Improved understanding of needs of individuals with autism in Russia has led to development at a federal level of the nation-wide continuous support system (CSS) for people with ASD and their relatives. This cross-sectoral system is meant to provide continuous support to autistic individuals and their families throughout their whole lives and covers the aspects of early care and diagnostics, education, medical care, psychological and social support. One of the most vital problems of Russian regions is low transport accessibility and in-person service availability in remote areas, and, at the same time, low availability of digital solutions (distant learning, remote diagnostics, telemedicine etc.), and it seems vital to evaluate possible barriers to the roll-out of such digital solutions for remote areas.

Objectives: A survey covering central and distant regions of Russia was needed to assess the opinion of autism professionals and parents of children with ASD on the current state of different aspects of the CSS and to evaluate the barriers perceived as most important.

Methods: A 52-item survey in Russian (approximately 20-25 min to complete) was arranged by a joint research team (Pushkin State Russian Language Institute, Rehabilitation Center for Children With Autistic Spectrum Disorders OUR SUNNY WORLD, Federal Resource Center for Organization of Comprehensive Support to Children with Autism Spectrum Disorders, and NGO “Project Office for the Development of the Arctic”). The data collection was performed online via a link shared across several professional and parental communities. Region of Russia, place of work (governmental vs non-governmental), and autism related work experience in years were assessed to get a clear demographic picture.

Results: 126 respondents from 11 regions of Russia (50 from Moscow and Moscow region, 76 from other regions) and more than 40 organizations completed the survey. 75 respondents had professional and/or volunteering experience (40 from non-governmental, 35 from governmental organizations), 53 were family members of people with ASD. The data analysis reveals that respondents from metropolitan areas assess the current situation significantly more positively in all the general aspects of the CSS (general efficiency of governmental, non-governmental and parental organizations) than respondents from remote regions (p_s ranging from <.015 to <.0001). In general, the efficiency of non-governmental agents was rated significantly higher than for governmental agents (p <.0001; this was true even for the respondents working in governmental structures). The attitude to distant learning and remote diagnostics for children with ASD was generally optimistic but the readiness of the existing structures, particularly governmental, to implement digital technologies is viewed as very low.

Conclusions: The quality of support for people with ASD and their families is perceived as lower in remote regions of Russia compared to metropolitan regions, particularly due to low availability of in-person services. Measures should be taken to eliminate this disparity but implementation of distant technologies and online education is hindered by very low readiness of different institutions to these changes. The results of the survey can be helpful not just for Russia but for other countries with areas of low transport accessibility.

444.034 *(Poster)* Increasing Access to Autism Diagnostic Consultation in Rural and Underserved Communities: Streamlined Evaluation within Primary Care

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Background: Embedding processes for effective triage and diagnosis of children at risk for ASD within the medical home may be a viable mechanism for reducing age at detection and initiation of services. In recent work, many young children with ASD (and those without) were identified using a streamlined diagnostic model embedded within our medical center’s primary care clinics. These findings supported preliminary feasibility, accuracy, and clinical utility of this model and resulted in dramatically reduced waits for diagnostic consultation, accurate diagnostic decision making, high levels of family/provider satisfaction, and reductions in referrals to an overtaxed tertiary diagnostic center. To combat growing disparities within rural and underserved communities, this model was then implemented across a diverse range of primary care clinics and through remote telemedicine clinics that provide healthcare to rural and underserved communities within our state. Success of this model also spurred implementation of a training program for pediatric residents designed to improve upon previously passive shadowing experiences by integrating procedural, physician-tailored training in within-practice diagnostic identification and care coordination

Objectives: To extend previous work by providing data pre- and post-implementation of the streamlined model across a diverse range of primary care clinics that provide healthcare to rural and underserved communities. Use and results of model through state-wide telehealth project and resident training initiatives will also be discussed.

Methods: Data about referral types, show rates, and latency to consultation and diagnosis were used to assess feasibility and impact and were collected via the medical record. Specifics of this model will be discussed. Using a streamlined diagnostic model, 400 children within the medical center’s primary care clinics were seen over 24 months. We will also report on data for the 80 children seen through clinics with a more rural/underserved catchment, and children seen through our resident training clinic.

Results: Implementation of the streamlined model resulted in a significant decrease in latency to diagnostic conclusion (mean of 144.7 days to 49.9 days). Median age at diagnosis was 32 months: considerably lower than national averages or comparable data from tertiary specialized clinics. Provider feedback indicated significant improvements related to quality and continuity of care and decreased waits for service. Updated feasibility and sustainability data will be provided in detail. Of the first 90 residents to complete the enhanced rotation activities, 94% completed new training requirements. Participants reported increased comfort differentiating ASD from other concerns, making a formal diagnosis, providing feedback about diagnostic decisions, and effectively connecting families with services.

Conclusions: By reducing waits and identifying concerns more efficiently, we may increase the ability of families to access early intervention and support services. Also, without giving pediatricians competence and ownership over diagnosing ASD within practice, wide-scale screening—and reliance upon specialty tertiary care diagnostic centers—will continue to create long waits for diagnostic evaluation. If we do not provide support/resources in the basics of ASD recognition, diagnostic triage, and post-diagnostic care coordination in the medical home, then "screen-and-refer" will continue to lead to lengthy waits for diagnostic confirmation, continuing to postpone access to early intervention services.

444.035 *(Poster)* Integrating Input from Service Providers and Service Recipients Relative to Autism Spectrum Disorder and Mental Health Issues: Toward Knowledge for Action.

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Background: The prevalence of autism spectrum disorder (ASD) in Canada according to the 2018 National Autism Spectrum Disorder Surveillance System (NASS) Report is 1 in 66. Parents raising children with ASD require an array of services across sectors such as health, social services and education. Unfortunately, the system of care is often fragmented, suboptimal, and difficult to navigate. Particularly concerning are the 30-70% of individuals who present with ASD and a co-existing mental health problem (dual diagnosis) (Moseley et al., 2011). These individuals and their families face additional challenges accessing appropriate and unified care, often encountering multiple barriers within and between systems of care.

Objectives: As part of a larger study, the objective is to identify navigation processes that are working well, and barriers or challenges, as perceived by stakeholders.

Methods: A Community Based Participatory Research orientation guided the interviews and focus groups that were conducted with 57 service providers and service recipients in relation to navigational services for children with a dual diagnosis in urban, rural and remote communities in Alberta. Interviews were based on a semi-structured interview guide. NVivo data management and analysis software was used. Analysis was comprised of 1) line-by-line coding, 2) review of codes for textual linkages both within and across transcripts and 3) examination of the emerging categorization of codes in yielding themes. Interrater review of data by leaders in the ASD and MH field verified themes.

Results: Based on families experiences a multi-level model emerged consisting of four care levels (universal support, specialized services, complex care and crisis care). Crisis was often identified as a service catalyst for families. At every level, service providers and families indicated that there was a need to make information more assessible to families, that more coordinated services were needed, especially in rural areas, and that parents play a key role, although parental care, preparation for the long haul, and training are sorely lacking. Peer support for families was highly valued and recommended as it addresses parent isolation, is non-judgemental, and offers hope to families.

Conclusions: Navigational support programming requires coordinated service network across sectors (health, social services, and education), particularly in rural and remote communities. There is also a need to involve people impacted by and /or with lived experience in service planning and policy development.

444.036 *(Poster)* Introduction of the Screening Tool for Autism in Toddlers and Young Children (STAT) in Ukraine and Vietnam

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Background: In both Ukraine and Vietnam, the diagnosis of autism in young children is made by child neurologists and child psychiatrists. These professionals have limited access to formal diagnostic assessments such as the ADOS-2, and the diagnosis is often delayed and made solely by clinical judgement.

Objectives: Introduce the Screening Tool for Autism in Toddlers (STAT), a relatively brief interactive level 2 screen, in 3 sites in both Ukraine and Vietnam to improve the identification of young children with autism.

Methods: We selected the STAT as it is a relatively brief interactive, observational tool, contains many key social communication items, and is relatively easy to learn and administer. We conducted 3 formal training workshops in Ukraine (Fall 2018); and 3 workshops in Vietnam (Spring 2019). Following the workshops, participants needed to score an online video of STAT administration (Helen video) and submit 2 separate videos of their own STAT administration for certification. We provided 2 STAT kits for use by participants in each of the 6 sites and 1 additional kit for Vietnam and 2 for Ukraine. We conducted follow-up online webinars by Zoom approximately 3 and 6 months after the initial workshops. The process we are following to introduce and validate the use of the STAT is as follows: translation, back translation (to improve clarity and identify wording errors), review and pilot use by 2 or more selected individuals in each site (to identify any items/activities that may need to be modified), and finally formal normative and validity studies.

Results: A total of 55 professionals attended STAT workshops in 3 sites in Ukraine in Fall 2018, and 101 in 3 sites in Vietnam in Spring 2019 (limited information on the Ukraine workshops was reported at INSAR 2019). Participants included psychologists, child psychiatrists, child neurologists and pediatricians. They rated the workshops highly, most planned to pursue STAT certification and use it in their practice. To date, 20 Ukrainian professionals have scored the Helen video; 8 submitted 1 video of their own STAT administration; and 6 submitted a second video. 26 Vietnamese professionals have scored the Helen video; 7 submitted 1 video of their own STAT administration; and none as of yet have submitted a second video. A total of 91 professionals from both Ukraine and Vietnam participated in the online webinars. We have completed translation and back translation of both the Ukrainian and Vietnamese versions of the STAT. We will initiate the pilot review process in Ukraine this Winter and in Vietnam this Spring. Following this review in each site, we will plan to begin normative and validity studies. Our work has been supported in part by 2 NGO's, the Samaritan Ministries in Ukraine and Project Vietnam.

Conclusions: The STAT, a level 2 screen for autism developed in the USA, can be successfully implemented in countries with limited resources. Barriers to and factors that support its use will be discussed.

444.037 *(Poster)* Investigating Variation in Pre-Employment Program Features for Transition-Aged Youth on the Autism Spectrum

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Background: Over 66% of young adults on the autism spectrum are disconnected from opportunities for work or schooling in the first few years after high school, especially low-income young adults on the spectrum[1]. They experience a "service cliff" ,[1] which often includes disruptions in access to needed supports as they age out of eligibility for school-based and pediatric care. Pre-employment programs offered to youth on the autism spectrum during transition could help them secure employment or connect with post-secondary training and educational opportunities. Recent federal policies mandate at least 15% of federal vocational rehabilitation (VR) state funds be used for pre-employment transition services for high school students with disabilities. However, little research has been done to identify if the recent VR policy has impacted pre-employment programming for youth on the autism spectrum. Also lacking is knowledge about possible differences in the types of pre-employment training and support that transition-aged youth on the autism spectrum.

Objectives: To identify the components of differently funded pre-employment programs for autistic youth and investigate differences in pre-employment program delivery.

Methods: This exploratory study examines differences in preemployment supports for a purposeful sample of transition-aged autistic youth, drawn from a multi-state area, including southeastern Pennsylvania, New Jersey, southern New York and the DC metropolitan area. Publicly available data was systematically collected using databases from the Department of Higher Education, Google Maps, and U.S. Census Bureau, as well as program descriptions found on program, school, district or state websites, to preliminarily survey pre-employment programming components and to determine program variation across SES.

Results: Three types of pre-employment programing for youth on the autism spectrum were identified. Programs exemplifying each type were selected. Types included 1) Combination VR & Other (i.e. district, non-profit and state) pre-employment support (n=9 sites); 2) Combination District and other (non-profit, private pay) pre-employment programing (n=9 sites) and 3) State Only (i.e. BOCES, IU) pre-employment programs (12 sites). Type 1 sites offered more advanced and basic features than Type 2 and Type 3. Type 1 sites served many low resources students. However, Type 2 programs were more common in higher income districts, while Type 3 programs were concentrated in low resource districts.

Conclusions: Federal policy to support pre-employment transition services is in section 113 of the Rehabilitation Act. Preliminary analysis suggests that combined VR funded programming allows for more fully developed pre-employment programs for young adults on the autism spectrum. Further investigation is needed to confirm findings.

444.038 *(Poster)* Investigating the Need for Autism Training for Custody Staff in England and Wales

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Background: Police custody can be a challenging environment for vulnerable individuals who have been arrested and detained as suspects of a criminal offence which can lead to significant adverse outcomes. Previous studies have suggested that autistic individuals may be more likely to come into contact with police officers and report negative experiences in the criminal justice system due to a lack of appropriate support (Crane et al., 2016; Helverschou et al., 2018). Importantly, research has also highlighted the need for effective and *role specific autism training* for police forces (Crane et al., 2016). Currently, there is no research that has examined the difficulties (e.g. communication, sensory) autistic individuals experience during the custody process (e.g. booking in, personal search) or the specific changes which may be required to improve support in police custody.

Objectives: Study 1 was conducted to explore the difficulties autistic individuals experience during the custody process and how to improve support. A training programme for custody staff was co-developed with autistic individuals and police officers based on these findings. Study 2 was conducted to investigate the effectiveness of this training programme for custody staff.

Methods: *Study 1* - semi-structured interviews were conducted with 12 autistic individuals (male=8; female= 4) about their experiences in police custody in England and Wales (age range 18-64). Data was analysed using a constructed grounded theory approach to explore where autistic individuals experienced difficulties during the custody process and whether changes were needed to improve support.

Study 2 - Fourteen training sessions for custody staff were delivered across four regions in England and Wales. Training was carried out in three formats: i) presentation only i) presentation and training video iii) presentation, training video and toolkit demonstration. Quantitative and qualitative data were collected through questionnaires.

Results: *Study 1* - All participants reported having negative experiences in police custody due to difficulties coping with the demands of detention such as: i) not knowing what was going to happen in police custody because of a lack of adequate (n = 10) and/or accessible information (n = 4) and/or ii) the sensory demands i.e. light (n = 9), noise (n = 9), space (n = 10) and touch (n = 7). Participants also reported difficulties participating in the custody process such as waiving their legal rights (n = 4) and/or being able to understand (n = 9) and/or answer (n = 6) questions.

Study 2 - Data collection from the training sessions is ongoing but data has so far shown positive feedback from custody staff in terms of their understanding of the needs and support of autistic individuals in custody. In particular, custody staff have reported greater awareness of communication and/or sensory needs and the adjustments they can make in their role to address these areas.

Conclusions: Autistic individuals report negative experiences in police custody which can lead to significant personal and legal outcomes when appropriate support is not provided. Context-specific autism training may be an effective way of improving the support of autistic individuals in police custody.

444.039 *(Poster)* Medicaid 1915(c) Home and Community-Based Services Waivers Are Associated with Lower Emergency Department Utilization Among Youth with Autism Spectrum Disorder

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Background: Youth with autism spectrum disorder (ASD) are more likely to experience exacerbation of physical illnesses or acute psychiatric episodes that require visits to the emergency department (ED) than those without ASD. Many states have enacted Medicaid home and community-based services (HCBS) waivers to improve access to services for individuals with ASD. However, little is known on the impact of these waivers on reducing the utilization of ED services.

Objectives: This study used the Medicaid claims data to investigate the effects of HCBS waivers on ED visits among youth with ASD.

Methods: We conducted a retrospective cohort study using the Medicaid Analytic eXtract (MAX) files from all 50 states to analyze the odds of ED visits by youth (aged ≤21) with ASD from 2008 through 2013. We identified ASD subjects as those having ≥2 outpatient visits or 1 inpatient/long-term care claim with a diagnosis of ASD (ICD-9 codes 299.xx) during the study period. A dichotomous variable (Yes/No) was created for each calendar year to indicate whether a subject had any ED visits. We categorized HCBS waiver status as: ASD waiver, IDD waiver (intellectual disabilities, developmental disabilities, or autism), other waiver types, and no waiver. Descriptive analyses and multivariable logistic regression were performed to estimate the effect of the waiver types on ED utilization.

Results: Our longitudinal cohort consisted of 574,337 subjects with ASD (Table 1), contributing 2,663,460 annual observations from 2008 to 2013. On annual average, 0.4% of youth were enrolled in an ASD waiver, 11.2% in an IDD waiver, 1.4% in a waiver in another category, and 87.0% had no waiver. Subjects on ASD waivers had the lowest rate of ED visits (13.5%), followed by those on an IDD waiver (18.8%), other waiver types (23.9%), and 28.5% for those not on a waiver. Lower ED utilization associated with ASD or IDD waiver was observed across race and age subgroups (Figure 1). Multivariable logistic regression with repeated measures of ED visit status at each year confirmed the findings from the descriptive analysis that HCBS waivers were consistently associated with a reduced risk of ED visits. The variables adjusted in the model included age, sex, race/ethnic group, calendar year at cohort entry, state and Medicaid eligibility type. There was a significant association between being enrolled in an ASD or IDD waiver and a reduced risk of ED visits (adjusted odds ratio [aOR]: 0.62; 95% Confidence Interval (CI): [0.58-0.66] and 0.65; [0.64-0.66], respectively; reference: no waiver). Risk of ED visit was not linearly associated with age, with higher risk for youth under age 6 and between the ages of 18 and 21 compared to those aged 9-11 (aOR:1.58 [1.56-1.60] and 1.45 [1.42-1.48], respectively).

Conclusions: Our study shows that 1915(c) waivers, particularly autism specific waivers and IDD waivers, are strongly associated with reduced risk of ED visits. These findings suggest that Medicaid 1915(c) waivers are effective at improving access to routine, evidenced-based services, thereby reducing the onset of acute adverse events leading to ED visits among children and adolescents with autism spectrum disorder.

444.040 *(Poster)* Mental Health Service Utilization and Early Work in Youth on the Autism Spectrum

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Background: Transition-age youth on the autism spectrum (TAY-ASD) experience high rates of both unemployment and mental health conditions. Over half of TAY-ASD are reported to have two or more mental health conditions and over half of TAY-ASD did not participate in postsecondary education or employment in the two years following their exit from high school. While unemployment for youth has been linked to poorer mental health in mid-life, untreated mental health conditions can also present challenges for early work experiences. TAY-ASD and their families may experience barriers to accessing mental health services due to a lack of mental health professionals competent to serve people on the spectrum, costs associated with services, or a lack of service providers in close proximity. However, the relationship between work and access to mental health services has not been thoroughly explored in TAY-ASD.

Objectives: Determine whether unmet needs for mental health services significantly impact participation in early paid work experience for TAY-ASD. Assess the correlates, including demographic factors and impairment characteristics, of participation in paid work for TAY-ASD.

Methods: We analyzed data from the 2016 and 2017 National Survey of Child Health (NSCH). Analysis included 894 TAY-ASD, ages 12-17, whose caregivers reported that they had a current ASD diagnosis. Caregivers were asked if their children had participated in paid work during the previous twelve months. We used logistic regression to assess whether unmet mental health service needs, demographic factors, and impairments associated with communication or intellectual disability (ID) were significantly associated with participation in paid work.

Results: Approximately 54.9% of TAY-ASD needed and received mental health services, while 12.7% of TAY-ASD needed mental health services but did not receive them, and 31.2% of TAY-ASD did not need or receive mental health services. TAY-ASD whose caregivers reported unmet needs for professional mental health services within the past year were significantly less likely to participate in paid work during that period compared to TAY-ASD who received mental health services and TAY-ASD who did not need mental health services (OR: 0.22; 95% CI: 0.07, 0.74). Odds of paid employment increased with age for TAY-ASD (OR: 1.40; 95% CI: 1.17, 1.67). Race, ethnicity, and poverty level were not significantly associated with participation in paid work in this sample of TAY-ASD. Odds of participating in paid work were significantly lower for TAY-ASD with ID (OR: 0.16; 95% CI: 0.06, 0.42) and TAY-ASD with communication impairments (OR: 0.62; 95% CI: 0.41, 0.96).

Conclusions: TAY-ASD with unmet mental health service needs were significantly less likely to have participated in paid work within the past year compared to TAY-ASD without unmet mental health service needs. Early paid work experience in TAY-ASD is associated with better adult employment outcomes, so unmet mental health service needs could have lasting, deleterious effects for this population. This research suggests that promoting access to mental health services for TAY-ASD could reduce disparities in early paid work participation for this population. Additional research should further explore the potential relationship between untreated mental health conditions and employment in TAY-ASD.

444.041 *(Poster)* Novel Approach to Reducing Variability in Diagnostic and Longitudinal Care Delivery through Echo Autism: Center Development & Support

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Background: As the reported prevalence of autism spectrum disorder (ASD) increases, so do demands for specialty services. ASD specialty centers report varying infrastructure and service delivery processes creating large variations in care. The Autism Treatment Network (ATN), consisting of 12 specialty centers throughout North America has a focus on developing and disseminating best practices for the core and associated medical and behavioral health conditions in ASD. ATN centers disseminate these findings directly to community providers using the Extension for Community Healthcare Outcomes (ECHO) model. The ECHO Model typically connects specialists and primary care providers (PCP) to improve medical care for individual patients. This project expands the use of the ECHO model by bringing together ASD specialty care teams with the goal of sharing common challenges, learnings and successes within practice protocols, unique business management ideas, and standardized and novel treatment and prescribing procedures. To our knowledge, this is the first time the ECHO framework has been applied to build capacity, share best practices, and support center development in ASD specialty centers.

Objectives: 1) Use the ECHO Autism model to engage interdisciplinary leaders from autism centers as they integrate clinical, research and family support practices

2) Assess the feasibility and participant experience related to a pilot implementation of the ECHO Autism: Center Development & Support model

3.) To develop a platform for developing and sharing best practices across the autism field, benefiting both the clinical and research field, and patients and families alike.

Methods: The ECHO framework uses multi-point video conferencing to share case-based learning in an “All Teach, All Learn” format, providing an 'in-person meeting' feel and team dynamic. 11 autism centers and 1 emerging autism center participated in this pilot. The specialist "hub" team included developmental-behavioral pediatricians, psychologists, administrators, family navigators, parent advocates, researchers, and an outreach/dissemination specialist. The ECHO Autism sessions were held for 75 minutes twice-per month and consisted of a "spoke" case/process-presentation, discussion and brief didactic. Didactic topics including diagnostic best practice, waitlist triage, incorporating the family voice, and integrating research into clinical practice.

Results: Key participant learning topics included family advisory councils (58%; n=7), quality improvement (50%; n=6), PCP trainings (42%; n=5) and standardized diagnostic batteries (42%; n=5). Overall, the individual participants reported high satisfaction with the ECHO Autism program, 94% (n=16) reporting being extremely or very satisfied, and 88% (N=16) reporting that participating in this project resulted in practice change. One participant described their experience as "Learning about other clinics and program has been amazingly helpful. I feel like I am building connections with other organizations, which will benefit long after this ECHO experience."

Conclusions: ECHO Autism: Center Development & Support offers a consistent, virtual opportunity for interdisciplinary teams from specialty centers to engage in shared learning. It appears to be feasible and participants report high satisfaction with the model and a high degree of practice change as a result of engaging with other centers.

444.042 *(Poster)* Parent Engagement in a Self-Directed Vs. Therapist-Assisted Telehealth Program for Families of Young Children with Autism Spectrum Disorder (ASD)

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Background: There is strong support for parent-mediated early interventions (PMI) for autism spectrum disorder (ASD) and related neurodevelopmental disorders. However, such programs are highly under-utilized in community settings, due in large part to a lack of trained professionals, lengthy waitlists, transportation, and reimbursement issues. These barriers compel examination of alternative service delivery methods, such as telehealth, to increase access to care. Indeed, telehealth is well-suited to deliver interventions with different levels of support depending on the specific needs of an individual and family. While self-directed programs have strong potential for dissemination and a large public health impact, the extent to which therapist-assistance or “coaching” influences program engagement and outcomes remains largely unknown.

Objectives: Our group developed a telehealth program, Mirror Me, to teach families of young children with ASD an evidence-based naturalistic developmental behavioral intervention called reciprocal imitation training (RIT). Mirror Me uses video modules to introduce intervention strategies and was designed to be used in either a self-directed or therapist- assisted format. A goal of this pilot randomized control trial was to determine differences in parent engagement between the self-directed and therapist-assisted formats of Mirror Me.

Methods: This 10-week pilot RCT compares two different formats of Mirror Me: self-directed to therapist-assisted. Participants include 21 families of young children, ages 16 to 49 months, with a diagnosis of ASD and deficits in social imitation skills. All families used the self-directed website for five weeks and then were randomized to continue on their own or receive remote therapist-assistance in the form of "coaching" once per week over the subsequent five weeks. Participants attended in person study assessment visits at baseline (pre-intervention), 10-weeks (post-intervention), and 15-weeks (follow up). Parent engagement with the website, intervention and study assessments was tracked across the active treatment and follow up phases.

Results: One hundred and thirty young children were screened over the phone for interest and eligibility. Twenty-eight enrolled in the study, with 21 (75%) meeting eligibility criteria. Of those 21, four families withdrew during the initial five weeks of the trial, while another three withdrew during the second five weeks of the trial. None of the nine families who withdrew had been randomized to the coaching condition. On average, parents rated Mirror Me as highly acceptable, relatively easy to use, and easy to "see" and "explain to others" the benefits of the program. However, the seven families who withdrew reported "feeling uncertain," having difficulties finding the time to use the website, and challenges determining how to prioritize Mirror Me with respect other concurrent services and interventions.

Conclusions: Results from this pilot study suggest that integration of support, in the form of remote therapist-assistance, may be beneficial for increasing sustained parental engagement with telehealth interventions. Identifying optimal timing and format of remote therapist assistance will be an important next step, along with understanding characteristics that might indicate which families are most likely to require that support. These lines of research will help build a foundation for the development of more adaptive and personalized approaches to telehealth.

444.043 *(Poster)* Patterns of Service Acquisition in Infant-Toddlers with ASD

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Background: Recognition of early behavioral indicators of children who are at risk for a later diagnosis of autism spectrum disorder (ASD) has improved greatly over the past few years. Largely, this is due to increased awareness of these factors (Landa et al., 2012; Sacrey et al., 2013) and understanding of genetic risk and heritability of ASD (Sandin et al., 2017). One of the main goals of early identification is to provide access to intervention for younger children. While there have been attempts to understand service use patterns in older children (Mire, Raff, Brewton & Kochel, 2015) less is known about the type and frequency of early intervention that infant-toddlers at risk for ASD are receiving.

Objectives: To describe patterns of service use of infant-toddlers who are at risk for ASD and whether factors such as children's cognitive abilities and sibling ASD status were related to likelihood of service acquisition.

Methods: This analysis includes baseline data from 80 infants with ASD who met for mild to moderate concern on the ADOS Toddler Module (MAge= 17.66 months, 54% non-white, 80% Male) enrolled in a clinical trial for children at risk for ASD (NCT01874327). Children's developmental age was assessed using the Mullen Scales of Early Learning and current intervention services were recorded via a parent report survey at baseline, post intervention (8 weeks), and at two, four and 12 months after baseline. Demographic information including sibling status was also collected at baseline.

Results: The two most common services that children received at each of the timepoints were Speech Therapy and Occupational Therapy. Patterns of service acquisition across time are noted in table 1. Of note, only one family was receiving intensive behavioral therapy at entry, 10% at exit, 34% at the two and four-month follow-up timepoints and 27% at the 12 month follow up. The median number of services at entry was 0 (max 3), 1 at exit (max-3), 2 (max- 6) at the 2 and 4 month follow-ups and 3 (max-7) at the 12-month follow-up. At baseline, having an older sibling with a diagnosis of ASD (n=16) did not increase the likelihood that children would be receiving services, ($X^2(1)= .17$, p=.68). Children who were receiving services had lower visual receptive t-scores (t(61) = 1.98, p=.04) at baseline, but did not differ across the other domains. Chronological age was also not a factor (all p>.05).

Conclusions: Overall, children's enrollment in each category of services increased over the course of the study. Consistent with research in older children, the most common types of services were speech and occupational therapy (Carlon, Stephenson & Carter, 2014). Children with older siblings with ASD were not more likely to receive services, which may be an artifact of the overall low number of services received at entry. Understanding which services children at risk for autism are likely to receive is the first step in evaluating the effectiveness of those services on their later outcomes.

444.044 *(Poster)* People with Autism Spectrum Disorder in the Criminal Justice System: Improving Recognition in Criminal Justice Mental Health Services, Identifying Views of the ASD Community and Developing Preliminary Guidelines for Support.

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Background: People with autism spectrum disorder (ASD) may have contact with the criminal justice system (CJS) as victims of crime, offenders, or from misunderstandings. The number of ASD people who offend is unknown. However, it has been suggested that ASD is over-represented and under-recognised in the CJS. Despite this, neither ASD training for criminal justice mental health services (CJMHS), nor clear ASD care-pathways or guidelines linking the CJS and health/social services are available. Furthermore, ASD community and CJMHS staff views regarding this are unknown.

Hence, interactions between the CJS and ASD people may be unnecessarily distressing, unsuccessful and costly. Lack of ASD awareness and absent ASD CJS care-pathways/guidelines may adversely impact on everyday police, court and prison processes and contribute to increased costs.

Objectives: To improve ASD recognition in a local CJMHS, determine ASD community and CJMHS staff views and, with the ASD community, draft first available UK CJS ASD guidelines.

Methods:

1. Local CJMHS staff received 1 day's ASD awareness training from ASD experts, including a) mental health/behaviour/communication/sex/risk/de-escalation, management of anxiety/distress, liason with local/national ASD services, local/national care pathways, b) Assessment (Observed-Structured-Clinical-Examination), c) 55-item ASD questionnaire (pre/post training), d) on-going supervision.
2. Two focus groups gathered views of 6 ASD adults with CJS experience and their families and of 5 CJMHS staff about ASD in the CJS.
3. A one day ASD CJS workshop invited expert speakers and multidisciplinary ASD/CJS professionals (including health/education/social care/CJS, and the National Autistic Society) to identify problems, solutions and develop ASD CJS guidelines.

Results:

1. CJMHS ASD knowledge significantly improved post-training ($p < .05$)
2. CJMHS staff felt significantly more able to a) identify ASD people in the CJS, b) communicate with, and safely manage, ASD people, c) understand ASD mental health/behaviour/communication possibly contributing to CJS difficulties/misunderstandings, and d) identify and access local and national ASD clinical-care pathways
3. Both focus groups expressed concerns; the ASD community regarding their CJS experiences and CJMHS staff regarding ASD awareness/management in the CJS. Both suggested possible improvements; these contributed to guidelines development.
4. Local ASD CJS guidelines and an ASD CJS film have been made and will be a) freely accessible educational materials for all staff/students across the study site, so enabling widespread and cost-effective dissemination (36,000 university/hospital staff and 25,000 students, with over 4.2 million patient contacts each year), b) available to local and national CJS teams, c)included in local health/social care pathways.

Conclusions: Brief training can raise awareness of ASD in CJMHS staff and may improve management of ASD people in the CJS. This supports statutory requirements for needs-led local services (UK 2009 Autism Act, 2010/2014 Autism Strategies) and responds to the UK 2009 Bradley report, tasking CJS liaison/diversion services to identify, assess and refer vulnerable people from their first police contact. The ASD community and CJMHS expressed ASD CJS concerns. The development of local and national ASD CJS training, guidelines, services and care pathways may enable ASD people to be better understood and to have their needs met, and may contribute to reduced individual and societal costs.

444.045 *(Poster)* Process Improvement Initiative to Increase Frequency of Genetic Testing in Autism Spectrum Disorders

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Background: Genetic testing including a chromosomal microarray (CMA) should be offered to all patients with non-syndromic autism spectrum disorders (ASD), however there are many barriers to CMA completion. Boston Children's Hospital (BCH) data from February 2015 through January 2016 demonstrated that only 40% of patients with a new ASD diagnosis underwent CMA testing. We conducted an anonymous mixed methods survey of providers in the BCH Autism Spectrum Center, which demonstrated that navigating insurance authorization was a major barrier to recommending genetic testing. 52.0% reported being uncomfortable with the prior authorization (PA) process. In response to the survey results, the BCH Autism Spectrum Center designed an intervention with the aim to improve recommendation rates and ultimately genetic testing completion.

Objectives: To describe the initial implementation of a process improvement project to increase adherence to genetic testing guidelines for patients newly diagnosed with Autism Spectrum Disorder in the BCH Autism Spectrum Center.

Methods: In response to the initial survey results key stakeholders from the Autism Spectrum Center, Genetics, Lab Medicine, and Patient Financial Services (PFS) at BCH convened to develop a standardized process to obtain insurance authorizations for CMA and Fragile X testing for patients newly diagnosed with ASD. Survey results and the proposed intervention plan were presented at departmental meetings in Spring 2019. Using the Plan-Do-Study-Act (PDSA) method, a process improvement pilot was launched in August 2019 with two Autism Spectrum Center providers. Actions taken to standardize the process included the development of a template Letter of Medical Necessity (LOMN), identification of specific roles for staff members in PFS and clinic administration, a tracking template, a communication algorithm, use of DNA Extract and Freeze blood samples, and an Autism Spectrum Center patient-family education sheet.

Results: Overall, the Autism Spectrum Center genetic testing recommendation rates increased from 85.7% to 90.3% between November 1, 2017 and October 31, 2019. For PDSA 1 of the pilot, twelve patients newly diagnosed with autism initially agreed to genetic testing. 75.0% of patients received insurance authorization for genetic testing since the pilot start in August 2019, 41.7% underwent phlebotomy with DNA extract and freeze, and 25.0% have genetic testing processed. 16.7% of patients had insurance that required a visit with a board-certified geneticist or genetic counselor for PA approval. Despite insurance authorization approval, 8.3% of families chose to forgo genetic testing.

Conclusions: Identifying provider barriers and presenting a multidisciplinary intervention plan can improve recommendation rates and completion for the standard-of-care genetic testing for patients with newly diagnosed ASD. With the support of key stakeholders, it is possible to create a standardized process to address the ever-changing complexities of genetic testing insurance. This pilot effort demonstrated high PA approval rates, though with low testing completion rates as a result of data collection limited to 3 months. Next steps include increasing the number of included Autism Spectrum Center providers, cost-analysis, ongoing data review, and a follow-up survey to evaluate the perceived benefits and potential flaws of this initiative.

444.046 *(Poster)* Project Echo Autism for Mental Health: Empowering Community Practitioners to Treat ASD Comorbidities

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Background: Despite recent comorbidity rates as high as 92%, there is little information available to empower mental health practitioners to meet the unique needs of patients diagnosed with both autism (ASD) and co-occurring mental health (MH) conditions (Brookmann-Frazee et al., 2017). The combination of ASD/MH conditions has shown to be predictive of significantly poorer health outcomes as well as greater parental dissatisfaction in providers. Still, these families utilize MH services with high frequency (Ahmedani & Hock, 2012). MH practitioners, however, often perceive working with children with ASD as a challenge for which they have not been trained (Brookmann-Frazee et al., 2012). Consequentially, there are far more families seeking MH services than there are practitioners prepared to provide appropriately adapted care, particularly in rural areas. Project ECHO Autism, a tele-mentoring platform which connects physicians to interdisciplinary ASD experts, has demonstrated improvement in primary care providers' ASD related knowledge, self-efficacy, and practice (Mazurek et al. 2017, 2019a, 2019b) and shows high potential to effect similar meaningful change for MH providers.

Objectives: Given the growing prevalence of ASD and need for autism-specific competencies in MH care, this study aimed to develop and implement a new adaptation of ECHO Autism to impact provider knowledge, self-efficacy, and knowledge application in community MH practitioners.

Methods: We developed and implemented a new MH focused curriculum in a 6-month (10 session) ECHO Autism pilot program for MH providers (N=24) across 11 counties (mostly rural) in North Carolina. Biweekly sessions were 90 minutes and consisted of a brief didactic (focused on MH treatments for anxiety, ADHD, and behavior management for clients with ASD) followed by provider case presentations. Each provider completed pre/post assessments; change in ASD knowledge was observed via an Autism Knowledge test and provider self-efficacy was measured via an adapted version of the Primary Care Autism Self-Efficacy (PCASE) survey (Mazurek et al., 2017). Participants also provided written case conceptualizations in response to applied vignettes as a measure of provider knowledge application. Satisfaction surveys were collected at posttest.

Results: At baseline, MH providers reported perceived barriers in treating children with ASD which included a lack of access to ASD specialists (n=15, 62.5%), knowledge about ASD resources (n=11, 45.8%), and prior training in ASD (n=11, 45.8%). At posttest, providers collectively demonstrated significant improvement in their knowledge of ASD ($t(24)=5.5$, $p<.0001$) and self-efficacy ($t(23)=9.3$, $p<.0001$). Additionally, participants reported high satisfaction with their experience (M=1.33, SD=.54) on a 5-point scale with "1" indicating the highest degree of satisfaction.

Conclusions: This study demonstrates the feasibility and impact of adapting the ECHO Autism model for a community mental health provider population. Significant improvements in provider competence related to comorbid treatment considerations suggests that this may be an effective way to build capacity among rural community mental health providers. We are engaged in qualitative analyses of vignettes to examine whether changes in knowledge lead to increased provider knowledge application as well as conducting follow up assessments to observe the stability of these gains.

444.047 *(Poster)* Provider Report on Part C Early Intervention Service Use: Who Is Engaging in EI, How Much and Why?

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Background: Early intervention (EI) providers work in community and home settings with young children (ages 0-3), and their families, to help identify developmental delays and build skills related to development. While rates of family engagement and retention in mental health treatment are variable (Ingoldsby, 2010), amount, in hours, of EI services received is linked to magnitude of positive functional impacts (McManus et al., 2019). Little is known about EI service use, intensity and barriers to engagement.

Objectives: To understand the utilization of EI services by families and to evaluate if EI provider or family characteristics, such as race, socioeconomic status, or primary language, lead to disparities in service engagement.

Methods: Participants include a subset of 100 EI providers from a larger study that evaluated implementation of an evidence-based autism screening intervention at three EI sites in Massachusetts. The present sample includes EI providers that attended a university-based diagnostic evaluation with a child and family and completed a survey about providing services to the family.

Results: EI providers (N=100) were primarily white, non-Hispanic (75.0%), females (98.0%) with an average of 3.4 years (SD=5.2) of experience working in EI. Eighty-nine percent of providers' first language was English, however 64.0% reported bilingualism or multilingualism. Families were diverse with respect to race/ethnicity (78.0% non-White or White Hispanic), poverty status (56.7%) and language (43.8% primary language not English). Eighty-three percent of children received an ASD diagnosis. Providers reported that 45.0% of families had at least one other EI provider previously. Children received a median of 3 sessions (range: 0-12) with the reporting EI provider in the month prior to completing the survey, and 54.0% of providers indicated that at least one session "did not happen or was shorter than planned in the last month." Providers endorsed "Parent does not have enough time or forgets" (16.0%) and "I have had to cancel sessions due to conflicts..." (13.0%) as primary reasons for why EI sessions did not happen or were shortened. Notably, no providers endorsed "Parent feels child does not need as many sessions" or "Parent does not believe it helps the child." The majority (70.4%) of providers indicated the child should receive additional services that he/she is not currently getting. Neither provider race nor child race was related to number of sessions the child received (χ^2=5.01, p>.05; χ^2=12.10, p>.05, respectively) or missed (χ^2=0.33, p>.05; χ^2=4.84, p>.05, respectively). Similarly, child primary language, poverty status or diagnostic status did not relate to number of sessions the child received (χ^2=15.10, p>.05; χ^2=0.723, p>.05; χ^2=5.28, p>.05) or missed (χ^2=1.99, p>.05; χ^2=0.69, p>.05; χ^2 =4.88, p>.05).

Conclusions: Surprisingly, level of engagement was not related to demographic factors of the provider or child. As treatment engagement is commonly moderated by sociodemographic factors, reflecting treatment disparities for low-income and minority populations, EI services may hold promise in reducing barriers to engagement in treatment for all children with developmental disabilities. Despite this, most providers reported that children needed more support, suggesting that access barriers to other forms of services may persist in EI.

444.048 *(Poster)* Psychotropic Medication Use By Children with ASD in Publicly-Funded Mental Health Services

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Background: Use of psychotropic medications for children is common in publicly-funded mental health (MH) services (Garland et al 2013). These services play an important role in caring for with children with autism spectrum disorder (ASD) for their co-occurring psychiatric conditions (Brookman-Frazee, Stadnick, Chlebowski, Baker-Ericzén, & Ganger, 2017). Understanding patterns and predictors of psychotropic medication use is imperative for children with ASD to guide care improvement.

Objectives: The present study seeks to: (1) characterize patterns of parent-reported psychotropic medication use for children with ASD in publicly-funded MH services (2) assess child, family and program-level factors associated with any psychotropic medication use and (3) examine predictors of specific medication classes (i.e., ADHD-targeted/stimulants, antipsychotics, antidepressants/SSRIs).

Methods: Data on medication use patterns were extracted from the baseline assessments of 202 children with ASD drawn from a community effectiveness trial of AIM HI ("An Individualized Mental Health Intervention for ASD") conduced in 29 publicly-funded outpatient and school-based MH programs in Southern California. Children were ages 5 to 14 years (M= 9.3 years; SD = 2.4), 60% Latinx and were receiving ongoing psychotherapy services at the time of the baseline assessment. Children were assessed for ASD (ADOS-2), cognitive ability (WASI-II or DAS-II), and psychiatric diagnoses (MINI Kid) at baseline. Parents reported child psychotropic medication use, family demographics, caregiver strain (CGSQ) and parent sense of competence (PSOC), as well as child autism severity (SRS-2) and behavior problems (ECBI).

Results: At study entry, 49.5% of participant children were reported to use one or more psychotropic medications. The average number of medications used was 0.72 (SD = 0.90, range = 0 to 4), with 37.8% of those who used medication using more than one. Rates varied by medication class, with the most prevalent classes endorsed including: ADHD-targeted medications (primarily stimulants; 31.2%), antipsychotics (14.9%), antidepressants (primarily SSRIs; 12.9%), and other (16.4%). Multiple logistic regressions including variables with significant bivariate associations with medication use suggest that children with white race/ethnicity (B= 1.22, p=.001), lower cognitive ability (B= - 0.03, p =.02), and whom meet criteria for ADHD (any subtype; B = 1.30, p<.01) were significantly more likely to use psychotropic medications. Children with higher autism severity were less likely to use ADHD medications and more likely to use antidepressants. There were no significant predictors of antipsychotic use.

Conclusions: Rates of any psychotropic medication use are comparable to epidemiological samples of children with ASD (Madden et al., 2017). Results of the study suggest that sociodemographic (race/ethnicity) and clinical factors (cognitive level, co-occurring psychiatric conditions, autism severity) play a role in patterns of psychotropic medication use in community MH settings, which may help to inform targeted care improvement interventions for this population.

444.049 *(Poster)* Relationships between Late Cancellations and Demographic Features in a High-Throughput Metropolitan Autism Center

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Background: Inequities in access to developmental services for ASD for under-resourced communities and for minorities are well-documented. It is not clear, however, how these inequities come to be, and whether challenges are manifest even at the first-line of contact in just making it to a scheduled appointment. This study examines particularly difficult cancellations, i.e. those cancellations that occur within 24 hours of the appointment time, or no shows. These cancellations result in tremendous strain in clinical resources and infrastructure. However, from the family perspective, they represent last-minute burdens and likely continuing challenges for obtaining services for their children.

Objectives: To examine how patient diagnosis, visit type, payment types, race, language, age, and sex relate to the likelihood of late cancellations (i.e. cancellations within 24 hours of the appointment time or no shows).

Methods: Data were obtained from 18,360 scheduled appointments involving 3,673 patients (M age = 9.74 years, SD = 4.97; 77.4% male, 72.6% ASD) involving a randomly sampled subset of scheduling and payer information extracted over the period 9/1/2018 to 8/30/2019. We used a generalized linear model with logistic link to model the probability of late cancellation as linear sum of group (ASD, non-ASD), visit type (new visit, return visit, or telemedicine), payment type (Medicaid/Medicare, commercial insurance, self-pay, or other), race (American Indian, Asian, Black, White, or unknown/unspecified), language spoken (English or non-English), age group (approximate age quartiles of 0-6, 6-9, 9-13, 13+ years), and sex. Significance of terms was assessed using Chi-square tests and odds ratios with 95% confidence intervals not overlapping reference categories (1.0) reported.

Results: Chi-square tests revealed significant effects of group (p<.001), visit type (p<.001), payment type (p<.001), race (p<.001), and age group (p=.013). The following factors were associated with greater likelihood of late cancellations: having an ASD diagnosis (Odds ratio (OR): 1.29; 95% CI: 1.13-1.47); visit types of return (OR: 2.58; 2.12-3.18) or telemedicine (OR: 2.24; 1.53-3.22); Medicaid payment type (OR: 1.44; 1.27-1.63); race of American Indian (OR: 1.64; 1.21-2.18) or African-American/Black (OR: 1.70; 1.45-2.00); age group 9-13 years of age (OR: 1.22; 1.06-1.41).

Conclusions: This work describes additional challenges faced in the effort to provide equitable services to minorities and families of under-resourced communities. While late cancellations result in strain on clinical infrastructure, it also reflects difficulty by families to acquire timely attainment of services for their children. This work suggests that additional support should be considered for families of children with a diagnosis of autism at the middle school/Junior-high age, who may lack resources for completing scheduled appointments. A focus on understanding the factors leading to difficulties in meeting scheduled appointments will help the design and development of such support with the ultimate goal of providing the greatest equity of access to developmental services for children and families in need.

444.050 *(Poster)* Staff Trainings to Improve Care for Youth with Autism Spectrum Disorder

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Background: Youth with autism spectrum disorder (ASD) access emergency services and are psychiatrically hospitalized at high rates. In the absence of specialized inpatient services for these youth, they are served in general inpatient psychiatric settings. However, this environment is challenging for youth with communication and social vulnerabilities. Plus, most providers are not trained in evidence-based practices (EBPs) for ASD. To improve outcomes for these patients, an ASD Care Pathway (ASD-CP) was developed and implemented within a general inpatient psychiatric service at a public hospital. Prior to implementation, clinic staff received a three-hour training on ASD symptoms and evidence-informed strategies for preventing and reducing challenging behaviors for youth with ASD. The ASD-CP was associated with significant reductions in crisis interventions (i.e., intramuscular medication, holds/restraints). The ASD-CP training has since been modified for dissemination to other sites providing care for youth with ASD.

Objectives: To improve care for patients with ASD and provide necessary specialized training for professionals, we created and modified the ASD-CP training for dissemination at five additional sites providing care, treatment, and housing for youth with ASD. The purpose of this study was to examine the effectiveness of trainings regarding knowledge of ASD and comfort providing ASD care.

Methods: Staff at five sites who participated in a modified version of the ASD-CP training (approximately 75 minutes in length) completed pre- and post-training assessments (n=233). Assessments included the Challenging Behaviour Attributions scale (CHABA) short form and a modified version of the Confidence in Coping with Patient Aggression Instrument. Additionally, staff selected evidence-based strategies for youth with ASD from a list containing both valid strategies and common misperceptions. The anonymous surveys also collected trainee age, gender, race/ethnicity, and education level. To examine associations between demographic characteristic and pre-training assessment scores, we used linear regression or Spearman correlation for continuous or ordinal characteristics and one-way ANOVA or Kruskal-Wallis tests for categorical characteristics. Paired sample t-tests examined differences between pre- and post-training responses.

Results: Pre-training responses on the CHABA short form differed by training location (p=.01). Education level predicted pre-training knowledge (p<.05). Significant differences were observed between all pre- and post-assessment scales. There was a significant increase in CHABA short form total scores from pre to post training (p<.001), indicating changes in perceptions about challenging behaviors. Significant mean differences in pre and post responses were also found on Confidence in Coping with Patient Aggression Instrument (p<.001), indicating higher comfort levels working with the ASD population following training. Staff also demonstrated more knowledge of EBPs for ASD following training (p<.001).

Conclusions: Through a short, focused training on strategies for reducing challenging behaviors of patients with ASD, significant improvements were observed between pre- and post-training assessments. Following the modified ASD-CP training, staff reported higher levels of comfort for working with the ASD population and greater knowledge of EBPs for ASD. Perceptions of challenging behaviors also changed. Limitations include potential differences between trainees who did and did not complete the surveys and lack of follow-up assessments to examine retention of knowledge and changes in clinical practice.

444.051 *(Poster)* Summary of Qualified Service Providers By the 'ABA in PA Initiative'

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Background: Despite the fact that Pennsylvania has had an autism insurance law on the books since 2008, Pennsylvania's Department of Human Services was not ensuring appropriate availability or quality of Applied Behavior Analysis (ABA) for children with Autism Spectrum Disorder (ASD). This deprived individuals in Pennsylvania access to this medically necessary intervention. The ABA in PA Initiative, a 501(c)(3) advocacy organization, supported the Disability Rights Network of Pennsylvania in a class action lawsuit (Sonny O. v. Dallas) filed in 2014 to hold the Department of Human Services accountable. As a result of the lawsuit, ABA must meet the evidence-based standards of the Behavior Analyst Certification Board ®. Furthermore, the ABA in PA Initiative supports PA HB1900, (Better Access to Treatment (BAT) Act), to set minimum training and experience standards to license behavior analysts. However, data is limited about the availability and quality of care delivered by provider agencies.

Objectives: To evaluate changes in the landscape of ABA provider agencies between 2016 and 2020, a time period of several key advocacy accomplishments in Pennsylvania.

Methods: The ABA in PA Initiative has curated a voluntary directory of ABA providers for Pennsylvania since 2014. Agencies are added if they contact us, or by internal outreach efforts. Only agencies that provide ABA services to children in PA using board certified behavior analysts qualify for inclusion. To learn about provider qualifications and availability, agency data was collected at several time-points and will continue into the future. Time-points were chosen to correlate with certain key advocacy accomplishments such as the Sonny O settlement, public awareness campaigns (BCBA® Appreciation Day) and BCBA licensure.

Results: We have collected simple demographics and compared data from June 2016 through September 2019. Of the 48 agencies identified in June 2016, 23% took Medicaid, 8% employed BCaBA's® and 21% employed registered behavior technicians (RBT's®). Of the 123 agencies identified in September 2019, 56% take Medicaid, 18% employ BCaBA's® and 51% employ registered behavior technicians (RBT's®), a significant improvement from 2016. An 11-item survey was developed to collect additional information including 1) agency size, 2) number of providers that hold the BCBA®, BCaBA® or BCBA-D® certification and RBT® credential, 3) The percentage of autism cases staffed with certified and credentialed providers, 4) payer mix to include medicaid, 5) hiring and staffing strengths and barriers and 6) opinions regarding licensure. Figure 1 demonstrates barriers agencies cite as to why they currently do not accept Medicaid.

Conclusions: The ABA in PA Initiative's convenient directory provides a comprehensive listing of these businesses in Pennsylvania. While autism insurance laws are important, additional advocacy is necessary to ensure that medically necessary, quality ABA reaches the public. Preliminary analysis of agency metrics indicates promising changes in the landscape of ABA following the efforts of initiatives undertaken by this Advocacy organization.

444.052 *(Poster)* Telehealth Diagnoses of Autism in Toddlers

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impairments in social interaction and communication, as well as repetitive behaviors and restricted interests. ASD is screened for at the 18- and 24-month well child visits as recommended by the American Academy of Pediatrics. Symptomology and impairments of ASD will continue throughout the child's lifespan, however they may be decreased with early interventions. Early recognition and identification is encouraged by health care professionals but there remains a significant amount of time difference between initial parental concern and the diagnosis of ASD. The average age for a diagnosis of ASD in the United States is above 4 years old. Telehealth (TH) models have been found to be successful across a variety of medical and psychiatric conditions, demonstrating improved service delivery, clinical impact, financial reimbursement, and applied behavioral analysis service delivery. Within the Department of Defense, families often may be located in areas that lack the capabilities to timely diagnose and treat ASD. Military Family stress, impacting soldier readiness, has been associated with reductions and difficulty in accessing diagnostic and therapeutic services for a young child with ASD. TH would provide a model capable of early evaluation of children without relying as much on community service or travel, potentially decreasing family stress, increasing soldier readiness, and improving long-term outcomes associated with ASD.

Objectives: Determine TH accuracy in diagnosing ASD in children aged 21 to 48 months.

Methods: Children receiving care at a military hospital in Alaska received comprehensive TH evaluations by two Developmental Pediatricians (DBP) located at an Army Medical Center in the Northwest. Following parent interview, two of the physicians independently observed the child while directing the parent to engage their child in the Selective Play Observation via Telehealth (SPOT), a brief structured observation adapted from the Screening Tool for Autism in Toddlers (STAT). Each item presented (ball, bubbles, balloon and car) was scored in accordance with the scoring standards of the STAT. The DBP providers then independently rendered a determination of the presence or absence of autism using a DSM-structured framework, completed a confidence scale (very confident, somewhat confident, and uncertain) regarding their diagnosis, and discussed their determination with the family. Parents completed satisfaction surveys and scheduled a confirmatory in-person evaluation with an independent DBP. Results of the TH and confirmation evaluation were then compared.

Results: Of the 15 children enrolled, 7 received ASD diagnoses after the TH evaluation. In-person evaluation diagnoses matched telehealth diagnoses in 15/15 children. 14/15 of the children completed the confirmatory evaluation with an independent DBP. DBP providers were more frequently 'very confident' (78%) using TH to evaluate a child for autism compared to Fellows (48%); and were similarly 'very confident' (100%) rendering a diagnosis of autism via TH compared to Fellows (40%). Caregiver satisfaction data will also be discussed.

Conclusions: This is the first study to report utilizing TH to diagnose ASD using a parent-led play observation. This study supports the concept of conducting ASD evaluations remotely without the need for an in-person provider**.**

444.053 *(Poster)* The Implementation of Reciprocal Imitation Training (RIT) within Part C Early Intervention

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Background: Despite the existence of several evidence-based Naturalistic Developmental Behavioral Interventions (NDBIs; Schreibman et al., 2015), few have been adapted for use in community-based settings, such as Part C IDEA Early Intervention (EI), where they may increase early access to ASD-specialized treatment for a broader segment of the population. Furthermore, little is known about how providers in the "real world" decide with whom to initiate treatment and what type of adaptations they make to meet the demands of the context/setting. This study examines the implementation of an NDBI--Reciprocal Imitation Training (RIT)--by community EI providers serving toddlers from birth to 3 years.

Objectives: To examine: (1) the effectiveness of a training workshop for EI providers for increasing their self-efficacy when providing intervention to toddlers with possible ASD; (2) toddler characteristics that lead providers to initiate RIT; (3) types of RIT adaptations implemented; and (4) EI providers' perceptions about the effectiveness of RIT for improving toddler outcomes.

Methods: 80 EI providers from 9 agencies in 4 counties across Washington State were enrolled. A stepped-wedge design was used to randomly assign counties to the timing of the training workshops. Survey data were collected at baseline (T1) and 12-months post-training (T2); 64 providers (80%) had T1 and T2 data. The 1-day interactive, training workshop focused on imitation impairments in ASD, the RIT cycle steps, and parent coaching. RIT (Ingersoll, 2008; 2010; 2012) is a manualized ASD-specialized treatment that is low intensity, easy to use, and applies an NDBI approach to teach object and gesture imitation within a play-based context. Self-report measures of practices and self-efficacy regarding ASD care were collected at T1 and T2. At T2, providers also: (1) indicated which child characteristics led them to use RIT and what adaptations they had implemented; and (2) rated how effective they perceived RIT to be.

Results: From T1 to T2, there were significant increases in providers' self-efficacy in discussing treatment goals and progress and in providing coaching to families of children with ASD, *ps*=.04. 52 providers (81%) reported using RIT with 490 children and coaching 358 parents. The top three most endorsed child characteristics that prompted providers to initiate RIT included: the presence of social communication delays (75%), motor imitation delays (66%), and/or a formal ASD diagnosis (55%). 20 providers (38%) indicated making adaptations due to their own clinical style (90%), child characteristics (70%), and/or parent/family characteristics (60%). The majority of providers using RIT perceived it to be effective at improving motor imitation (90%), social interactions (79%), and communication (75%).

Conclusions: A relatively brief training for EI providers' led to increases in their sense of efficacy and subsequent widespread use of an evidence-based ASD treatment over the course of a year. RIT seems promising as an accessible treatment that can help families get an early start on specialized services within an established infrastructure available across the U.S. Additional research is needed to *directly assess* child moderators of treatment response, RIT adaptations that may impact treatment fidelity, and RIT's effectiveness at improving child outcomes.

444.054 *(Poster)* The Relationship between Age of Diagnosis and Core Deficits in Autism Spectrum Disorder (ASD)

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Background: Autism Spectrum Disorder (ASD) is the fastest growing developmental disability in the United States. While the American Academy of Pediatrics (AAP) recommends screening for ASD at 18 and 24 months of age, the average age of diagnosis in the United States is approximately 4 years of age. One of the most widely disseminated messages regarding treatment practices for children with ASD is that early intervention results in the most optimal outcomes. As such, the majority of research to date has focused on the evaluation and intervention on the core deficits in ASD. While growing attention on the early services in children with ASD is warranted, what is not well understood is the relationship between the core deficits of ASD and age of diagnosis.

Objectives: The objective of this study was to determine if there is a relationship between the core deficits of ASD and the age of diagnosis, using a large and representative dataset.

Methods: The current study is a secondary data analysis from the Simons Foundation Powering Autism Research for Knowledge (SPARK) cohort. 4,388 children with ASD, ages 1 to 18 years (M=8.23, SD = 3.88 years), were selected for analysis based on complete data. The sample was 80.4% male and all children had a formal diagnosis. The principle caregiver of the child completed the Autism Impact Measure (AIM); a 41-item survey on a 5-point Likert-scale to measure the frequency and impact of core ASD deficits. The AIM includes five subdomains including Repetitive Behavior, Communication, Atypical Behavior, Social Reciprocity, and Peer Interaction. Caregivers also reported the specific ASD diagnosis, date, and method. Linear regression was used to examine the relationship between AIM subdomains at present and the age of ASD diagnosis.

Results: On average, children with ASD in the sample were diagnosed at approximately 4.5 years (M=53.68, SD = 32.96 months). The R2 for the linear regression model was 0.26 ($F(7,4380) = 221$, $p < .001$). The age at diagnosis was significantly associated with current age ($\beta = 0.32$, $p < .001$), sex ($\beta = -.05$, $p < .001$), AIM Repetitive Behaviors subscale ($\beta = -.05$, $p < .01$), AIM Communication subscale ($\beta = -.30$, $p < .001$), and AIM Atypical Behavior subscale ($\beta = 0.20$, $p < .001$). The additional AIM subscales were not significant predictors in the model, including Social Reciprocity ($\beta = -.02$, $p = .39$) and Peer Interaction ($\beta = .01$, $p = .61$).

Conclusions: Among core deficits, current findings suggest subscales on the AIM including repetitive behavior, atypical behaviors as well as communication are significantly related to age of diagnosis. Outcomes from this study should underscore the importance of accurate measures evaluating core delays and deficits in children early on in development. This may lead to an earlier ASD diagnosis and more impactful intervention. Next, further investigation is warranted into the gender differences in age of diagnosis, the current study suggests males are diagnosed significantly earlier than females.

444.055 *(Poster)* Unpacking the Mechanisms of High-Quality Therapist Training on Parent Attendance in Mental Health Treatment for Children with ASD

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Background: Parent or caregiver (hereafter referred to as parent) engagement is widely documented as an important component and key quality indicator in evidence-based interventions for children, and specifically for children with autism spectrum disorder (ASD) (Becker et al., 2018; Haine-Schlagel & Walsh, 2015; Nock & Kazdin, 2005; Wright et al., 2019), Community mental health (MH) services are particularly important for children with ASD in caring for their common co-occurring psychiatric conditions (Brookman-Frazee et al., 2009). Previous research shows sub-optimal parent engagement in MH services for this population; however, there is limited research on determinants of parent engagement and the impact of therapist training in evidence-based, parent-mediated interventions.

Objectives: The current project examines: 1) the effect of training community-based therapists in "An Individualized MH intervention for ASD (AIM HI)" Brookman-Frazee et al., 2016 on parent attendance at children's therapy sessions; and 2) key moderators and mediators of therapist training on parent attendance.

Methods: Data for the current study are drawn from the AIM HI community effectiveness trial conducted in outpatient and school-based MH services in Southern California.

Participants included a subset of trial participants including 189 children with ASD aged 5-14 years (M age=9.15 years; SD=2.46; 84.1% male) and their parents (M age=40.24 years; SD=8.35; 93.1% female; 51.3% Hispanic/Latinx) corresponding to 168 therapists (M age=34.13 years; SD-8.18; 86.3% female; 34.5% Hispanic/Latinx) from the trial with available session attendance data. 145 families from 127 therapists were in the AIM HI condition; 44 families with 41 therapists were in the usual care (UC) condition.

The outcome measure was percent of sessions with parent attendance over the 6-month study period. Moderator variables included baseline caregiver strain, parenting sense of competence, caregiver race/ethnicity, therapist licensure status, therapist previous training in parent-mediated interventions, and primary treatment setting (school versus other community setting). Mediator variables included observationally coded therapist fidelity.

Results: Multilevel regression models in Stata were used to account for the clustered of nature of the data (i.e. therapist-client dyads [level 1] nested within enrolled MH programs [level 2]). Parents working with therapists trained in AIM HI attending a higher percentage of their child's treatment sessions ($EMM_{AIM\ HI}$=73.44, SE=4.95) compared to usual care (EMM_{UC}=42.62, SE=5.60), *Estimate*=30.82, p<.01). No parent-level or therapist- level factors were significant moderators. Service setting was a significant moderator (*Estimate=-25.78,* Wald $X^2(5)$=156.99, p<.01), such that higher parent attendance was observed in non-school (i.e. outpatient, home) settings compared to school settings but in the AIM HI condition, the difference between school and non-school settings was significantly smaller compared to UC. The percentage of parent attendance in schools for families in the AIM HI condition approximated that seen in other settings (e.g., clinics, home) among the UC condition. Treatment fidelity significantly mediated the relationship between therapist training condition and parent attendance.

Conclusions: The results suggest that AIM HI may be an effective way to increase parent participation in MH treatment for children with ASD served in school settings, which may further contribute to improved child outcomes.

444.056 *(Poster)* Using Measurement-Based Care to Inform Course of Treatment in Autism Spectrum Disorder: Evidence from a Community Clinic

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Background: Measurement-Based Care (MBC), or the use of repeated measurement of patient progress, is an evidence-based practice in research, community, and university clinic settings with adults. MCB has been used to evaluate course of treatment and to indicate appropriate treatment termination across a variety of disorders and populations. However, no current work has used MBC to evaluate course of treatment in individuals with Autism Spectrum Disorder (ASD). ASD is a neurodevelopmental disorder with a manifestation of symptoms that makes it difficult to monitor the effectiveness of treatment progress and to select appropriate treatment goals.

Objectives: The current study aimed to evaluate the course of treatment for youth with ASD, compared to clinical controls without ASD, using MBC in a community clinic. A supplementary objective was to use a novel statistical method to analyze MBC data and to evaluate course of treatment over time.

Methods: Participants (n = 40, 15 females) seeking treatment at a community, cognitive-behavioral clinic completed brief, symptom-specific questionnaires at each treatment session. Twenty ASD participants were sex-, age- and primary presenting problem-matched with 20 clinical controls (M_{age} = 13.9, SD = 4.89). Individual session scores were z-scored based on the outcome measure's global means and standard deviations to compare across participants. T-tests were conducted to evaluate group differences in overall symptom changes and number of sessions. Multilevel growth modeling was used as a novel methodology to evaluate individual patterns and change over course of treatment.

Results: Results of t-tests indicated differences in number of treatment sessions, $t(38) = -2.23$, $p = .03$, where ASD clients (M = 31.7; SD = 20.43) were seen significantly longer than non-ASD clients (M = 20; SD = 11.06). Further, ASD clients had significantly smaller change scores than non-ASD clients, regardless of treatment duration, $t(38) = 2.42$, $p = .02$. Results from multilevel growth model analyses indicated no significant group difference on the severity of the symptoms at intake, $t(36) = .38$, $p = .71$ or the rate of change over time, $t(36) = 1.39$, $p = .17$. However, model-based trajectories suggested that the subclinical cutoff differed by group: non-ASD group reached subclinical levels after 23 weeks, but ASD only after 37 weeks.

Conclusions: These results yield an important practical implication: clients with ASD require significantly longer courses of treatment (on average 50% more sessions) to make the same amount of progress as non-ASD clients. This is the first examination of MBC in ASD using novel methodologies to address challenges in treatment progress. These results demonstrate the ability of MBC to provide valuable information regarding the treatment trajectories of effective intervention in a challenging clinical group and for significant public policy impact.

444.057 *(Poster)* Using Participatory Process to Bridge the Research to Practice Gap in Intervention Development: Flexible Futures, a Novel, School-Based Executive Function Treatment for Transition-Age Autistic Youth

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Background: Large numbers of autistic and their families report "falling over a services cliff" as they transition to adulthood due to the loss of school and social supports after high school graduation. Autistic people have much to contribute to society, including unique perspectives, knowledge and skills, but are often prevented from sharing their gifts because executive function (EF) weaknesses get in the way. EF problems are pivotal targets for intervention because they are common, linked to independence, and responsive to treatment in younger children. However, there are no evidence-based EF treatments for transition-age youth and youth have difficulty generalizing skills learned in the clinic to real-world settings. In response to these needs, we utilized community-based participatory research methods to develop a novel EF intervention, designed to be implemented by school personnel to maximize accessibility, intervention dosage and generalizability.

Objectives: To 1) develop and iteratively refine intervention content using input from stakeholders (autistic individuals; parents and teachers of autistic youth), and 2) assess intervention feasibility and acceptability (retention, fidelity, consumer satisfaction) in a RCT across 8 high schools.

Methods: In the course of development we conducted focus groups with autistic high school and college students (*n*=5), their parents (*n*=9), and high school/college personnel (*n*=7) to develop curriculum content. Iterative refinement of content was based on 1) youth feedback during clinic-based groups (*n*=22), 2) teacher feedback during pilot testing in two schools, 3) review by the Autistic Self Advocacy Network, 4) and parent, youth, teacher program satisfaction from the RCT. Barriers and facilitators to implementation were examined during focus groups (*n*=7) conducted with RCT interventionists.

Results: Feedback from stakeholders highlighted the importance of curriculum content focusing on: flexible problem-solving, time management, motivation, independent goal setting, planning, and social flexibility skills. Curriculum changes based on feedback included: lessons focusing on neurodiversity and self-advocacy (from autistic youth), inclusion of more activities (autistic youth/interventionists), skills practice connected to real-world situations (i.e., registering for disabilities services in college; sending e-mail, navigating a college-roommate agreement; college/high school teachers).

- **Retention**: 100% of the schools completed Flexible Futures and 92% of students completed the post-testing.
- **Fidelity:** Observations of interventionists indicated strong procedural implementation fidelity and competence (*M*=7.6 out of 10, *SD*=1.16)
- **Acceptability**:
    - Interventionists (*n*=9): 100% reported that each lesson could be conducted easily and 95% indicated each lesson was helpful in acquiring new skills
    - Parents (*n*=25): 95% reported Flexible Futures helped their child; 100% learned something new; and 70% indicated their child's flexibility and planning skills improved.
    - Teens (*n*=26): 88% would recommend the intervention to other teens; 100% were more flexible afterwards and 72% were better at planning; They used skills at home (92%), school (92%), with parents (76%), and friends (68%).

Conclusions: The incorporation of stakeholder feedback in the development of a novel intervention led to an intervention that could be implemented with minimal training (3 hours) by school staff with fidelity and high consumer satisfaction. FF holds promise as an accessible, low-cost intervention targeting skills needed for successful transition to adulthood.

444.058 *(Poster)* Utilization of the Medical Homes As Developmental Extenders to Provide Level 2 Autism Screening for Children < 5 Years Old

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Background: Prevalence of Autism Spectrum Disorder (ASD) in young children has been steadily rising over the last 20 years. Efficient screening within the medical home leading to timely identification of children less than 5 years old at risk for ASD is necessary especially for military facilities that are in remote and overseas locations. Primary care clinics in the military currently refer, on average, 25 children annually for every 1000 empaneled to a sub-specialty clinic to rule out ASD. The time from initial MCHAT screening to evaluation is often longer than 9 months. Recent studies suggest that the use of supported specialty-trained community primary care providers as part of a spoke-and-hub model ("STAT-MIL") that are connected to ASD evaluation centers of excellence can serve as a significant force multiplier. In the military, additional benefits of strategically placed providers with targeted extender capabilities include improved readiness and access to resources in environments where these were previously unavailable.

Objectives: Determine the feasibility of utilizing a tier 2 screening tool (Screening Tool for Autism in Toddlers & Young Children-STAT), in a medical home supported by a hub site tertiary autism center to improve access and decrease age of diagnosis while maintaining high fidelity of diagnostic accuracy.

Methods: Within a remote military medical home, a trained primary care provider with the assistance of a nurse coordinator identified children at-risk for ASD using the MCHAT-R + F/U, or the Autism Spectrum Quotient – 10. These children then received a tier 2 screening evaluation utilizing the STAT and received a provisional diagnosis of ASD, when appropriate. Metrics measured included number of referrals, age of diagnosis, time from referral to diagnostic evaluation, and validity of diagnosis when compared with sub-specialty evaluation. Data was then compared both with national community averages as well as pre-implementation data from the local treatment facility.

Results: Over 6 months, the developmental extender trained in the STAT-MIL performed 22 evaluations for ASD, with 13 receiving a provisional diagnosis of ASD. Note review and a follow up visit with a Board Certified Developmental Pediatrician determined validity between sub-specialist and primary care diagnosis to be 100%. To date, the program has a conservative cost savings of $27,000 with anticipated cost savings of $245,000 in FY2019. Since STAT-MIL inception the average age of diagnosis has been 32.5 months of age which is 15.5 months earlier than the national average. Time to diagnosis from referral has also been reduced from 28.8 weeks to 12.1 weeks in first 3 months (Oct-Dec 2018) and further reduced to 3.9 weeks during the subsequent 3 months (Jan-Apr 2019).

Conclusions: This Developmental Extender model (STAT-MIL) appears to be a promising force multiplier in remote environments by enhancing diagnosis capabilities, improving access to resources which augments military family readiness. This high reliability model empowers primary care to utilize additional tools which provide comprehensive coordinated care through an integrated relationship between primary medical homes and specialty care services.

444.059 *(Poster)* Validation of a Statewide System of Early ASD Diagnosis: A Preliminary Report on Diagnostic Accuracy

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Background: Autism spectrum disorder (ASD) can be reliably diagnosed during the second year of life. However, the average age of diagnosis across the United States is 4 to 5 years, with diagnosis of lower income, minority, and rural children lagging further behind. The significant delay between the emergence of ASD symptoms and diagnosis means that young children are missing critical opportunities for evidence-based interventions at the time of optimal impact. As such, developing and testing streamlined community-based methods of ASD diagnosis has been identified as a priority.

Objectives: To determine the diagnostic accuracy of a statewide system for early ASD diagnosis in the primary care setting. Specifically, we sought to 1) determine ASD diagnostic agreement between primary care providers (PCP) trained to conduct standardized ASD evaluations and an expert ASD specialist, and 2) identify child characteristics associated with diagnostic accuracy.

Methods: Fourteen Early Autism Evaluation (EAE) Hubs have been established in primary care practices across Indiana. PCPs in the EAE Hubs participated in standardized didactic and practicum training on early ASD diagnosis. Over 2000 children, ages 18-42 months, have been evaluated by PCPs in the EAE Hubs using a standard assessment protocol (including the Screening Tool for Autism in Toddlers). In the current study, one EAE Hub was selected to refer consecutive children for follow-up comprehensive evaluation (within 8 weeks) by an expert neurodevelopmental team, including a clinical psychologist specializing in early ASD diagnosis. During this evaluation, the Mullen Scales of Early Learning (MSEL), Vineland Adaptive Behavior Scales (VABS-3), Autism Diagnostic Observation Schedule (ADOS-2), and caregiver DSM-5 ASD interview is conducted. Data collection and analysis is ongoing (projected N=25-30).

Results: To date, 12 children (8 male) have been evaluated (age: M: 2.5 years; SD: 0.6). For 9 of 12 (75%) children, there was diagnostic agreement between the EAE Hub PCP and ASD specialist (k: 0.53; $p < 0.05$) indicating a moderate level of agreement. Four cases were true positives (TP; diagnosed by both EAE Hub PCP and ASD expert with ASD) and 5 cases were true negatives (TN; diagnosed by both EAE Hub PCP and ASD expert with non-ASD). The 3 diagnostic disagreements were false negatives (FN; EAE Hub PCP diagnosed non-ASD, ASD expert diagnosed ASD). Compared to TP cases, FN cases tended to be older (TP: age: 2.4 years; FP: age: 3.3 years) and have higher non-verbal (TP: MSEL Visual Reception T: 23; FN: MSEL Visual Reception T: 35), language (TP: MSEL Receptive T: 23; MSEL Expressive T: 25, VABS-3 Communication SS: 50; FN: MSEL Receptive T: 24, MSEL Expressive T: 28, VABS-3 Communication SS: 67), and adaptive abilities (TP: VABS-3 ABC SS: 58; FN: VABS-3 ABC SS: 71).

Conclusions: Preliminary findings suggest that community-based PCPs trained as part of a statewide EAE Hub system make ASD diagnoses in young children with moderate accuracy. Diagnostic misses were associated with older age and higher cognitive, language, and adaptive functioning. These results have implications for how ASD diagnostic training for community clinicians may be improved to facilitate more accurate diagnosis.

444.060 *(Poster)* Vulnerabilities Associated with Physical Health Concerns for Emergency Department Utilization in Adolescents with Autism Spectrum Disorder

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Background: Utilization of the Emergency Department (ED) for urgent and/or higher levels of care can be a strong indicator of poor overall physical health and well-being. Given the frequent occurrence of both physical and mental health comorbidities, adolescents with Autism Spectrum Disorder (ASD) have been found to have higher ED utilization compared to adolescents without ASD. Little attention has been given to identification of physical health risk factors specifically associated with ED utilization in this population.

Objectives: This study uses a large, national healthcare claims database of a privately insured population in the United States to profile physical health concerns for adolescents with ASD and evaluates their potential associations with elevated ED utilization.

Methods: Using the 2005-2014 MarketScan® database, we design a retrospective, longitudinal study to examine the physical health profile among adolescents with ASD (aged 12-21) in association with risk of ED visits. This database contains billing claims from commercial insurers of large employers across the US. We identify ASD subjects as those with ≥2 documentations of ASD (ICD-9 codes 299.0x, 299.8x). Causes of ED visits were established by the billed primary/second diagnoses. Descriptive analyses and multivariable logistic regression were performed to examine the effects of prior physical health problems in conjunction with, mental health comorbidities and prescribed medications on ED utilization.

Results: Our longitudinal cohort consisted of 185,076 observations from 63,886 subjects with ASD from 2006 to 2014. Some subjects had multiple ED visits during the same calendar year. A total of 11,115 ED visits were examined. Overall, 85.4% of all the ED visits were at least partially due to one or more urgent physical health concerns and 26.5% were particularly due to acute injuries. 20.8% of the ED visits documented a mental health concern other than ASD as primary or secondary diagnosis (Figure 1a). Adolescents who presented to the ED frequently had co-occurring physical and/or mental health concerns aside from ASD. We also observed high incidence of ED visits among top comorbid illnesses including: epilepsy (15.8%), GI problems (16.4%), asthma (13.6%), pneumonia (15.1%), injures (15.9%) and eating disorders (24.3%) (Figure 1b). The adjusted regression analysis (Table 1) showed that prior physical health conditions, mental health conditions and polypharmacy of psychotropic medication were significantly associated with elevated ED utilization. In particular, epilepsy was found to be strongly associated with the increased ED utilization (adjusted Odds Ratio [aOR]: 2.33; 95% confidence interval [CI]: 2.10-2.59). So were GI problems (2.14; 1.95-2.35), asthma (2.19; 1.91-2.52) and pneumonia (1.82; 1.43-2.31). Prior injuries posted the highest risk of ED visit (2.54; 2.34-2.74) among all physical and mental health risk factors.

Conclusions: This study documents high ED utilization for physical health concerns by adolescents with ASD. Individuals with co-occurring physical health concerns, particularly respiratory illness, GI illness, epilepsy and prior injuries, appear to be at high risk.

444.061 *(Poster)* Youth with ASD and the Criminal Justice System

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Background: Few studies have examined the involvement of individuals with autism spectrum disorder (ASD) and intellectual disability (ID) with the criminal justice system, and the results are still mixed as to whether individuals with ASD are more likely to be involved in the criminal justice system than the general population. No studies have examined recidivism in individuals with ASD.

Objectives: The goal of this study is to describe the lifetime involvement of transition-age youth and young adults (ages 17– 23) with ASD with the criminal justice system and to examine rates of recidivism.

Methods: Data for this study come from a large epidemiological autism dataset [i.e., South Carolina Autism and Developmental Disabilities Monitoring (SC ADDM) Network], which was linked with datasets from multiple state agencies [i.e., Department of Juvenile Justice (DJJ); SC Law Enforcement Division (SLED)]. Four participant groups were included in the study: individuals with ASD without intellectual disability (ASD-only; n=316), individuals with ASD and ID (ASD+ID; n=291), individuals with ID without ASD (ID-only; n=1277), and a population control (PC; n=2980) group, identified via birth records and 5:1 frequency matched to ASD participants by gender and birth year.

Results: The ASD+ID group (1.37%) was less likely to be charged through the DJJ than the PC group (4.70%) [OR (95%CI) 0.28 (0.10-0.77)]; whereas the ID-only group (6.81%) was more likely to be charged compared to the PC group [OR (95%CI) 1.48 (1.13-1.95)]. The ID-only group (5.09%) was more likely than the PC group (2.72%) to be charged with crimes against person in DJJ [OR (95%CI) 1.92 (1.38-2.68)]. The ID-only group had the highest DJJ recidivism rate (5.17%) compared to PC (3.62%), ASD-only (3.48%), and ASD+ID (1.03%) groups. Similarly, the ASD+ID (3.09%) and ASD-only (6.65%) groups were less likely to be involved in the adult legal system (SLED) than the PC group (11.04%) [OR (95%CI), ASD+ID: 0.26 (0.13-0.50); ASD-only: 0.57 (0.36-0.91)]. The PC group had the highest recidivism rate (5.50%) compared to ID-only (4.86 %), ASD-only (4.11 %), and ASD+ID (1.72%) groups.

Conclusions: Individuals with ASD had lower charge rates compared to youth with ID-only or PC in both the juvenile and adult justice systems. There are also important differences in rates of recidivism across groups, such that individuals in the ASD-only and ASD+ID groups had the lowest rates of recidivism in both the juvenile and adult justice systems.

Social Cognition and Social Behavior

PANEL SESSION — SOCIAL COGNITION AND SOCIAL BEHAVIOR
222 - Novel Approaches to Understand the Cognitive and Neural Bases of Social Interaction in Autism

Panel Chair: Elizabeth Redcay, *Department of Psychology, University of Maryland, College Park, MD, Neuroscience and Cognitive Science Program, University of Maryland, College Park, MD, Department of Psychology, University of Maryland, College Park, MD, Neuroscience and Cognitive Science Program, University of Maryland, College Park, MD*

Difficulties with reciprocal social interaction are core to the diagnosis of autism. These social difficulties affect cognitive and social development and quality of life. However, much of our understanding of cognitive and neural underpinnings of social interaction comes from an “observer” approach in which participants are not directly engaged in interaction. Further, relatively few studies examine interpersonal or dyadic measures of interactions. The current panel discusses novel social-interactive approaches spanning eye-tracking, motion-tracking, EEG, and fMRI to investigate mechanisms of social interaction in autism. Papers highlight the feasibility of novel dyadic measures in autism such as nonintrusive motion tracking, dual head-mounted eye tracking, and dual-brain EEG measures. Novel findings demonstrate that the presence of an interactive partner changes patterns of gaze to objects and modulates oscillatory brain activity. Further, interpersonal measures of gaze can predict diagnostic group. Finally, the neural response to social-interactive reward (i.e., a reciprocal response from a peer) predicts interaction enjoyment in peer interactions in both typically developing and autistic children. Overall, this panel highlights the cutting-edge approaches and findings to identify the mechanisms contributing to real-world challenges with social interaction in autism.

222.001 *(Panel)* Autistic Traits Influence Oscillatory Cortical Dynamics during Dual Brain EEG Recording

***M. J. Rolison**, A. Naples, H. Rutherford and J. McPartland, Child Study Center, Yale University School of Medicine, New Haven, CT*

Background: Humans are innately social creatures, and the social environment strongly influences brain development. Autism spectrum disorder is hallmarked by interpersonal difficulties emerging early in development. Neuroimaging studies consistently implicate atypical resting activity across multiple modalities in ASD. However, the association between resting-state activity and social function is incompletely understood. Despite strong evidence for associations between at-rest brain activity and social function, the majority of research has measured brain activity when participants are in isolation; we know little about brain activity during in vivo social interactions. In this study we examined how the presence of another person modulated resting state brain activity by recording EEG simultaneously from pairs of participants during varying levels of interpersonal proximity. We expected that variation in oscillatory activity between contexts, as a marker of sensitivity to social context, would be associated with autistic traits, as measured through self-report measures of autistic traits.

Objectives: Examine the influence of different levels of interpersonal proximity on resting state brain activity and its association with autistic traits.

Methods: EEG was recorded simultaneously from 20 typically-developing participants (10 pairs) during 3 social contexts: in separate rooms, together facing away from one another (back-to-back), and together face-to-face (facing). Additionally, heart rate variability was recorded from all participants. Participants completed a series of self-report questionnaires designed to measure variation across sub-clinical to clinical levels of autistic traits including the Social Responsiveness Scale 2nd Edition (SRS) and the Broad Autism Phenotype Questionnaire (BAPQ).

Results: Theta activity was greater when separate compared to back-to-back, p=0.01, or facing, p=0.04. Additionally, alpha activity was greater when separate compared to back-to-back, p=0.03, or facing, p=0.02. Further, gamma was greater when separate compared to back-to-back, p=0.01, or facing, p=0.01. Correlations with behavioral measures revealed that a greater difference in beta power when back-to-back versus facing was associated with lower scores on the BAPQ, r=0.60, p=0.03. Further, higher total score on the BAPQ was associated with greater difference in gamma activity between separate and back-to-back, ρ=0.61, p=0.03. Additionally, this difference score between separate and back-to-back was associated with higher total score on the SRS, ρ=0.70, p<0.01.

Conclusions: Interpersonal proximity modulated broadband EEG power from 4-55hz and individual differences in self-reported autistic traits modulated these effects in the beta and gamma frequency bands. These results suggest that the social presence of another human, regardless of interpersonal orientation, modulates brain activity. These findings provide novel insight into the influence of social environment on brain activity and its association with autistic traits through dual-brain EEG recording and demonstrate the importance of using interactive methods to study the human brain, with particular importance for understanding ASD.

222.002 *(Panel)* Neural Correlates of Social Interaction Enjoyment in Children with Typical Development and Autism Spectrum Disorder

***K. A. McNaughton**[1], D. Alkire[1], L. A. Kirby[2], K. R. Warnell[3], H. A. Yarger[4], D. Moraczewski[4] and E. Redcay[4], (1)Neuroscience and Cognitive Science Program, University of Maryland, College Park, MD, (2)Yale Child Study Center, New Haven, CT, (3)Department of Psychology, Texas State University, San Marcos, TX, (4)Department of Psychology, University of Maryland, College Park, MD*

Background: Although social reward processing during everyday interactions is proposed to be atypical in autism spectrum disorder (ASD), its underlying mechanisms are predominantly studied in static, non-interactive contexts. Yet there are significant differences between the cognitive and neural processes engaged in these non-interactive contexts and those engaged in reciprocal social interactions, highlighting the importance of characterizing neural and self-reported reward during naturalistic social interaction in ASD.

Objectives: To examine the neural and behavioral predictors of self-reported enjoyment of a face-to-face peer interaction in children with typical development (TD) and ASD.

Methods: 40 children 8-14 years old (14 ASD, 2 female, mean IQ=118; 26 TD, 4 female, mean IQ=122) participated in two visits to examine relations between neural response to perceived peer interaction and self-reported enjoyment of a face-to-face peer interaction. In the first visit, children participated in a text-based, real-time peer interaction while undergoing a functional magnetic resonance imaging (fMRI) scan. Briefly, children sent text messages to a perceived peer or computer (e.g. “I like cookies”) and received engaged (e.g. “Me too!”) or disengaged (e.g. “I’m away”) responses. Following the scan, children reported their enjoyment of interacting with the perceived peer. Neural response in the bilateral nucleus accumbens, a key region in the reward network, was examined for the differential response to the receipt of the engaged compared to disengaged peer messages controlling for response to engagement in computer messages. In a follow-up visit, children were invited back in pairs to participate in a 25-minute face-to-face interaction with a real peer that consisted of both structured tasks and free conversation. Children rated their enjoyment of this interaction using an interaction success measure, and parents completed the Social Responsiveness Scale to quantify autistic traits.

Results: Increased self-reported enjoyment of interacting with the perceived peer in the fMRI task significantly predicted increased self-reported enjoyment of the face-to-face interaction (beta=2.04, standardized beta=0.36, p<0.05). Furthermore, increased nucleus accumbens response significantly predicted increased enjoyment of the face-to-face interaction (beta=8.08, standardized beta = 0.34, p<0.05). These predictions remained after controlling for age, time between scan and face-to-face interaction, the mean level of autistic traits in the dyad, and the discrepancy on autistic traits in the dyad, none of which significantly predicted enjoyment of the face-to-face interaction. ASD diagnosis was not a significant predictor of enjoyment of the face-to-face interaction, nor did diagnosis significantly interact with the neural response to or self-reported enjoyment of the perceived peer to predict enjoyment of the face-to-face interaction.

Conclusions: In this preliminary sample, we identify relationships between self-reported enjoyment of interacting with a perceived peer, neural selectivity to engaged messages from a perceived peer, and self-reported enjoyment of a live face-to-face interaction with a real peer. Importantly, these relationships were seen in both children with TD and ASD, providing novel evidence of nucleus accumbens selectivity to a reciprocal response from a peer as a transdiagnostic neural correlate of enjoyment of live social interactions.

222.003 *(Panel)* Using Dual Head-Mounted Eye Tracking to Study Visual Attention in Socially Interactive Contexts in Young Children with ASD

D. P. Kennedy[1,2,3], *J. R. Yurkovic*[1,2], *R. Shaffer*[4], *E. Pedapati*[5], *C. A. Erickson*[5,6] *and C. Yu*[1,2], *(1)Psychological and Brain Sciences, Indiana University, Bloomington, IN, (2)Cognitive Science Program, Indiana University, Bloomington, IN, (3)Program in Neuroscience, Indiana University, Bloomington, IN, (4)Division of Developmental and Behavioral Pediatrics, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (5)Cincinnati Children's Hospital Medical Center, Cincinnati, OH, (6)Department of Psychiatry and Behavioral Neuroscience, University of Cincinnati College of Medicine, Cincinnati, OH*

Background:

The vast majority of eye tracking research on visual attention in ASD is acquired during highly controlled and non-interactive conditions, typically with a participant passively seated in front of a 2-dimensional screen and presented with various stimuli. However, visual experiences in the real world are actively constructed, and choosing when and where to look involves the complex coordination between one's own movements (e.g., of heads, bodies, hands), behaviors of their social partner, and their environment. Here, we adapt a recently developed technology — dual head-mounted eye tracking — to study visual attention in young children with ASD while freely interacting with their parents in an unconstrained toy play context.

Objectives: Our goals were to (1) examine the feasibility of using this dual head-mounted eye tracking technology with young children with ASD (24-48 months), (2) examine whether patterns of visual attention differ as a function of interactive vs. non-interactive toy play (joint vs. solo conditions), and (3) examine whether individuals with ASD are sensitive to the coordinated visual attention of their parent.

Methods: Young children with ASD and their parents both wore light-weight head-mounted eye trackers (SR research) while freely playing with 24 toys, thus providing first-person egocentric video acquired simultaneously with gaze. During the joint play condition, parents were instructed to simply play with their child as they would at home. During the solo play condition, parents were asked to fill out a questionnaire and respond appropriately to their children but not engage further. Gaze was calibrated offline and targets of gaze were defined.

Results:

We successfully acquired dual eye tracking data from 21 dyads (i.e., children with ASD together with their parents). Cases of unsuccessful data acquisition were primarily due to children refusing to wear or repeatedly removing the eye tracker, or difficulty with subsequent calibration. Preliminary analyses on a subset of dyads revealed that children shifted their gaze between objects more often in the joint play vs. solo play conditions ($p < 0.01$, Cohen's $d = 1.36$). We also found that during joint play, when parents and children simultaneously looked to the same object, child gaze to an object was extended in time relative to gaze at objects not jointly gaze at ($p < 0.01$, Cohen's $d = 0.89$). Both of these findings suggest that gaze in dynamic, real world environments in young children with ASD is modulated by the joint interaction of a social partner.

Conclusions:

We demonstrate that dual head-mounted eye tracking is a feasible method for examining visual attention in complex environments in ASD. We also show that young children with ASD are sensitive to the interactive responding by a parent and modulate their gaze accordingly. These findings suggest that dual head-mounted eye tracking can serve as a new method to explore visual attentional differences in ASD, and may provide novel insight into the real-world mechanisms underlying altered social, communicative, and cognitive development in ASD.

222.004 *(Panel)* Interaction-Based Phenotyping to Characterize the Autism Spectrum

L. Schilbach *and J. M. Lahnakoski, Max Planck Institute of Psychiatry, Munich, Germany*

Background: Autism is characterized by profound impairments of social interaction, but currently no observer-independent, quantitative measure of disorders of social interaction is available in clinical or research practice.

Objectives: To implement a novel tool that can be used to provide interaction-based phenotyping in autism (and other disorders), we constructed an unintrusive, infrared-based motion tracking system that enables detailed analysis of behavior at the individual and dyadic interpersonal level.

Methods: We conducted a suite of behavioral studies to validate the new setup in comparison to conventional, wearable motion tracking sensors and to use the new setup as part of ADOS interviews that were conducted in adult individuals that presented to the outpatient clinic for disorders of social interaction at the Max Planck Institute of Psychiatry. In terms of data analysis, we evaluated dyadic measures of joint orienting and distancing, synchrony and gaze behaviors to summarize data collected during natural conversation and joint action tasks as well as ADOS interviews.

Results: Our results demonstrate that patterns of proxemic behaviors, rather than more widely used measures of interpersonal synchrony, best predicted the subjective quality of the interactions. Furthermore, we tested the utility of the novel motion tracking technique by using it during ADOS interviews that were conducted in adult individuals as part of a diagnostic procedure for autism. Here, results of preliminary analyses demonstrate that interpersonal gaze plots derived from motion tracking can be used to predict the diagnostic group with good accuracy, particularly in cases when ADOS scores alone are not informative.

Conclusions: Taken together, this set of findings demonstrates that observer-independent measures of social behavior can be obtained in an unobtrusive manner in clinical interview and other everday life situations. These measures are particularly sensitive to the subjective quality of social interactions and appear to be useful as part of clinical autism assessments.

PANEL SESSION — **SOCIAL COGNITION AND SOCIAL BEHAVIOR**

223 - Personality Traits in Autism Spectrum Disorder

Panel Chair: Jennifer Lodi-Smith, *Psychology, Institute for Autism Research, Canisius College, Buffalo, NY*

Understanding the relationship between personality trait variability and symptom variability in the context of autism spectrum disorder (ASD) is critical as personality traits are important indicators of adaptive outcomes in clinical and non-clinical samples across the lifespan. The first talk reviews a meta-analysis and secondary data analysis of personality traits in ASD. The second talk explores the personality trait differences between the typically-developing and ASD population in both youth and adult subsamples as well as how these differences may translate to variability in clinical characteristics. The third talk presents a latent profile analysis which identifies personality subgroups in an ASD youth sample from a cognitive-behavioral therapy randomized, controlled trial and examines its concurrent validity across various clinical measures. The final talk presents evidence for the potential value of extending emerging personality-based interventions to individuals with ASD. The speakers will close the panel with a discussion of best practices in and future directions for research in personality and ASD.

223.001 *(Panel)* Meta-Analysis and Secondary Data Analysis of Big Five Personality Traits in Autism Spectrum Disorder

J. D. Rodgers[1], *J. Lodi-Smith*[2], *S. Cunningham*[3], *C. Lopata*[1], *M. Thomeer*[1], *S. L. Brennan*[1] *and H. J. Virginia*[4], *(1)Institute for Autism Research, Canisius College, Buffalo, NY, (2)Psychology, Institute for Autism Research, Canisius College, Buffalo, NY, (3)Fordham University, New York, NY, (4)Clinical Psychology, Clark University, Worcester, MA*

Background: Understanding personality in the context of ASD is critical as personality traits are important indicators of adaptive outcomes in clinical and non-clinical samples (Soto, 2019).

Objectives: This talk presents a meta-analysis of the relationship of Big Five personality traits to ASD. It then provides evidence from a preregistered analysis of archival data from the National Database for Autism Research (NDAR) addressing the most notable gap in the published literature on personality traits and ASD - how core diagnostic symptoms relate to personality traits.

Methods:

- Study 1. Meta-analysis: Studies were included if they (1) either (a) measured ASD characteristics using a metric that yielded a single score quantification of the magnitude of ASD characteristics and/or (b) studied individuals with an ASD diagnosis compared to individuals without an ASD diagnosis and (2) measured Big Five traits in the same sample or samples. Fourteen reviewed studies include both correlational analyses and group comparisons. Eighteen effect sizes per Big Five trait were used to calculate two overall effect sizes per trait. Meta-analytic effects were calculated using random effects models.
- Study 2. NDAR data: The relationship of personality traits to ASD symptoms was tested in two independent samples from the NDAR. Sample 1 is a sample of 98 children from NIMH/NIH #R01MH094391-01 (Wood, 2012) who completed the Big Five Questionnaire-Children version (BFQ-C; Caprara et al., 1993). Participants were 9.84 years (SD = 1.94, range = 6.17 – 13.92), primarily male (n = 84, 85.7%) and White (n = 51, 52.0%). Sample 2 is a sample of 32 adults from NICHD/NIH #P50HD055748-01 (Minshew et al., 2007) who completed the NEO Five Factor Inventory (NEO-FFI; Costa and McCrae, 1992). Participants were 23.89 years (SD = 7.92, range = 14.00 – 44.17), primarily male (n = 28, 87.5%), and White (n = 29, 90.6%). In both samples, ASD symptoms were measured by the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) and the Autism Diagnostic Interview-Revised (ADI-R; Rutter et al., 2003).
- All analyses were conducted in R.

Results:

- Study 1. Meta-analysis: Correlational findings yielded a negative association between each Big Five personality trait and ASD characteristics (Fisher's *z* ranged from -.21 [conscientiousness] to -.50 [extraversion]). Effects from comparisons of individuals diagnosed with ASD to neurotypical individuals were also substantial (Hedges' *g* ranged from -.88 [conscientiousness] to -1.42 [extraversion]).
- Study 2. NDAR data: Conscientiousness, agreeableness, and openness were negatively related to Autism Diagnostic Observation Schedule scores (Lord et al., 2000). Effects were not as robust as in the meta-analytic findings and varied across samples and symptoms.

Conclusions: Meta-analytic findings indicate that individuals with ASD and elevated ASD characteristics have personality trait profiles that may put them at heightened risk for poor outcomes. However, the relationship of ASD symptoms to personality traits appears to be less robust within individuals with ASD, replicating the one prior published report of the relationship of personality trait variability to ASD symptom variability within ASD (Schriber et al., 2014). These patterns suggest a relative independence of ASD diagnostic characteristics and personality traits.

223.002 *(Panel)* Exploring Multiple Autisms through the Lens of Personality: Differences in ASD Phenotypes

A. C. Cho[1], *J. J. Wood*[1], *K. A. Rosenau*[2] *and A. R. Johnson*[1], *(1)Human Development & Psychology, University of California, Los Angeles, Los Angeles, CA, (2)GSE&IS, University of California, Los Angeles, Los Angeles, CA*

Background: Within the autism spectrum disorder (ASD) population, there is considerable variability in individuals' symptom expression, verbal/intellectual ability, and comorbid symptoms. This heterogeneity can also be observed in the ASD genetics and neuroscience literature, which presents ASD as a neurodevelopmental syndrome that consists of multiple separable phenotypes with different etiological causes (Tordjman et al., 2017). Thus, a recent goal in ASD research has been to identify the possible subtypes that are represented under this broad clinical diagnosis. Although the relationship between personality traits and ASD symptomatology has been explored (Lodi-Smith et al., 2018), personality research has yet to be utilized in identifying underlying subtypes and etiological pathways, something which has been effective in other mental health fields. Comprehensive descriptions of personality such as the five-factor model incorporate most areas of human behavioral variability into their taxonomies, providing a unique lens for identifying meaningful subgroup differences with a frame that goes considerably beyond clinical symptoms and theoretical constructs such as social motivation. As such, the intersection between personality research methods and the "multiple autisms" model provides a promising direction in understanding the heterogeneity within the ASD population.

Objectives: To identify meaningful, homogeneous personality subgroups that may be representative of autism subtypes in the ASD population.

Methods: The current study utilized data from a randomized, controlled trial comparing personalized cognitive-behavioral therapy (CBT) to group CBT for school-aged youth with ASD (N=105). A latent profile analysis was conducted using the participants' baseline personality measure scores (i.e., Hierarchical Personality Inventory for Children). A best-fitting model was determined by relative fit indices, including the Bayesian Information Criterion (BIC) and sample size-adjusted Bayesian Information Criterion (SS-BIC), as well as considerations for parsimony and interpretability. Concurrent validity was assessed by comparing the identified personality subgroups (i.e., classes) on measures of ASD symptomatology and comorbidities (SRS, CASI, CBCL) and measures of cognitive performance (WISC-IV, D-KEFS).

Results: A 4-class solution emerged as the best-fitting model with significant reductions in fit indices through four classes, while the 5-class solution presented an increase in BIC value. The additional class in the 5-class solution was deemed spurious given its similarity to another class and small class membership (representing less than 5% of the sample). The class with the largest membership (n=55) was characterized by low scores across all five personality factors, while another (n=9) exhibited the highest scores across all factors. A third class (n=27) presented uniquely low scores in Agreeableness and Emotional Stability, while the fourth class (n=14) presented very low Extraversion with high Agreeableness. The four classes were significantly different in SRS-2 and WISC-IV scores, as well as CASI, CBCL, and D-KEFS subscale scores.

Conclusions: Results suggest that subgroups of children with ASD (IQ>70) seeking behavioral treatment may possess distinct personality profiles which may affect the autism symptom expression, severity level, cognitive features, and comorbid symptomatology which characterize them. Future research should determine the clinical significance of identified personality subgroups and whether or not they are identifiable on a neurobiological level as well.

223.003 *(Panel)* Beyond the Lorna Wing Typologies: Personality Profiles in Autism Spectrum Disorder Reconsidered

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Background: Recent research has highlighted the substantial association between personality traits (as assessed by the Five-Factor Model [FFM]) and autism spectrum disorder (ASD) characteristics (Lodi-Smith et al., 2018). Notably, FFM personality domain scores appear to differ across typically-developing and ASD populations and are moderately correlated with ASD symptom expression. However, there is a great deal of variability in personality profiles of individuals with ASD (Vuijk et al., 2018), reflecting the notion of "multiple autisms" found in the ASD genetics and neuroscience literatures (Tordjman et al., 2017). Additionally, few studies have evaluated how the relationship between ASD symptomatology and personality traits varies as a function of age within the ASD population (Schriber et al., 2014). By observing ASD symptomatology through a personality lens and across age groups, it may be possible to better understand variability in symptom profiles and identify potential ASD subtypes.

Objectives: The present study aimed to (1) replicate previous findings on differences in personality traits between typically-developing and ASD populations, (2) determine the extent to which personality traits predict autism symptom expression in both youth and young adults, and (3) identify common personality profiles that may be representative of autism subtypes in the ASD population.

Methods: Personality and ASD symptom expression data were collected in a sample consisting of both typically-developing individuals and individuals with ASD ages 12 to 22 (N=176). Youth with ASD (cASD; n=47; M_{age}=14.49 years) were compared with typically-developing youth (cTYP; n=49; M_{age}=14.47 years) and young adults with ASD (aASD; n=41; M_{age}=19.88 years) were compared with typically-developing adults (aTYP; n=39; M_{age}=19.95 years) on each Big Five Inventory (BFI) domain (Extraversion, Agreeableness, Conscientiousness, Negative Emotionality, Open-Mindedness) and secondary personality facets. Regression models were used to calculate the variance accounted for by BFI domains and facets in Social Responsive Scale (SRS-2) scores. A K-means cluster analysis was used to examine BFI score patterns to identify common profiles within the ASD subsample (n=81), and clusters were validated by various clinical measures.

Results: T-tests revealed significant differences (p<.05) across three domains (Extraversion, Conscientiousness, Negative Emotionality) between the cTYP and cASD groups and across all five domains between the aTYP and aASD groups. Personality facets accounted for 30% and 37% of variance in autism core symptom expression in youth and adult subsamples, respectively. Three personality profiles were identified in the ASD subsample (37%, 35%, and 28% of the sample, respectively). The clusters differed markedly on Extraversion, Agreeableness, Conscientiousness, and Negative Emotionality, and presented differential scores on various clinical measures (e.g., SRS-2, Personality Inventory for DSM-V).

Conclusions: The present results converge with previous findings, suggesting a significant association between personality traits and ASD characteristics. Consistent with past literature, this relationship is more pronounced in the adult subsample. Three identified cluster subgroups presented distinct personality profiles that are indicative of notably heterogeneous ASD phenotypes. In accordance with the NIMH's Research Domain Criteria project (Insel et al., 2010), the present study's findings may be leveraged to better understand the etiology and symptomatology of autism and the associated neurobiological mechanisms that underlie them.

223.004 *(Panel)* Potential for Personality-Based Interventions in the Context of Autism Spectrum Disorder

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Background: Meta-analytic work (Lodi-Smith et al., 2018) indicates that individuals with autism spectrum disorder (ASD) and elevated ASD characteristics have personality trait profiles that may put them at heightened risk for poor outcomes (Soto, 2019). Personality-based interventions are, therefore, a potential future resource for this community. However, before personality-based interventions can be initiated, a number of additional assumptions must be tested through basic research.

Objectives: This talk provides evidence that important assumptions underlying personality-based interventions replicate in the context of ASD. Specifically, we summarize findings from an ongoing preregistered three sample study (current n = 718) testing the hypothesis that individuals with ASD and elevated ASD characteristics desire to change their personality traits, an important component of successful personality-based interventions (Hudson & Fraley, 2015).

Methods: The relationship of personality traits to desired trait change is tested in three independent samples. Participants in all three samples completed an ASD diagnostic history form, the Autism Quotient Scale (AQ, Baron-Cohen et al., 2001) and a measure of desired personality trait change developed for the project combining features of the C-BFI (Hudson & Roberts, 2014) and the Ten Item Personality Inventory (Gosling et al., 2003). Sample 1 is a sample of 395 adults who completed the surveys via MTurk. MTurk participants were 33.76 years (SD = 11.07), primarily female (62%) and White (70%). Sample 2 is a sample of 86 students who completed the surveys for course credit. Student participants were 22.03 years (SD = 7.28), primarily female (74%), and White (78%). Sample 3 is a sample of 237 adults who completed the surveys as part of the Canisius Aging in Autism Study (NIA/NIH #1R21AG059051-01). Sample 3 participants were 66.77 years (SD = 13.78), primarily female (58%), and White (92%). All analyses were conducted in R and collapsed across samples for a combined sample size of 718 participants, 61 of whom self-reported an ASD diagnosis.

Results: Findings indicate that ASD characteristics were modestly related to desired change in personality traits (correlation coefficients ranged from .13 - .20, $p < .05$). Individuals who self-reported having an ASD diagnosis also self-reported a desire to become less neurotic relative to individuals who did not self-report an ASD diagnosis ($t = 2.37$, $p < .05$).

Conclusions: Findings indicate that individuals with self-reported ASD and elevated ASD characteristics desire personality trait changes in ways that closely replicate desired personality trait change in general community samples. Combined with existing evidence that personality is adaptive in the context of ASD in ways that are parallel to those seen in non-clinical samples and other clinical populations, these findings give added support for the potential value of extending emerging personality-based interventions to individuals with ASD.

PANEL SESSION — SOCIAL COGNITION AND SOCIAL BEHAVIOR
224 - Translational Perspectives on Social Motivation in Autism Spectrum Disorder

Panel Chair: Emily Neuhaus, *Seattle Children's Hospital, Seattle, WA*

Discussant: Alexandra P.F. Key, *Vanderbilt Kennedy Center; Dept. of Hearing and Speech Sciences, Dept, of Psychiatry and Biological Science, Vanderbilt University Medical Center, Nashville, TN*

Social motivation lies at the foundation of social functioning, promoting specialized neural development as early as infancy and setting the stage for sophisticated social cognition and skill throughout development. Prominent etiological theories of autism spectrum disorder (ASD) propose deficits in social motivation as a core feature of ASD, shifting developmental trajectories, altering brain development, and underlying social difficulties across the lifespan. In this panel, we will present innovative research on distinct facets of social motivation in ASD, spanning neuroscience to intervention. Speakers will present novel research exploring (1) conceptualization of social motivation as a construct with respect to neural and behavioral correlates, (2) relations between social motivation and emotional difficulties as they contribute to social success and challenges, (3) social motivation as a target of naturalistic behavioral intervention, and (4) effects of social skills intervention on ERP correlates of social motivation among teens with ASD. As a whole, this panel presents a translational perspective on social motivation that bridges neural mechanisms to clinical outcomes.

224.001 *(Panel)* Assessing the Construct Validity of Social Motivation

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Background: The notion of social motivation deficits as a core construct of autism spectrum disorder (ASD) has been a source of great interest in recent years (Dawson et al., 2005; Chevallier et al., 2012). While recent meta-analyses support the role of social motivation in ASD (Clements et al., 2018), other theoretical (Jaswal & Akhtar, 2019) and empirical (Garman et al., 2016) work suggest its role to be inconsistent at best, and perhaps even contradictory. One source of these conflicting findings is the lack of consistent and clear construct specification of social motivation (Keifer, Dichter, McPartland, & Lerner, 2019). To date, no known study has psychometrically evaluated the validity of measures of social motivation in ASD.

Objectives: We sought to test the convergent and divergent validity of a measure of social motivation in ASD.

Methods: 56 youth with ASD (M_{age}=12.06, SD_{age}=2.95; 73% male) completed social skills ratings (SSIS; Gresham & Elliott, 2008) and a facial recognition task (Nowicki et al., 2004) with concurrent EEG measurement (specifically the N170, an event-related potential often associated with ASD symptoms; Kang et al. 2018). Their parents completed a measure of social motivation (the social motivation subscale of the Dimensions of Mastery Questionnaire [DMQ], representing social persistence; Morgan et al., 2014), as well as other social-emotional and behavioral measures (SSIS, SRS-2 [Constantino et al., 2012], CASI-5 [Gadow & Sprafkin, 2013], MASC-2 [March, 2013]). To test convergent validity, we examined associations of DMQ with social-emotional and EEG measures hypothesized to be related to social motivation (SRS-2, SSIS, and the N170 latency). To test divergent validity, we examined associations between DMQ and demographic and behavioral variables hypothesized *not* to be related to it (Age, gender, IQ, ADHD and anxiety symptoms).

Results: The DMQ subscale correlated with SRS-2 total score and both parent- and self-reported social skills on the SSIS, and the N170 latency to faces (Table 1). The association between the DMQ and SRS-2 was driven by relations with social motivation (convergence on the same construct), social awareness, communication, restricted interests & repetitive behaviors (all r<-.292; all p<.05), but not social cognition (p=.20). The DMQ's association with the parent-report SSIS was driven by empathy and engagement (r>.290, p<.05), and self-report SSIS by cooperation, assertion, responsibility, empathy, and engagement (r>.292, p<.05). The association with N170 latency was driven by high intensity faces (r=.291, p=.034). As hypothesized, the DMQ was not associated with most demographic and clinical variables (parental age, ADHD or anxiety symptomatology, parent- or self-reported problem behaviors, composite, verbal, or nonverbal IQ scores, or sex) except for child age (Table 1).

Conclusions: Overall, these results largely support the convergent and divergent validity of the DMQ as a measure of parent-reported social motivation in youth with ASD. Notably, even more distal hypothesized convergent variables (child self-report social skills; N170 ERP) correlated with the DMQ, supporting the utility of social motivation as an observable construct. Future investigations should examine the reliability and other forms of validity of the DMQ to systematically evaluate this instrument as an index of social motivation.

224.002 *(Panel)* Contributions of Social Motivation and Emotion Dysregulation to Social Outcomes Among Children and Adolescents with Autism Spectrum Disorder

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Background: Prominent hypotheses suggest that early-emerging alterations to social motivation underlie social difficulties in autism spectrum disorder (ASD), and neurophysiological and behavioral studies support social motivation as a contributor to social cognition and behavior. However, links between social *motivation* and social *outcomes* are not straightforward, with influence from any number of individual differences. In particular, recent work from our group suggests that emotional difficulties may blunt the facilitative effects of social motivation on social functioning, and that these relations may be further moderated by sex.

Objectives: In a large sample recruited intentionally for balanced sex ratios, we sought to explore (1) contributions of social motivation to social skills and social problems among youth with and without ASD, (2) possible moderating effects of emotional difficulties across a number of symptom areas, and (3) possible moderation of social-emotional associations by diagnostic group and participant sex.

Methods: Data were collected within a large, multisite study spanning four U.S. sites, yielding a total of 309 children and adolescents (47% female; mean age=12.6 years, SD=2.95, range=8-18 years) with ASD (n=147) or with typical development (n=162). All participants were verbally fluent, without intellectual disability, and well-characterized clinically. Social motivation, social skills, and social problems were assessed via the Social Reciprocity Scale, 2nd edition, Vineland Adaptive Behavior Scales, 2nd edition, and Child Behavior Checklist, respectively. Emotion dysregulation was assessed via the Child Behavior Checklist (internalizing, aggression, attention concerns) and the Repetitive Behavior Scale, Revised (self-injurious behavior). Direct effects of emotion dysregulation and interactions between social-emotional variables were tested with a series of regression models.

Results: For participants with and without ASD, stronger social motivation was associated with stronger social skills (rs>.3, ps<.001) and fewer social problems (rs>.21, ps<.01) but sizeable variation in social outcomes remained unexplained. Among those with ASD, models including emotional difficulties accounted for significant variance in social problems, with internalizing (r^2_{adj}=.33, p<.001), aggression (r^2_{adj}=.40, p<.001), attentional concerns (r^2_{adj}=.39, p<.001) and self-injurious behaviors (r^2_{adj}=.11, p<.001) emerging as more robust predictors of social outcomes than social motivation. This pattern was largely consistent across sexes. Among typically developing individuals, sizeable interactive effects emerged as well, such that associations between social motivation and broader social outcomes were moderated by internalizing symptoms (r^2_{adj}=.52, p<.001), aggression (r^2_{adj}=.31, p<.001), and attentional difficulties (r^2_{adj}=.30, p=.009). Effects varied according to sex, but models for some forms of emotion dysregulation accounted for over half of the variance in broader social outcomes (e.g., among males, aggression: r^2_{adj}=.83, p<.001).

Conclusions: Although social motivation does appear to promote social skills and attenuate social difficulties among verbal youth with ASD, it is not sufficient for understanding broader social outcomes. Instead, difficulties with emotion regulation appear to overshadow social motivation as a predictor of outcomes. Clinically, these results highlight the need to assess and treat emotion dysregulation in the service of social functioning. Theoretically, findings reinforce both the value and the nuance of social motivation as a construct for understanding social outcomes, and underscore the need to consider social motivation in relation to other individual differences.

224.003 *(Panel)* Social Success: Using a Naturalistic Behavioral Intervention Approach with Parent Training to Enhance Child Motivation to Initiate Peer Interactions

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Background: Social deficits in children with Autism Spectrum Disorder (ASD) are difficult to remediate and can have long-term negative consequences (e.g., loneliness, lower self-worth, impaired ability to function in the community, and weaker academic performance). As social functioning requires child social motivation, there is a critical need for treatment models that directly enhance motivation to initiate and interact with peers. Naturalistic developmental behavioral intervention strategies applied in inclusive settings have particular promise given their emphasis on natural contingencies and enhancing child social motivation.

Objectives: This presentation reviews child outcome data from a randomized controlled trial of Systematic Use of Cooperative Contingencies to Enhance Social Success (i.e., the Social SUCCESS program). Social SUCCESS is a novel social intervention using naturalistic behavioral treatment strategies which includes both child social groups and parent training which specifically target child motivation to initiate to peers.

Methods: Children with ASD (4-6 years old) were randomly assigned to the Social SUCCESS intervention or a delayed treatment control group (DTG). SUCCESS participants received 12 weekly social group sessions with typically-developing peers, during which therapists arranged cooperative activities to teach and reinforce initiations to peers. Parents also participated in a weekly parent training group to learn naturalistic behavioral strategies for facilitating positive peer interactions during play dates at home, in addition to receiving coaching during social group sessions. Participants in DTG continued stable community-based services. To date, data from multimethod, multi-informant assessments are available for 23 children with ASD (SUCCESS=11; DTG=12).

Results: Following the 12-week treatment, an independent clinician blinded to group assignment rated children in the SUCCESS group as more improved following treatment on the Clinical Global Impressions Improvement Scale (CGI-I; p=0.006). Specifically, the majority of participants in the SUCCESS group (64%) were rated as “Much Improved”, while all the participants in DTG were rated as either “No Change” (45%) or “Minimally Improved” (55%). A new measure of social motivation (Stanford Social Motivation Scale) was also collected as a potential predictor of treatment response. For participants in the SUCCESS treatment, low baseline social motivation was associated with greater improvement in frequency of initiations following intervention based on parent ratings on a Visual Analog Scale (r=-0.815; p=0.002). Standardized measures of social functioning (Vineland-3, SRS-2) and parent use of effective facilitation strategies (i.e., setting up cooperative arrangements, prompting initiations to peers and coaching peers to provide contingent reinforcement) as measured by behavioral coding of videos at baseline and post-treatment will also be discussed.

Conclusions: Findings suggest that naturalistic behavioral treatment and parent training focused on teaching children to successfully initiate to peers shows promise for enhancing social motivation and aspects of social functioning in children with ASD. Implications for design of effective inclusive social skills programming and remediation of core social deficits in ASD will be discussed.

224.004 *(Panel)* Impact of PEERS Social Skills Intervention on Social Motivation and Reward

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Background: Individuals with ASD have social-communication difficulties that impede their ability to form friendships. Social skills interventions for adolescents that target conversational skills and perspective taking (PEERS©) are effective in ameliorating these challenges (Laugeson et al., 2012). However, neural mechanisms of behavioral improvements remain unclear. Event-related potentials (ERPs) can objectively measure differences in brain activity pre- and post- intervention and identify potential underlying mechanisms of change.

Objectives: We measured two ERPs related to social motivation and reward: the stimulus preceding negativity (SPN) measuring reward anticipation, and the reward positivity (RewP) measuring reward processing. Children were presented with rewards accompanied by incidental face or non-face stimuli.

Methods: Brain activity was measured in teens with ASD before (T1) and after (T2) the 16-week intervention, and 16-weeks later (T3) in an immediate treatment (IT) group. Individuals on a waitlist control (WLC) are currently completing the intervention. Neurotypical (TD) teens, age and gender-matched to teens with ASD, had brain activity measured identically but did not participate in the intervention. We report T1 and T2 data for the IT group (N = 7, M = 13.3 yrs) and T1 data for the WLC (N = 8, M = 14.06 yrs) and TD groups (N = 11, M = 13.3 yrs).

Results: *SPN.* Age and SPN amplitude were significantly correlated across groups such that younger children evidenced larger reward anticipation for faces (p = .022). Age was used as a covariate in all analyses.

T1 and T2: Children with ASD evidenced increased reward anticipation from pre- to post-intervention across stimulus types (p = .03). Post intervention, a correlation was observed (p = .016) between SPN amplitude to faces and scores on the social skills improvement system (SSIS). Adolescents with *better social* skills evidenced *smaller* SPN magnitude to faces.

T1: A significant interaction between group and condition was observed (p = .02) —TD adolescents evidenced larger SPN amplitude to non-faces vs. faces; those with ASD evidenced the opposite pattern. Across groups, a correlation was observed (p = .047) between SSIS score and the SPN to faces—teens with *better social* skills evidenced *smaller* SPN amplitude to faces.

Results: *RewP.*

T1 and T2: A marginal correlation was observed (p = .076) between change in the SSIS and the RewP to faces—children with a larger RewP to faces at T1 had greater improvement in social skills from T1 to T2.

Conclusions: This is the first study to compare reward anticipation and processing in both adolescents with ASD before and after PEERS© and well-matched controls. At T1, adolescents with and without ASD differ—neurotypical teens anticipate non-social rewards *more* than social rewards; teens with ASD show the opposite. SPN results suggest that for adolescents with ASD, reward anticipation significantly increases after participation in PEERS©. Brain and behavioral correlations indicate that all teens with better social skills have *less* robust SPNs to faces. Reward processing data suggest that as social skills improve in adolescents with ASD, reward processing of faces increases. The results have important implications for the social motivation theory of autism.

ORAL SESSION — **SOCIAL COGNITION AND SOCIAL BEHAVIOR**

327 - Cognitive and Social-Cognitive Functioning Across Domains

327.001 *(Oral)* Better Cognitive Level, Communicative Gestures and Joint Engagement Behaviors in Toddlers with Autism Spectrum Disorder Predict Better Outcome in Adolescence

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Background: Long-term outcomes for individuals with autism spectrum disorder (ASD) can range from having continuous severe social-communication and functional impairments to nearly typical functioning in adolescence. Very few prospective long-term studies searched for baseline predictors for favorable outcomes. Previous research found that optimal outcome was associated with improved restricted and repetitive behaviors during the first year after ASD diagnosis, less severe parental reports on social interaction symptoms, and early intensive intervention. This is a long-term prospective study that followed toddlers who were diagnosed with ASD until adolescence.

Objectives: -To compare characteristics in toddlerhood (cognitive ability, adaptive functioning and autism severity), birth risk factors, and neurological conditions of three groups in adolescence, one with 'best outcome' (BO) - not meeting cut-off points for ASD and IQ scores ≥85; the second with high functioning HF-ASD, and the third with lower functioning LF-ASD.

-To compare the aforementioned three outcome groups for: the severity of comorbidities that are considered inherited conditions, attention deficit hyperactivity disorder (ADHD), and anxiety symptoms

-To search for characteristics in toddlerhood that may predict future membership in one of the outcome groups

Methods: The study included 69 adolescents, 64 males and 5 females, with a mean age of 13:10 years (SD=1:11), diagnosed with ASD at toddlerhood. Participants (BO-16%; HF-ASD-20%; LF-ASD-62%) underwent a comprehensive assessment of cognitive ability, adaptive skills and autism severity at toddlerhood (T1) and adolescence (T2). In addition, the severity of ADHD and anxiety symptoms was assessed using standardized questionnaires.

Information on birth risk factors, micro/macrocephaly. and developmental regression at toddlerhood were obtained from the baseline medical charts.

Results: Among the behavioral characteristics at T1, less severe autism symptoms - mostly in the social affect domain of the Autism Diagnostic Observation Schedule (ADOS -) were documented for the BO and HF-ASD groups as compared to the LF-ASD group. Of the examined ADOS pro-social behaviors at T1, less severe impairments in ‘frequency of vocalizations directed toward others', 'pointing', 'facial expression directed toward others', 'showing' and 'response to joint attention', were associated with membership in the BO group. BO had also the lowest prevalence of significant T2 inattention symptoms (11.1% vs. 30.8% and 59.5% for the HF-ASD and LF-ASD groups respectively). In addition, the BO group had the lowest percentage of participants with significant symptoms in at least one anxiety subdomain (27.3% vs. 69.2%, 57.1 for the HF-ASD and LF-ASD groups respectively). No significant differences between the three outcome groups were noted in the prevalence of developmental regression, low birth weight, prematurity, assisted reproductive technology, or macro/microcephaly, although their prevalence in the entire group was higher than in the general population.

A linear regression model revealed that higher cognitive ability and better showing and pointing behaviors at toddlerhood predicted belonging to the best outcome group, and in total explained 27% of the variance.

Conclusions: Better cognition and social communication skills, specifically better communicative gestures and joint engagement behaviors in toddlers with ASD, and later lower prevalence of ADHD and anxiety are associated with better outcome in adolescence.

327.002 *(Oral)* Interactive Psychometrics for Autism with the Human Dynamic Clamp: Measuring Interpersonal Synchrony from Sensory-Motor to Socio-Cognitive Domains

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Background: The Human Dynamic Clamp (HDC) is a human-machine interface for studying dynamic bidirectional interaction in real time between a human and a virtual avatar. Interpersonal Synchrony (IS) comprises multiple components, such as socio-cognitive, sensory-motor, and motor skills, as well as adaptive capacities. HDC thus allows to probe IS under controlled and reproducible conditions.

Objectives: Here, we propose to probe the validity of the HDC as psychometric instrument for quantifying social aptitude in neurotypical and Autism Spectrum Disorders (ASDs) children. This condition is frequently found to be associated with difficulties in the ability to attribute mental states to oneself and to others. In addition to these primary deficits in social communication skills, about 80% of children diagnosed with ASDs also show impairments in motor skills and 50% to 80% deficits in perceptual motor performance. Furthermore, ASDs children tend to have more difficulties in IS.

Methods: To study behavioral synchrony, based on the interaction with the HDC avatar, we derived five standardized scores following a gradient from sensory-motor to higher socio-cognitive skills. Our sample comprised 155 individuals (113 with ASDs, 42 typically developing participants; aged 5 to 25 years; IQ>70) who received extensive cognitive assessments. We used normative modeling to normalize the scores across developmental trajectories.

Results: Regression analyses were conducted to predict normalized HDC scores from avatar behavior (cooperative/competitive), human task (in-phase/anti-phase), diagnosis (Controls/ASDs), and age. We observed that children with ASDs tend to have significant lower scores than control participants for motor skills. Sensory-motor skills, task comprehension and socio-cognitive skills significantly improved as age increased. Socio-cognitive skills were also strongly modulated by the difficulty of the ongoing task and the cooperativeness of the avatar.

Conclusions: The weaker performance in ASDs participants for motor skills suggest convergent validity and support motor skills as a developmental marker of children and adolescents at risk with ASDs. Results provide additional evidence of a relationship between sensory-motor and socio-cognitive skills. As we found a significant main effect of age, HDC may be useful to decipher the developmental trajectories of sensory-motor and socio-cognitive skills during real-time social interaction. Through its standardized and objective evaluation, the HDC not only represents a valid paradigm for the study of interpersonal synchrony but also a clinically relevant psychometric instrument for the evaluation and stratification of disorders with a social dimension such as ASDs.

327.003 *(Oral)* Overall Cognitive Functioning Partially Mediates the Relationship between Facial Emotion Recognition Accuracy and Social Impairment Related to Autism Spectrum Disorder Among Adolescents

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Background: Facial emotion recognition (FER) ability is often associated with levels of social impairment for individuals with autism spectrum disorder (ASD; Trevisan & Birmingham, 2016). This finding is frequently interpreted as evidence for the importance of FER in promoting effective social communication and interaction. However, successful FER relies on domain-general cognitive abilities such as sensitivity to spatial relations (Bombari et al., 2013) and verbal ability (Barrett et al., 2007). Moreover, both FER ability and impairments in social communication vary by overall cognitive functioning, as indexed by an intelligence quotient (IQ; Harms, Martin, & Wallace, 2010; Skuse et al., 2009). Therefore, it may be that, in its association with ASD-related social impairment, FER performance accuracy acts as a proxy for overall cognitive functioning. Yet, this relationship has not been directly tested in a large sample of individuals with varying degrees of social impairment. Given the importance of domain-general cognitive abilities to successful FER, we hypothesized that overall cognitive ability would mediate the relationship between FER and ASD related social impairment.

Objectives: To determine if the relationship between FER behavioral accuracy and ASD-related social impairment is mediated by IQ among adolescents with and without ASD.

Methods: One hundred and forty-one adolescents with and without ASD completed a standardized FER task (Table 1). IQ was assessed by the Kaufman Brief Intelligence Test-2 (KBIT-2; Kaufman & Kaufman, 2004). ASD related social impairment was measured using the Social Responsiveness Scale, second edition (SRS-2; Constantino et al., 2012). A model whereby the relationship between FER accuracy and ASD related social impairment is mediated by IQ was tested.

Results: FER accuracy was indirectly related to social impairment through its relationship with overall cognitive ability (Figure 1). Higher FER accuracy was associate with higher FSIQ, and higher FSIQ was subsequently related to lower SRS-2 t-scores. The indirect effect of FER accuracy on SRS-2 T score through FSIQ was significant. Additionally, FER accuracy remained associated with SRS-2 t-score after taking into account FSIQ, although this effect was attenuated.

Conclusions: As predicted, findings indicated that the relationship between FER performance accuracy and ASD-related social impairment was partially mediated by overall cognitive functioning in a large sample of adolescents. Consistent with previous interpretations (Trevisan & Birmingham, 2016), this suggests that the inability to accurately recognize emotional facial expressions of others uniquely predicts impairment in social functioning, and this process is potentiated via differences in cognitive ability. While higher overall cognitive functioning may represent increased use of compensatory processing mechanisms (Rutherford & Troje, 2012), even small aberrations in the ability to recognize facial cues of emotion likely hinders appropriate and sensitive responding to conversational partners (Izard et al., 2001). Thus, the improvement of FER abilities should remain a primary target of social skills interventions for adolescents with ASD-related social impairment, though consideration of how IQ may impact translation of these abilities to social outcomes (i.e., this translation may be especially facilitated for those with greater cognitive abilities) is important.

327.004 *(Oral)* Cognitive Profiles in Toddlers Identified with Autism Spectrum Disorder

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Background: Although prevalence discrepancies in autism spectrum disorder (ASD) across racial and ethnic groups have decreased over time (Baio et al., 2018), disparities remain related to age of diagnosis, access to intervention, and outcomes for children diagnosed with ASD (e.g., Durkin et al., 2017; Zeleke, Hughes, & Drozda, 2019). In the CDC study by Baio and colleagues (2018), the gap in prevalence between Caucasian and African American children has narrowed to a difference of only 1.2 per 1000, yet the rate of intellectual disability remains twice as high in African American (44%) as in Caucasian (22%) 8-year-old children. Parents note developmental concerns by age 36 months for 85% of children with ASD, yet only 42% of children reportedly complete a comprehensive evaluation by this age (Christensen et al., 2019). Recent work by Constantino and colleagues (under review) suggests that African American families experience significant delays in timing of diagnosis relative to first concerns. This work also provides further evidence of a higher burden of intellectual disability found in African American children with ASD.

Objectives: This study contrasted cognitive profiles of African American and Caucasian toddlers within a clinical sample. We hypothesized that African American and Caucasian children who are identified at an earlier time point than the national median may demonstrate less discrepant cross-racial cognitive profiles than children identified later in childhood, possibly due to the progressive effects of health disparities accruing during the period between toddler and school-age years.

Methods: A sample of 285 medically-insured African American (n = 127) and Caucasian children (n = 158) between the ages of 16 and 30 months (M_{age}= 25.22 months, SD = 3.60) were evaluated in an academic medical center clinic and received a diagnosis of ASD. Each child was evaluated using the *Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) Toddler Module*, *Mullen Scales of Early Learning (MSEL)*, and clinician best estimate diagnosis.

Results: When comparing developmental delay as defined by state early intervention eligibility requirements, 95.6% of Caucasian toddlers (n = 151) and 96.9% of African American toddlers (n = 123) met criteria using *MSEL t*-scores within this sample. Focusing on *Visual Reception t*-scores, 48.0% of African American toddlers (n = 61) and 34.2% of Caucasian toddlers (n = 54) fell two standard deviations below the mean. Preliminary analyses controlled for factors such as gestational age, maternal education, and lapse in time between age of first concerns and age of diagnosis. Significant differences (p = .03) in *Visual Reception t*-scores between African American (M = 31.06, SD = 10.44) and Caucasian toddlers (M = 34.32, SD = 10.80) had a small effect size (d = 0.3).

Conclusions: Preliminary exploration within a clinically-referred sample of African American and Caucasian toddlers with ASD indicate less discrepancy in early cognitive skills than those found in school-aged children with ASD. Contrasting the current toddler sample to the CDC sample, a similar percentage of African American children with ASD remains cognitively delayed, whereas there is considerable reduction in developmental delay status in Caucasian children with ASD.

POSTER SESSION — SOCIAL COGNITION AND SOCIAL BEHAVIOR
445 - Social Cognition and Social Behavior Posters

445.001 *(Poster)* A Combinatorial Approach for Determining Social Motivation in Children with and without Autism

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Background: Determining the neural mechanisms that underlie the heterogeneity of social-affective behaviors is challenging in developing children, especially when social-affective processing is disrupted, leading to difficulty in establishing relationships and effectively regulating emotions. The factors that influence the heterogeneity of these social behaviors in both typically developing (TD) children and children with Autism Spectrum Disorder (ASD), for whom disruptions in social behaviors are among the core deficits, are currently unknown.

Objectives: We aimed to determine whether alterations in social behavior in children with ASD are driven by an aversion to, or lack of reward from, social interactions using a combination of remote eye-tracking techniques and detailed behavioral coding of social play.

Methods: We adapted our previously established associative learning paradigm of conditioned place preference (CPP) in young children for use with a social unconditioned stimulus (US). In this paradigm, during an initial preference test (IPT), TD children (30-60 months) and children with ASD (36-66 months) freely explored two neutral rooms in our child-friendly castle. Then, across training trials (TT), children alternated play between the two rooms while one of the rooms, the conditioned stimulus (CS), was paired with the US, a novel and interactive social experimenter. During the final preference test (FPT), children again freely explored both rooms, in absence of the US. Social CPP (sCPP) scores were calculated as the difference in time spent in the social-paired room during the IPT and FPT. Additionally, these children watched a 6-minute video comprised of social and non-social naturalistic scenes as well as cartoon animations. Eye movements were recorded using a Tobii Pro Spectrum eye-tracker and software. Eye-tracking metrics were then used for a supervised machine learning algorithm to predict performance in the sCPP task.

Results: We found significant heterogeneity in social preference in both typically developing children and in children with ASD, with no differences in sCPP scores between groups. The two groups did demonstrate differences in gaze patterns across the video stimuli, though social scenes produced more frequent fixations in both groups. Preliminary machine learning indicated that eye-tracking metrics accurately predicted sCPP class in these same children.

Conclusions: This work provides a more comprehensive understanding of the mechanisms driving social motivation. The heterogeneity of sCPP scores provides a continuous range of social motivation for both groups and may offer a unique opportunity to distinguish the endophenotypes of social behaviors not defined by ASD diagnosis alone. The high accuracy prediction models suggest that the sCPP task and the eye-tracking paradigm may be measuring a similar social motivation construct.

445.002 *(Poster)* A Follow-up Study of Peer Relationships in Youths with and without Autism Spectrum Disorder: A Mediation Analysis of Autistic and Other Emotional and Behavioral Symptoms

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Background: The core features of autism spectrum disorder (ASD) include impairment of social communication and restricted and repetitive behaviors or interests. In addition to the autistic symptoms, literature documents different levels of emotional and behavioral problems commonly seen in individuals with ASD. With age, individuals with ASD may encounter difficulties in the interactions with peers and problems with peers. However, there is limited information about whether autistic features and other emotional and behavioral problems can mediate the outcome of peer interaction and problems with peers.

Objectives: This longitudinal study aimed to investigate the mediation effects from autistic symptoms, inattention, anxiety/depression, and delinquent behaviors on the link from ASD diagnosis at baseline to peer relationships at follow-up.

Methods: A total of 366 youths with a clinical diagnosis of ASD (mean age: 16.7±4.9 years at follow-up; male, 89.1%) and 134 typically developing controls (TDC) were assessed at baseline and follow-up. The ASD group received Autism Diagnostic Interview-Revised interview at both time points and Autism Diagnostic Observation only at follow-up to confirm the diagnosis. The autistic trait was measured by the Chinese version of Social Responsiveness Scale (SRS), and emotional and behavioral problems were measured by the Child Behavior Checklist (CBCL) at baseline. The peer interactions and problems with peers were assessed by using the Social Adjustment Inventory for Children and Adolescents (SAICA) at follow-up. Multiple mediation models were used.

Results: Youths with ASD scored higher in Social Communication, Unique Mannerism, and Social Emotion Subscores (SRS) than TDC. They also had more severe problems of aggressive behaviors, anxiety/depression, attention problems, delinquent behaviors, social problems, somatic complaints, thought problems, and withdrawal (CBCL). At follow-up, ASD youths had more severe problems with peers and less active interactions with peers than TDC. Simple mediation analyses showed that each subscore of SRS and CBCL had significant mediation effects. Multiple mediation analyses showed that impaired social communication and delinquent behaviors mediated the link from ASD to less active interactions with peers at follow-up after controlling for sex, age, and Full-scale IQ. Moreover, we found that social communication impairment and social, emotional difficulty (SRS), as well as attention problems (CBCL), predict problems with peers after controlling for sex, age, and Full-scale IQ. After considering the mediation effects, ASD still significantly predicted more severe impairment in interactions and problems with peers.

Conclusions: Our findings support that ASD youths suffer from more emotional and behavioral problems and impaired peer relationships. The strong links between ASD and impaired peer relationships can be mediated by social communication and emotion impairments, as well as attention problems and delinquent behaviors. Our other analyses did not find parenting style or family support mediated this link. Hence, our findings suggest to develop specific measures targeting on social communication and emotion, attention problems, and delinquent behaviors may partially offset the interactions difficulty and problematic relationship with peers at their adolescence and young adulthood. Future exploration of potential mediators for the link between ASD and impaired peer relationships is warranted.

445.003 *(Poster)* A Quantitative Content Analysis of Autistic Children's Friendship Conceptualizations: Expectations and Transgressions

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Background: It has been argued that autistic and non-autistic people's friendship relationships fundamentally differ (Baron-Cohen, 1991). Yet recent work has demonstrated that autistic and non-autistic children experience some aspects of friendship similarly (Petrina, Carter, Stephenson, & Sweller, 2017). Since friendship can serve as a buffer against adverse social experiences such as bullying (Brendgen et al., 2013) and autistic children can be prone to such acts (Chen & Schwartz, 2010), understanding their friendship conceptualizations is important for practitioners working to support these children's relationships.

Friendship expectations, or attributes and behaviors that children expect their friends to possess and enact (Hall, Larson, & Watts, 2011) and friendship transgressions, or violations of these expectations (MacEvoy & Asher, 2012) can provide a concrete framework for understanding autistic children's friendship conceptualizations (Bottema-Beutel et al., 2019a; 2019b)). However, existing friendship expectation and transgression measures have been designed using the perceptions of non-autistic individuals. Comparing autistic and non-autistic children's perspectives using open-ended interview techniques can provide useful information for the development of instruments that more adequately examine autistic children's friendship.

Objectives: The purpose of this study was to solicit autistic children's friendship expectations and transgressions, and identify differences in the expectations and transgressions described by autistic and non-autistic children.

Methods: 3rd-5th grade autistic (*n*=20) and non-autistic children (*n*=21) matched for mental age were interviewed using a semi-structured protocol probing for friendship expectations and transgressions. We employed quantitative content analysis, which allows researchers to make replicable and valid inferences from qualitative texts to understand social phenomena (White & Marsh, 2006). Units of analysis were statements of friendship expectations and transgressions identified in interview transcripts. A coding scheme was developed by inductively classifying participants' open-ended responses into analytical constructs (Neuendorf, 2017). Researchers blind to group coded interview transcripts for the presence or absence of codes, and, using an intact-group design, $\chi 2$ tests of homogeneity were conducted to identify codes with significant between-group differences.

Results: Tables 1 and 2 provide friendship expectation and transgression codes that emerged from the coding process, and results of $\chi 2$ analyses. No friendship expectations were named by a majority of autistic children. *Social Aggression* was the only transgression identified by a majority of the autistic sample. There were no statistically significant between-group differences for any expectation or transgression categories.

Conclusions: Findings suggest that intra-individual variation in autistic children's friendship conceptualizations may be more critical than variation found between autistic and non-autistic children more generally. Practitioners may need to ask individual children struggling with friendship about their friendship expectations, in order to better support the formation and maintenance of friendships that will conform to their conceptualizations. Researchers may need to present a wide variety of expectations to gain a more comprehensive understanding of children's friendships. Transgressions presented in previous research on autistic children's friendships (*Betrayal, Lack of Validation/Emotional Support, Lack of Instrumental Help, Unreliable Partner)* were identified by less than one-fourth of our autistic sample, suggesting that future work should include other, more salient transgressions (e.g., aggressive acts).

445.004 *(Poster)* ASD Traits Predict Attenuated Social Mimicry in a Subclinical Sample

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Background: Evidence suggests that some problems exhibited by individuals with autism spectrum disorder (ASD) are present to varying degrees in the general population (Skuse, Mandy & Scourfield, 2005). The concept of a Broad Autism Phenotype (BAP) has been used to describe the mild autism characteristics exhibited by individuals who do not clinically meet the threshold of ASD (Reed et al., 2011). The advantage of studying BAP traits in general samples is that it allows one to take advantage of greater range in the expression of particular ASD traits such as reduced ability in social interactions across individuals. Automatic mimicry and the matching of emotional content in facial expressions are reduced in some individuals with ASD (Rogers et al., 2003). However, research has yet to show whether impairment of the automatic mimicry of facial expressions are present in the BAP.

Objectives: The aim of this study was to determine whether social mimicry is attenuated in individuals without ASD who score high on a measure of autism traits and whether poor social mimicry is associated with lower levels of empathy and higher levels of alexithymia, social responsiveness and facial mimicry.

Methods: A total of 42 participants were recruited with an age range of 18 to 37 years. Participant completed the Autism Quotient, Cambridge Behavioural Questionnaire, Perth Alexithymia Questionnaire, and the Social Responsiveness Scale (SRS). Facial mimicry was recorded using electromyography (EMG). Participants passively viewed facial expressions while the activity of the corrugators and zygomaticus muscle was recorded. Average peak activation for happy and sad expressions in millivolt was included as the dependent variable.

Results: As predicted, higher autistic traits were associated with a reduction in muscle response to happy expressions (r = -.39, p =.01). Reduced levels of mimicry were associated with higher level of alexithymia (r = -.40, p = .01), and higher scores on the SRS (i.e., inferior social responsiveness; r = -.44, p = .01). In contrast, muscle activation was positively associated with empathy scores (r = .46, p = .002). In relation to the expression of sadness, reduced muscle activation was associated with higher level of alexithymia (r = -.33, p = .02), and higher scores on the SRS (r = -.32, p = .02).

Conclusions: Individuals taking part in the study did not have a diagnosis of ASD, but those who scored higher on autistic traits showed reduced automatic facial mimicry when viewing happy and sad expressions. These results have implications for families with children with ASD where a parent shows elements of the BAP (Austin, 2005; Hoekstra et al., 2008; Hurst et al., 2007). Potentially, reduced social mimicry may be reduced across some family members, and more research is needed on how mimicry affects dyadic interactions in families when autism is present.

445.005 *(Poster)* Alexithymia Predicts Poor Social Competence in Youth with and without ASD

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Background: Alexithymia, a condition characterized by difficulties identifying and describing one's own emotions, has high co-occurrence with Autism Spectrum Disorder (ASD) and other disorders (Bird & Cook, 2013). There is a need to understand factors that contribute to different strengths or challenges in social competence in youth with and without ASD. One factor that may play an important role in social competence is alexithymia. Specifically, the compromised understanding of others' emotions in people with alexithymia may give rise to problems in social interaction (Poquérusse, Pastore, Dellantonio & Esposito, 2018). Given that alexithymia frequently co-occurs with ASD, and that both populations have difficulties with social interactions, it is of interest to determine whether alexithymia can help to parse some of the heterogeneity in social competence seen not only in individuals with ASD, but also those without.

Objectives: The aim of the study was to explore the relationship between alexithymia and social competence in youth with and without ASD.

Methods: 241 youth, between the ages of 6 and 14, including 120 with (M=10.20; SD =1.91), and 121 without (M=9.50; SD =1.73) ASD. Caregivers rated their child's social competence on the Multidimensional Social Competence Scale (MSCS; Yager & Iarocci, 2013), and alexithymia traits on the Children's Alexithymia Measure (CAM; Way et al., 2010). Children's IQ scores were assessed using the Wechsler Abbreviated Scale of Intelligence, or Stanford-Binet Intelligence Scales, abbreviated version.

Results: Pearson's correlations indicate that CAM scores were negatively correlated with overall MSCS scores (r (239) = -.73, p<.001). Results of a hierarchical multiple linear regression analyses indicated that age, IQ, sex, diagnosis status, and CAM scores account for 71.2% of the variance in parent-reported social competence. Importantly, after controlling for age, IQ, sex, and diagnosis status, CAM scores accounted for an additional 18% of the variance in social competence (ΔR^2 = .18, ΔF (1,235) = 153.513, $p<.001$). Further investigation of the seven domains of the MSCS [social motivation (ΔR^2 = .15), social inferencing (ΔR^2 = .11), demonstrating empathic concern (ΔR^2 = .11), social knowledge (ΔR^2 = .07), verbal conversation skills (ΔR^2 = .11), nonverbal sending skills (ΔR^2 = .22), and emotion regulation (ΔR^2 = .17)] revealed that alexithymia traits significantly negatively predicted poorer social competence in each individual domain of the MSCS after controlling for age, IQ, sex, and diagnosis status (all p values < .001).

Conclusions: The results indicate that greater alexithymia traits predict lower levels of social competence, suggesting that increased difficulty in identifying and describing one's own emotions is associated with poorer social competence. Additionally, alexithymia predicted overall social competence in all seven individual domains of social competence over and above age, IQ, sex, and diagnosis status. This research contributes to the understanding of the factors associated with the development of social competence in youth with and without ASD and potential targets for the design of interventions to improve social competence.

445.006 *(Poster)* Attention to Emotional Faces and Associations with Emotion Recognition and ASD Traits in College Students

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Background: Attention to socially-relevant information, particularly faces, promotes social interactions (Chun et al., 2011). Studies have found that individuals with ASD show less attention to core features of faces and correlations between social attention and adaptive function (e.g., Klin et al., 2002). Work has also found differences in attention to faces when examining non-ASD participants endorsing low vs. high levels of ASD traits (e.g., Chen & Yoon, 2011). Swanson and Siller (2014) studied ASD traits on a continuum in non-ASD adults and found that fewer traits related to better attention to socially-relevant information.

Objectives: The current study expands on past work with a non-ASD sample to look at attention to faces as it relates to emotion recognition and ASD traits. These traits will be examined both continuously and categorically.

Methods: Participants included 80 college students. Gaze data was collected using an SMI RED 120Hz eye-tracker as participants viewed 24 emotional faces (fearful, happy, neutral) from the NimStim database (Tottenham et al., 2009). Each image was displayed for three seconds. Afterwards, participants completed the Social Responsiveness Scale, Second Edition (SRS-2; Constantino & Gruber, 2012), a measure of ASD traits that has been used in ASD and non-ASD samples, and the Reading the Mind in the Eyes test (RMET) of emotion recognition (Baron-Cohen et al., 2001). Eye-tracking variables focused on number of fixations and proportion of looking time to eyes and mouth (proportions divided by time on face).

Results: Two 2 (Region: mouth, eyes) x 3 (Emotion: fearful, happy, neutral) repeated-measures ANOVAs were conducted, with parallel results for number of fixations and proportion of time: main effects of Region (eyes > mouth, *p*s< .001) and Emotion (fearful < happy = neutral, *p*s< .005), and Emotion x Region interactions (*p*s< .001; Figure 1). Correlations between eye-tracking variables (collapsed across emotions), RMET, and SRS-2 Total t-scores were conducted. Significant positive associations were found between both measures of attention to eyes and RMET (*r*s> .29, *p*s< .01), but no relations were found with SRS-2 (*r*s< .14, *p*s> .23). Exploratory analyses then divided the sample based on SRS-2 t-scores based on the cutoff of 59 to create groups high (*n*=19) and low (*n*=61) on ASD traits. Neither group showed relations between eye-tracking and SRS-2. The low traits group showed significant associations between both measures of attention to mouth and RMET (*r*s< -.26, *p*s< .05), and between proportion of time on eyes and RMET (*r*= .31, *p*= .017). For the high traits group, the only association was between number of fixations to eyes and RMET (*r*= .58, *p*= .023; Figure 2).

Conclusions: Overall, we found a positive relationship between attention to eyes and emotion recognition in college students, but no direct associations were found between social attention and ASD traits. When looking separately at groups high and low on ASD traits, differential relations between attention and emotion recognition were found. This work highlights the value of examining ASD traits both continuously and categorically to better understand the associations between ASD-related characteristics and emotion processing.

445.007 *(Poster)* Attention to Faces in Children with Autism Spectrum Disorder

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Background: Research has often pointed to an overall reduction in the attention to social stimuli, such as faces, and has been hypothesised to underlie social difficulties in autistic children. Previous findings have indicated that while significant differences in attention to faces between ASD and TYP cohorts are evident in the presence of objects of high autism interest (HAI, e.g. cars), these differences lose their significance in the presence of objects of low autism interest (LAI, e.g. household items). Furthermore, significant associations with popular measures of social disability have not been replicated (Unruh, 2016). The variability in social attention literature calls for replicability studies to support published findings and facilitate understanding into the nature of social attention impairments in ASD and their relationship with social disability.

Objectives: The aim of this study was to replicate previous findings identifying differences in attention to faces in the presence of high- and low-autism interest objects using an established visual preference paradigm.

Methods: Thirty typically developing children (mean (SD) age: 7.4 (2.63) years) and 34 children with ASD (mean (SD) age: 8.2 (2.58) years) were presented with 20 trials of images containing a face paired with a HAI or LAI object while eye tracking measures were taken. As indices of social orientation and attention, the dependent variables latency to first fixate to face and first fixation duration to face were calculated. Participants were also administered the Leiter-R nonverbal IQ test, and the Social Responsiveness Scale – Second Edition (SRS-2).

Results: Compared to the TYP group, latency to first fixate to face was significantly greater in the ASD group when paired with either HAI or LAI objects (p = .001). When paired with a HAI object, first fixation duration to face was significantly reduced in the ASD group (ASD: Mean (SD) = .26 (.09) TYP: Mean (SD) = .35(.18), p = .009). There was no significant difference between groups when a face was paired with a LAI object (ASD: Mean (SD) = .29 (.09), TYP: Mean (SD) = .34 (.21), p = .50). There were no significant associations between social orientation and attention indices and SRS-2 Total scores across groups.

Conclusions: Contrary previous findings, current results suggest that in ASD, divergence in social orientation was present regardless of interest level of competing non-social stimuli. Influence of object type in ASD was evident when calculating the first fixation duration variable, indicating a reduction in the maintenance of attention to social stimuli, but only in the presence of HAI objects, supporting previous findings. Additional research using larger sample sizes is warranted given the inconsistencies with published literature.

445.008 *(Poster)* Atypical Sense of Agency in Autism: Intentional Un-Binding at the Implicit Level

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Background:

Generating an action triggers a subjective experience called 'sense of agency' (SoA), of central importance in social and motor cognition. Cue integration models (Synofzik et al., 2013) suggest that SoA can arise at an implicit, pre-reflective level that can be assessed via Intentional Binding (IB). IB is a *compression* of the perceived time interval between one's movement and its consequences, when compared to two external events (Haggard et al., 2002). Implicit SoA is believed to rely mostly on the integration of sensorimotor prospective (before action) and retrospective (after action) signals, but could also be influenced by social context. In a task where participants had to press a button to create a visual outcome, Sperduti and al. (2014) have found that IB is abolished in autism, offering first evidence of altered implicit SoA in autism. This points to a difference in the underlying integration principles by which sensorimotor and social cues are integrated.

Objectives:

We sought to characterize cue integration in autism by assessing the relative contributions of prospective/retrospective sensorimotor and social cues to implicit SoA, as measured by IB.

Methods:

To date, 10 autistic (M=26.6 years) and 7 neurotypical (M=30.14) participants were recruited. A validated task of movements with ballistic visual outcomes was administered. We manipulated social context and feedback position to alter the relative availability/reliability of sensorimotor and social cues. We investigated IB using a temporal reproduction method (Humphreys & Buehner, 2010) and calculating a relative temporal reproduction error (RTRE). We ran a repeated measures factorial ANOVA using a linear mixed model approach with social context (one, two agent), experimental conditions (observation; no, small, large feedback alteration), and groups (autistic, neurotypical) as independent factors.

Results:

The mixed model for RTRE showed significant main effect of Group ($F(1,17)$=5.757; p<0.05) and significant interaction of Group X Condition ($F(3,3553)$=16.263; p<0.001). Post-hoc pairwise comparisons (Bonferroni corrections) revealed differences in RTRE levels across groups for each feedback alteration conditions (p<0.05), but not for the observation condition. Intragroup differences in RTRE levels across feedback alteration conditions were not significant. However, intragroup differences in RTRE levels between the observation condition and each feedback alteration condition were significant in both autistic (p<0.005) and neurotypical (p<0.001) groups.

Conclusions:

Our preliminary results corroborate previous findings showing atypical functioning of implicit SoA in autism. However, unlike Sperduti and al. (2014) who saw IB as abolished in autism, we detected in the autistic group an effect of intentional *un*-binding, that is, an *expansion* in the perceived time intervals between intentional actions and their consequences, while for the neurotypical group, we found the expected temporal *compression* of perceived time (IB effect).

We also found that implicit SoA was only influenced by prospective sensorimotor cues for both autistic and neurotypical groups, whereas manipulating social context and reliability of retrospective sensorimotor cues (feedback congruency) had no effect on IB strength.

This suggests that implicit SoA is based upon similar cues in autism, but that these prospective sensorimotor cues create an opposite implicit experience of being the author of an action (*un*-binding vs binding).

445.009 *(Poster)* Atypical Social Behavior Is Associated with More Positive Interaction Among Peers with Autism Spectrum Disorder.

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Background: Recent literature has suggested that atypical patterns of social behavior in those with Autism Spectrum Disorder (ASD) may represent unique, not diminished, patterns of social engagement (Heasman & Gillepsie, 2018). Additionally, atypical social communication ability may be associated with increased positive first impressions as rated by peers with ASD (Granieri et al., 2019). Thus, it may be that such impressions arise from differences in the peer interaction elicited by youth presenting with atypical social communication. However, no studies have examined the impact of atypical social communication ability on actual interactions between peers with ASD.

Objectives: This study aimed to explore the effect of atypical communication ability on interactions between peers with ASD. A secondary aim was to examine effects on parent-ratings of these same youth, to better understand the discrepancy between peer interaction among youth with ASD and expectancies of their parents.

Methods: 55 youth with an IQ≥70 and ADOS-2-confirmed diagnoses of ASD participated in 1.5 hours of small group interaction (Table 1). Atypical social behaviors (vocalizations, gestures, eye-contact, facial expressions) were indexed using clinician-report from the ADOS-2 (Lord et al., 2012). Peer interactions were observationally coded from unstructured peer interaction during the session using the social interaction observation scale (SIOS; Bauminger, 2002). Reliability of codes for overall (ICC=.768), positive (ICC=.947), negative (ICC=.924), and low-level (ICC=.775) interactions was excellent. Perceived level of social skills (Gresham & Elliott, 2008) and social motivation (Morgan et al., 2011) were indexed using parent-report. ADOS-2 items were entered into generalized estimating equations (accounting for groupwise nesting) predicting social behavior according to observers and parents.

Results: Those with *moderate amounts* of atypical vocalizations had *more* positive interactions and *more* negative interactions (See Table 2). Those with *more* atypical gestures had *more* negative interactions. However, only those with *large amounts* of atypical gestures had *fewer* positive interactions, *fewer* overall amounts of interaction and were reported by parents as having *lower* social motivation. Those with *less* well-modulated eye contact had *more* overall interaction, despite being reported by parents as having *poorer* social skills. Lastly, those with *more* atypical facial expressions had *more* positive interactions and *fewer* low level interactions, but were also reported by parents as having *less* social motivation. Additionally, only those with *large amounts* of atypical facial expressions also had *more* negative interactions.

Conclusions: Similar to previous literature (Sturm et al., 2017), parents of children with ASD were more likely to report low social skills and motivation when their child presented with more atypical behaviors. However, our findings extend Granieri et al., (2019), suggesting that these same nonverbal behaviors were associated with more interactions (positive and negative) among peers with ASD, reinforcing the presence of unique – but not necessarily ineffective – patterns of communication among individuals with ASD (Heasman & Gillespie, 2018). Findings thus suggest that parental expectations of normative social behavior may not reflect behaviors that lead to successful interactions among peers with ASD, and indicate the potential benefit of reframing assessment and interventions which aim to target these expressive behaviors.

445.010 *(Poster)* Autism Inclusion Training Improves First Impressions of Autistic Adults

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Background: Stigma towards autistic individuals remains common (Someki et al., 2018), and evidence suggests that peers form negative first impressions of autistic adults and report a reluctance to interact with them (Gillespie-Lynch et al., 2015; Sasson et al., 2017). These judgements and behaviors can negatively affect the social experiences of autistic adults. More optimistically, however, perceptions of autistic adults are more favorable among neurotypicals with increased autism knowledge (Sasson & Morrison, 2019), suggesting that increasing autism knowledge in the general population may improve social outcomes for autistic adults.

Objectives: The current study explores whether a brief inclusion training program designed to increase autism knowledge and sensitivity improves perceptions of autistic adults among college undergraduates.

Methods: Undergraduates (n = 198) were randomly assigned to one of three conditions: general mental health, autism inclusion, or no intervention. For the general mental health and autism inclusion conditions, participants watched a 25-30-minute-long video on either general mental health diagnoses (e.g. depression, anxiety) that did not mention autism, or one adapted from a module developed by Dr. Grace Iarocci that focused on autism and related issues (e.g., social disability, sensory sensitivity, autistic strengths, and neurodiversity). All participants then viewed 10-second videos of twenty autistic adults (stimulus participants; see Sasson et al., 2017), half including an accurate diagnostic label and half with no label, and evaluated each using the First Impressions Scale (Sasson et al., 2017) to assess impressions of six social traits and interest in future interactions.

Results: Multi-level modeling examined the effects of training condition, diagnostic label, and the interaction between them.

Stimulus participants with a diagnostic label were rated significantly more favorably on nine items (p<.001 for eight of them; p=.037 for dominance). Ratings for "I would feel uncomfortable sitting next to" did not improve, and actually decreased when a diagnostic label was included (p =.001).

Undergraduates in the autism inclusion condition rated the stimulus participants more favorably on intelligence (F(197)=18.52, p<.001) and "hanging out with" (F(197)=2.96, p = 0.05) compared to participants in both the general mental health and control conditions, and more favorably on "sitting next to" relative to the control condition F(198)=3.01, p=0.05). No significant interactions were found between condition and diagnostic label for any of the 10 items.

Conclusions: Interventions seeking to reduce social disability in autistic adults have typically focused on improving their social cognition and social skill, with mixed success (Bishop-Fitzpatrick et al., 2014; Gates et al., 2017). Here, we demonstrate that an "intervention" focused on increasing autism knowledge and acceptance within a sample of college students can improve perceptions of autistic people, over and above general mental health training. Most notably, autism inclusion training increased two ratings related to social interest and acceptance of autistic adults. Whether such improvements would extend beyond the immediate testing or translate to real-world environments are open questions warranting future study. Such evidence is needed before extending the preliminary findings reported here to broader educational and professional settings to help improve the social experiences of autistic adults within neurotypical-dominated environments.

445.011 *(Poster)* Baseline Arousal Modulates Face Scanning in Autism Spectrum Disorder

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Background: Atypical arousal has been proposed to be the potential mechanisms underlying atypical social behaviors in autism spectrum disorder (ASD). For example, the popular social motivation theory (Chevallier et al., 2012) stated that ASD find social information less rewarding and salience than TD, thus have reduced motivation to look at them. On the contrary, the eye avoidance hypothesis (Tanaka & Sung, 2013) and the intense world theory (Markram & Markram, 2010) proposed that direct eye contact elicits anxiety and discomfort in ASD. Arousal has been hypothesized to play an important role in attention to social stimuli in ASD (Cuve, Gao, & Fuse, 2018), and has attracted much research attention. Many studies have investigated tonic/baseline arousal and arousal level during tasks separately using pupillometry when viewing social and non-social objects (e.g., Martineau et al., 2011). However, few researches focused on the association between baseline arousal and the task performance in ASD.

Objectives: The main purpose of this research is to examine how attention to objects with different levels of social saliency vary during the spontaneous fluctuation of baseline arousal in ASD, reflected by their pupil diameter. We also concern whether baseline arousal influences attention in ASD and TD in different ways.

Methods: Thirty-one children with ASD and 22 TD children participated in the current study. Participants were asked to scan face and house pictures freely and then tell whether they like the picture or not. These two categories of pictures were presented separately in two blocks (see Figure 1). We recorded eye movements and used pupil diameter as a proximate indicator of arousal level. Three areas of interests (AOIs) were defined: the eye region of face, the whole region of face, and the whole region of house. Using these AOIs we established a hierarchy of social saliency from strong to weak.

Results: We tested the effect of baseline arousal (averaging pupil diameters 1000 ms before stimuli onset) on single-trial basis with subjects as the random effect (Figure 2). We observed negative correlations between baseline arousal and eye looking time as well as face looking time in both ASD and TD groups. Importantly, the impact of baseline arousal on eye looking time was more pronounced in ASD than TD, but its impacts on face looking time were approximately the same in ASD and TD groups. As a comparison, no significant association was found between baseline arousal and house looking time in either group. In addition, we found that the variance of baseline pupil diameter was larger in ASD group than TD group, implying that the arousal level of ASD is more unstable.

Conclusions: We found that baseline arousal level was negatively associated with attention to eyes and face, but not house in ASD and TD. Baseline arousal influenced attention to eyes greater in ASD than TD. Our study contributed to a more comprehensive understanding of the arousal atypicality in ASD, and its role in the social attention in ASD.

445.012 *(Poster)* Bidirectional Disconnection between Autistic and Neurotypical Adolescents: A Mixed-Methods Exploration on Autistic and Neurotypical Peer Interaction in Inclusive Context

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Background: An increasing number of autistic adolescents are included in general education, yet their social engagement with neurotypical peers remains challenged. Little research has examined the complex peer interaction among autistic and neurotypical adolescents in inclusive contexts. Further, while peer interaction in adolescence emphasizes peer behaviors and acceptance, research primarily focuses on autistic social behaviors rather than the interplay between autistic and neurotypical behaviors. Investigating bidirectional social behaviors in autistic, neurotypical, and autistic-neurotypical interactions can shed light on the disconnection presented in autistic and neurotypical peer interaction.

Objectives:

1. To investigate bidirectional social behaviors among autistic and neurotypical adolescents in an inclusive school-club, including (a) autistic-to-neurotypical, (b) neurotypical-to-autistic, (c) autistic-to-autistic, and (d) neurotypical-to-neurotypical social behaviors
2. To describe characteristics of disconnected peer interactions among autistic and neurotypical adolescents in comparison to reciprocal interactions

Methods: This sequential explanatory mixed-methods study observed natural peer interaction among six autistic adolescents (grade 6-8, one female, IQ>75) and their six neurotypical peers (grade 6-8, two females) in an inclusive design and making school club.

Part 1 (Quantitative): To quantify participant social behaviors, a structured behavior observation on videotapes of 14 45-minute school-club sections was conducted. Trained observers coded (1) each verbal and non-verbal *social initiation*, including its intended *social partner* (autistic/ neurotypical/ or more than 1 partner), *type* (seeking/ sharing/ attending/ offering/ joking), *purpose* (social/functional), and *outcome* (responded/ not responded), and (2) each *social response,* its *quality* (topic-extending/ topic-relevance/ tangent), and whether the conversation is further *continued* (responded/ not responded). Interrater agreement was above 85%.

Part 2 (Qualitative): Based on the structured behavior coding, we identified disconnected peer interactions defined as (1) not-responded social initiation and (2) not-responded social response, both of which stopped continued interaction. Content analysis of the disconnected interactions over videotapes and transcription was conducted to describe and explain the disconnection.

Results:

While autistic and neurotypical adolescents had comparable rates of social initiation and response, they presented a clear preference for same-group social partners that related to their social initiation type and outcome. Participants of each group tended to choose social partners within the same group. Autistic adolescents interacted more with their autistic peers than neurotypical peers, and vice versa ($p<0.001$, Fig. 1). Further, same-group social initiations were more likely to yield a response than cross-group social initiations in both autistic and neurotypical adolescents ($p<0.001$, Fig. 2). Dominant types of social initiations were contingent upon the group and partner ($p=0.04$, Fig. 3). For both autistic and neurotypical adolescents, same-group social initiations were primarily to share thoughts or experience (43% and 44% of total initiations by autistic and neurotypical adolescents, respectively), while cross-group initiations were to seek help or objects (39% and 38%). Qualitative characteristics of disconnected interaction will be discussed.

Conclusions: By examining bidirectional social behaviors, we found a reciprocal disconnection between autistic and neurotypical adolescents in inclusive interactions. Both autistic and neurotypical adolescents showed more initiation and higher responsiveness in same-group than cross-group peer interactions. These findings emphasize a bidirectional mismatch between autistic and neurotypical interaction.

445.013 *(Poster)* Camouflaging Autistic Traits: Examining the Relationship between Severity of Traits, Timing of Diagnosing, and Educational Support in Adolescents and Young Adults with Autism

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Background: Through better detection and intervention, adults on the spectrum are now able to report good outcomes (e.g. graduating, finding employment), but still struggle in daily life, including navigating higher education. Young adults have begun reporting a high degree of anxiety, depression, and other social problems due to what is described as “camouflaging” their behaviors (Hull et. al., 2019). These individuals often also seem to be of normal or above average intelligence and find their way to college, yet continue to struggle with social norms and proper integration into the workforce or in holding down a job. Because a student may camouflage their autistic traits in structured environments by mimicking, complying, or obeying, a teacher may not see flags to ask for an evaluation or refer to special education. Parents, however, see their child in every other aspect of their life and have a unique perspective to the daily struggles that no other observer can report.

Objectives: The goal of this study was to identify what relationships exist between severity of autistic traits and possible camouflaging of traits (e.g. masking/compensating) in early (age 0-11) versus late (12+) diagnosis of autism spectrum disorder. The current study surveyed parents of children ages 12-24 with an autism spectrum disorder diagnosis.

Methods: A revised Social Responsiveness Scale-2 (Rutter, 2003), Strengths and Differences Questionnaire (Goodman, 1997), and demographic questions on age of diagnosis, interventions, and co-occurring disorders was created for parents of children currently ages 12-24 with an ASD diagnosis. Online surveys were collected from five online parent support groups in the US, Canada, UK, and Australia.

Results: Early detection and diagnosis correlated with a higher degree of autistic traits and fewer camouflaging behaviors. Children with a diagnosis later than age 12 had a wider variety of autistic traits reported and greater degree of camouflaging.

Conclusions: It is hypothesized that a child will camouflage for as long as their cognitive load can tolerate, and right around puberty this could reach the limit of social understanding and communication, thus leading to an autism diagnosis. Signs for early identifiers of camouflaging traits and coping are suggested.

445.014 *(Poster)* Computerised Assessment of Motor Imitation (CAMI) during a One-Minute Task Distinguishes Children with Autism with High Accuracy

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Background: Imitation is an early-emerging and crucial mechanism for social bonding and learning in typically-developing (TD) populations. Mounting research shows motor imitation deficits in autism spectrum conditions (ASC) and imitation-based intervention techniques aim to improve social-communicative functioning in ASC. Although imitation assessments offer promising avenues for early diagnosis and treatment, the scalability of these assessments is poor due to (a) the need to manually identify the important components of the movements being imitated, (b) requiring highly-trained coders to rate imitation performance, (c) subjectivity of imitation performance ratings, and (d) imitation tasks being lengthy. To address these issues, we developed an algorithm that automatically assesses performance from a one-minute imitation task and accurately classifies children into diagnostic groups.

Objectives: To develop a computerised assessment of motor imitation (CAMI) algorithm that objectively assesses imitation performance through automatically detecting the important components of a movement segment.

To examine how well imitation scores obtained from CAMI classifies the children into diagnostic groups (ASC vs TD) and how well they are associated with other known social and motor impairments in ASC.

Methods: Forty-eight children aged 8-12 years (females: 3 ASC, 3 TD) participated in a "dance imitation" game, during which they imitated a video avatar as she performed some unfamiliar dance moves across three one-minute trials. The children's motion data were recorded through two Kinect Xbox depth cameras at 30 frames-per-second, one placed in front of and one behind the children. The children's motion data was compared to the avatar to assess imitation performance.

CAMI algorithm performed dynamic time warping to evaluate the similarity between the child's and the avatar's motion data. Using metric learning, it automatically detected the important joints for each movement segment and returned an imitation performance score that considered not only spatial positions but also timing differences between the child and the avatar.

Results: Children's scores from the three trials were averaged to obtain a single imitation score. We confirmed the validity of CAMI by comparing its results to imitation scores obtained through human coding conducted on the same dataset (r= .917, p<.0001). A support Vector Machine (SVM) classifier trained in a 5-fold cross-validation scheme using CAMI's imitation scores revealed superior classification ability (accuracy= 82.1%) as compared to the human coding method (accuracy= 74.3%; Figure-1). Finally, we found that the lower imitation scores were significantly associated with poorer social-communicative function (parent-report Social Responsiveness Scale: r= -.501, p=.001), poorer motor ability (Movement Assessment Battery for Children-2: r= .608, p<.0001) and more errors in the Florida Apraxia Battery modified for children (r= -.655, p<.0001, Table-1).

Conclusions: This brief (one-minute), highly engaging (videogame format) algorithm can validly assess imitation performance and moreover, is superior at distinguishing ASC from TD than human coding methods. Further, we found robust associations of CAMI performance and both social-communicative and motor impairments in children with ASD. The findings indicate that the CAMI algorithm is a promising, highly scalable tool for assessing children with ASD given it is brief, engaging and does not require special training by clinicians and parents.

445.015 *(Poster)* Contagious Itching Is Heightened in Children with Autism Spectrum Disorders

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Background: Theories of *embodied cognition* speculate that the means by which we develop empathy is by mentally simulating the experiences of others, as we embody their actions. Sharing motor – and thus, neural – representations with social partners may be especially important early in development, as embodying the actions of others may allow the body to implicitly feel and assign meaning to the actions of others. Therefore, the exploration of emotional contagion in individuals with ASD may shed light on early developmental processes that go awry in autistic development.

Contagious yawning in individuals with ASD appears to be reduced across a variety of contexts (Arnott, Singhal, & Goodale, 2009; Giganti & Esposito Ziello, 2009; Helt et al., 2010, 2019; Senju et al., 2007). Susceptibility to contagious laughter is also reduced in ASD, and both yawning and laughing contagion are inversely correlated with ASD severity (Helt et al., 2010, 2019). Less is known about other contagious behaviors, that may tap different emotional processes or depend less on visual attention to the face and eyes.

Objectives: In the current study, we explore the phenomena of contagious *itching*, yawning, and laughing and their respective relationships to empathy and autism symptoms in typically developing children and children with ASD.

Methods: 55 children with Autism Spectrum Disorder (ASD) and 106 typically developing (TD) children, matched for mental age (n=53) or chronological age (n=53; see Table), watched a series of videos in which an actor would itch, yawn, or laugh, and were coded for contagious behaviors. Children in the control group completed the MDEES, a measure of empathy.

Results: Contagion was significantly different across conditions, p<.001, η^2=.06; itching was the most commonly contagious, followed by laughter, and finally yawning. The main effect of Group was not significant, p=.21, η^2=.02, but the Group by Condition interaction was significant and large, p<.001, η^2=.23, suggesting that the three groups responded to the three target contagious behaviors in different ways. Post-hoc pairwise comparisons demonstrated that children with ASD were less likely to yawn and laugh contagiously relative to controls, but were *more* likely to itch contagiously (see Figure). In the ASD group, ADOS scores were positively correlated with itching (r(52)=.43, p=.001), but unassociated with yawning (r(52)=-.21, p=.12) or laughing (r(52)=-.07, p=.62). In controls, empathy was positively correlated with both contagious yawning (r(103)=.46, p<.001) and laughing (r(103)=.33, p=.001) but unassociated with contagious itching (r(103)=-.03, p=.73).

Conclusions: Consistent with previous literature, children with ASD were less likely to yawn or laugh contagiously compared with their TD peers. However, children with ASD showed *increased* susceptibility to contagious itching compared with their TD peers. Contagious yawning and laughter were positively correlated with emotional empathy in the TD group. In contrast, contagious itching showed no relationship to empathy, and was positively correlated with autism symptom severity in the ASD group, suggesting that contagious itching is associated with distinct social-emotional phenomena from contagious yawning and laughter, and providing novel insight into empathy differences in this population.

445.016 *(Poster)* Discovr-a; Virtual Reality Social Cognition Training for Adults with Autism

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Background: Deficits in social cognition are among the most challenging aspects of autism spectrum disorder (ASD), impairing individuals throughout their lives. Building relationships or finding a job does not come naturally, when the intention and comprehension of rules and subtle cues of social interaction are poorly understood. This can lead to social exclusion and deteriorating quality of life. Social skills training is usually initiated to handle problems in the emotional- & social perception and poor metalizing skills (Theory of mind) of people with ASD. Some interventions based on Cognitive Behavioural Therapy (CBT) have shown to be effective. However, it is crucial for the effectiveness of the training to achieve transfer of knowledge and skills to situations in everyday life and novel environments. It is therefore important that practicing social skills can happen in a setting that has the same dynamic, complex and interactive nature of true social situations. Advancements in technology, like Virtual Reality (VR), make it possible to offer a more tailored social cognition training. VR provides a safe, dynamic and interactive treatment setting, that could transcend the social cognition training as it is available today. VR offers an 'ecologically valid', immersive environment to experiment with (new) social behavior in a secure, controlled setting that provides direct feedback and learning experiences.

Objectives: In this pilot-study, we explore a VR CBT-based intervention (16, one hour sessions), that aims to enhance the social cognition of adults with ASD. Outcomes of this study are feasibility, tolerance and acceptance of the intervention, and improvements in social cognition.

Methods: A pre-post assessment design (including a 12 week follow-up) is used to assess the outcomes (i.e. feasibility, tolerance/acceptance, and improvements in social cognition). Social cognition was assessed using the Movie for the Assessment of Social Cognition (MASC) and Empathy Quotient (EQ) and social responsiveness with the Social Responsiveness Scale-A (SRS-A). Other relevant measures are also assess focussing on social anxiety and emotion recognition.

Results: Starting in April 2018, the treatment was embedded into multiple mental health organisations in the Netherlands. So far, 13 participants completed the intervention and n= 11 the post assessment (mean age 32.31, mean total IQ 103.42 (SD 14.41), 10 males, 3 females).

Qualitative interviews revealed good f acceptance of the intervention: mean evaluations of the intervention were 7.6 (out of 10), and participants would recommend the training to other people with autism indicating a 7.9.

Preliminary analyses (n=11) showed that MASC scores slightly improved from 30.31 to 33.27 points, yet non-significant ($F(1,22) = 1.514$, $p = .231$).

Conclusions: The preliminary results of 13 participants are clinically relevant and promising. Complete results, including follow-up data will be presented at the conference.

445.017 *(Poster)* Does a Difference in Recursive Embedding Underlie the Varied Features of Autism?

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Background: Autism is characterized by a number of cognitive-perceptual differences relative to neurotypicals, including differences in theory of mind; local vs. global processing; perceptual flexibility; visual search; imagination; self-categorization; mental time travel; and creativity. It is not immediately clear why these varied features cluster together in the same condition. A deeper analysis of these features, however, reveals that each relies on the cognitive mechanism of recursion – that is, the ability to hierarchically embed concepts within concepts, potentially ad infinitum. Recursion is central to Theory of mind, for example, because understanding the world from another person's point of view requires a perceiver to embed the other's mental representations into their own. Similarly, recursion is central to self-categorization because constructing complex relations between self and other – the main function of self-categorization – requires a perceiver to embed their personal sense of self in higher level self-representations, such as the groups to which they belong. Given the recursive nature of these and every other feature of autism, we argue that a key difference between autistic people and neurotypicals might lie in the tendency of each to recursively embed, and disembed, information.

Objectives: The current project aimed to test the novel proposal that the varied features of autism might emerge from a difference in the tendency to recursively embed information. Specifically, we aimed to test whether the degree of autistic traits would positively predict a measure of recursive disembedding tendencies (i.e., weaker recursive embedding), which in turn would predict theory of mind and self-categorization – both known to function differently in autistic people.

Methods: Across three Experiments with general population samples recruited from Prolific Academic, we measured: participants' autistic traits with the Autism-Quotient (AQ); their recursive disembedding tendencies (RDT) with a number of language-based recursion tasks; their theory of mind abilities (ToM) with an embedded false belief task; and their tendency to self-categorize (SC) with a measure of group-based social identification.

Results: Mediation analyses across all three Experiments revealed negative relationships between AQ and SC, and between AQ and ToM (null in Expt. 1). The relationships between AQ and SC were mediated by RDT, as predicted, such that AQ was positively related to RDT, and RDT was negatively related to SC. The relationships between AQ and ToM were also mediated by RDT, but in contrast to results for SC and to predictions, this indicated a suppression effect, whereby RDT and ToM were positively, rather than negatively, related.

Conclusions: The three Experiments provided reliable support for a weaker recursive embedding tendency at higher levels of autistic traits, and partial support for our broader proposal that the varied features of autism might emerge from a difference in the recursion mechanism. This recursion difference was associated with decreased self-categorization as expected, but, contrary to predictions, it was associated with increased theory of mind. These divergent results will be discussed with reference to the sub-processes underlying theory of mind in autism, and to widely used measures of theory of mind.

445.018 *(Poster)* Dyadic Play in 12-Month-Old Infants at-Risk of Autism Spectrum Disorder

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Background: In addition to impaired social communication, children with autism spectrum disorder (ASD) also show unusual play with object. Together, these atypicalities can make it difficult for caregivers to engage their children in reciprocal play. Indeed, infant siblings of children diagnosed with ASD show less engagement during dyadic play (Wai Wan et al., 2012).

Objectives: The purpose of this study was to examine the relationships between the quality of child-and-caregiver play at 12 months of age and ASD symptom presentation at 24 months of age in a high-risk sibling cohort.

Methods: Participants: Dyads of high-risk infants and caregivers (HR; have an older sibling diagnosed with ASD; n = 77) and low-risk infants and caregivers (LR; no family history of ASD; n = 37). *Assessments:* At 12 months, infants and caregivers engaged in a 3-minute session of free play. At 24 months, the Autism Diagnostic Observation Schedule-2 (ADOS) was administered. *Coding*: Free Play sessions were coded using Coding Infant Behaviour (Feldman, 1998), a dyadic rating scheme for infants aged 2 to 36 months that consists of 43 scales: 22 adult, 16 child, and 5 dyadic scales. Composites are calculated: Parent Sensitivity, Parent Intrusiveness, Parent Limit-Setting, Child Involvement, Child Withdrawal, Child Compliance, Dyadic Reciprocity, Dyadic Negative States. *Statistical Analyses*: Free Play composites were compared by Group using Mann-Whitney U analyses. Within the HR group, children were divided and compared based on 24-month ADOS Total score ($\geq$ 8 'moderate- to high-risk'; $\leq$ 7 'low-risk'). The relationship between Free Play composite scores and ADOS Total severity score was explored using Spearman's Correlations.

Results: Mann-Whitney U tests comparing LR and HR dyads showed that (1) caregivers of LR infants were less intrusive and set more limits in play compared to caregivers of HR infants (ps < .05), (2) LR children were more compliant to their caregivers compared to HR children (p <.05), and (3) LR dyads displayed higher levels of reciprocity and lower levels of negative states compared to HR dyads (ps < .05). Mann-Whitney U tests comparing HR infants who were 'low' versus 'moderate-high' risk showed that (1) caregivers of 'low-risk' children had greater levels of sensitivity and limit setting (ps < .003), and (2) children who were 'moderate-high' risk showed less involvement, engaged in less reciprocity with their caregivers, and showed higher levels of negative states (ps < .05). Correlations between Free Play composite scores and ADOS Total severity score showed significant relationships for Parent Sensitivity (r = -.41, p < .001), Parent Limit-Setting (r = -32, p < .01), and Child Involvement (r = -.34, p < .01) in HR dyads but no relationships in LR dyads.

Conclusions: As anticipated, caregiver-child play interactions in HR dyads are less synchronous and reciprocal compared to LR dyads, and these differences are associated with later ASD symptom presentation. Understanding differences in dyadic play can help inform play-based interventions for infants at risk of ASD.

445.019 *(Poster)* EEG Frequency (Beta, Theta & Beta: Theta ratio) during Resting State Eyes Open in Children with ASD and ASD+ADHD: The ACE Gendaar Network

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by social, behavioral, and communication impairments. Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by inattention and/or hyperactivity-impulsivity that interferes with functioning and occurs in 14% of children with ASD (CDC, 2013). The Theta-Beta (EEG power) ratio (TBR), which is comprised of increased theta activity and decreased beta activity, has been proposed as a biomarker for a subtype of ADHD (Arns et al., 2013), although this is controversial (Saad et al., 2018). A previous study in male youth with ADHD and ASD+ADHD found increased theta power in the ADHD group compared to the ASD+ADHD group (Bink et al., 2015). To address the hypothesized alterations in beta and theta in these conditions and to expand this work to include female youth, we analyzed data from the GENDAAR study, a multi-site collaboration focused on understanding sex-based differences in youth with ASD.

Objectives: To explore resting-state EEG theta and beta power in youth with ASD, ASD+ADHD, and typically developing (TD) controls, including both male and female participants.

Methods: In 70 youth ages 8 to 18 years; 24 with ASD [7 female], 25 with ASD+ADHD [12 female], and 21 TD controls [11 female] participated in this study. All ASD youth had a community clinical diagnosis, which was confirmed via the ADOS and ADI, and DSM-V criteria. TD youth had no elevated ASD traits. ADHD+ status was determined using the Child Behavior Checklist (CBCL) ADHD DSM scale >63. All participants completed the DAS-II and has an IQ >70. An EEG resting experiment was completed in which children passively observed short, screensaver-like videos. EEG data was collected from a 128 channel EGI system at 4 sites; post acquisition the EEG data was filtered (.1 to 100Hz), segmented in 1 second segments, artifacted detected for values out of range and eye artifacts, re-referenced to an average reference, and then subject to a fast fourier transformation (FFT). Theta was defined as the average power from 6 to 10 Hz; beta was defined as the average power from 12.5 to 30 Hz. We focus on the midline-electrodes at frontal, central and posterior regions.

Results: ANOVAs were conducted to explore differences in group (ASD, ASD+ADHD, TD) and sex (male, female) for beta and theta power. Individual analyses were conducted for each region of interest. Neither of the clinical groups (ASD / ASD+ADHD) differed from the TD group for either theta (all Fs<.45, ps>.50) or beta (all Fs<.17, ps>.68).

Conclusions: In this preliminary analysis, our results do not support a pattern of elevated theta/ decreased beta in children with ASD or ASD+ADHD compared to TD children. Additional analysis will explore qualitative relations between power and ADHD symptoms, as well as the impact of stimulant medication on EEG power in this sample to further understand variability in theta and beta in ASD

445.020 *(Poster)* Elevated Autism Diagnoses and Autistic Traits in Transgender and Gender Diverse Individuals: A Study of over 600,000 Individuals

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Background: Previous studies in small clinic-based samples have identified an association between gender dysphoria and autism. However, it is unclear whether transgender and gender diverse individuals have elevated rates of autism or autistic traits compared to cisgender individuals in large non-clinic-based datasets.

Objectives: To investigate if transgender and gender diverse individuals have elevated rates of autism/autistic traits compared to cisgender individuals in non-clinic-based datasets.

Methods: We used four independently recruited cross-sectional datasets consisting of 603,885 individuals (N_1=514,100; N_2=85,670; N_3=2,312; and N_4=1,803) who completed information on gender (either classified as male or female [comprising cisgender], or other gender identities [comprising transgender and gender diverse]), neurodevelopmental and psychiatric diagnoses, and measures of traits related to autism (self-report measures of autistic traits, empathy, systemizing, and sensory sensitivity). We also conducted sensitivity analyses to adjust for potential confounders such as educational attainment and age.

Results: Compared to cisgender individuals, transgender and gender diverse individuals had higher rates of autism (ORs: 4.59-6.36). Using subsampling bootstrap testing, we confirmed that the ORs were statistically comparable across the four datasets despite differences in recruitment, ascertainment of gender identity, and autism diagnosis. For both autistic (Cohen's D: 0.55-1.05) and neurotypical individuals (Cohen's D: 0.32-0.96), transgender and gender diverse individuals scored higher on self-report measures of autistic traits, systemizing, sensory perception, and lower on self-report measures of empathy. Transgender and gender diverse individuals also had higher rates of six other neurodevelopmental or psychiatric conditions (ADHD, bipolar disorder, depression, learning disorder, OCD, and schizophrenia) compared to cisgender individuals (1.92 [learning disorders] to 6.39 [schizophrenia]).

Conclusions: Across four independently recruited datasets, transgender and gender diverse individuals have elevated rates of autism and higher autistic traits, compared to cisgender individuals. The results have clinical implications for improving access to care and support for transgender and gender diverse individuals.

445.021 *(Poster)* Emotional Theory of Mind Deficits in Adolescents and Young Adults with ASD

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Background:

Theory of Mind can be separated into the ability to infer the mental states (ToM-O) or emotional states (ToM-E) of others, which is distinct from drawing physical inferences. Bodner et. al. (2015) developed the Pittsburgh Inference Task (PIT) to probe whether difficulties in inferencing reported in ASD are due to a general deficit in the ability to make inferences, or to a specific deficit in one type of inferencing. They found ToM-E inferences are especially difficult in those with ASD and identified language ability (verbal IQ) and experience (age) as important factors influencing inferencing ability. Crystallized intelligence, then, which depends on past learning and experiences, should relate to inferencing ability in ASD compared to fluid intelligence, which captures the ability to process new problems (Horn and Cattell, 1967).

Objectives:

1. Replicate previous work showing a deficit in ToM-E but not ToM-O ability in ASD.
2. Using NIH Toolbox to measure fluid and crystallized intelligence, determine their association with different types of inferencing in ASD vs. TYP.

Methods:

42 ASD (Age = 19.64(3.17); VCI = 97.36(15.90)) and 32 TYP participants (Age = 18.56(3.15); VCI = 100.00(12.36)) performed the PIT, consisting of twenty-eight real-life stories read out loud followed by questions requiring participants to verbalize inferences about characters or situations in the stories. Responses are scored correct if appropriate based on the context and according to which type of inference was made (Physical (control), ToM-E, or ToM-O). Participants also completed the NIH Toolbox Cognition Battery, consisting of seven well-validated tasks that produce scores of fluid and crystallized cognition (Akshoomoff et al., 2014).

Results:

A repeated measures ANCOVA was conducted to determine the effect of diagnosis on the number of correct physical, ToM-E, and ToM-O inferences made, controlling for verbal IQ and age (Fig. 1). Results showed a significant main effect of diagnosis ($F(1, 70)=8.46$, $p = .005$) and a significant interaction of diagnosis and inference type ($F(1.98, 138.22)=5.20$, $p = .007$). Post hoc analyses (Bonferroni corrected, $p < .05$) revealed the ASD group provided significantly fewer correct ToM-E answers (M=7.21, SD=2.32) compared to the TYP group (M=9.10, SD=1.65). Within the ASD group, participants provided significantly fewer correct ToM-E answers compared to ToM-O (M=8.71, SD=2.15).

Crystallized cognition scores correlated positively with scores on each type of inference within the ASD group. In the TYP group, the only significant correlation was between ToM-E scores and fluid cognition. Verbal IQ correlated significantly only with ToM-E scores in the ASD group (Fig. 2).

Conclusions: Participants with ASD show a specific deficit in ToM-E inferencing, but no difficulty making ToM-O inferences. Increased crystallized cognition ability in ASD is associated with all three types of inferencing ability, but most strongly with ToM-E. This provides further evidence that those with ASD rely on previous knowledge and verbal ability to make correct inferences, especially in emotional contexts. Conversely, ToM-E in the TYP group relates to the processing of new situations. Data collection is ongoing and future analyses will look at the number and type of words used in responses.

445.022 *(Poster)* Empathy As a Predictor Variable of Bullying, Aggression, and Anger Control: An Analysis of Children with ASD and Children with Conduct Problems

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Background: Extensive research indicates that children with autism spectrum disorder (ASD) struggle with social understanding and have diminished reaction to others' emotions (i.e., lack of empathy). Research identifies two types of empathy: cognitive and affective. It is theorized that children with ASD have deficits in cognitive empathy, but not affective empathy. Another clinical population that struggles with empathy, theoretically affective empathy, is children with conduct disorder (CD). Despite the theorized difference in the etiology of deficits in empathy between ASD and CD, there is a lack of research examining the role empathy plays in aggression, anger control, and bullying within these populations.

Objectives: We aim to investigate whether empathy is a predictor of bullying, aggression, and anger control in children diagnosed with ASD and children exhibiting significant levels of conduct problems. We hypothesize that in children with ASD, empathy, aggression, and anger control will strongly predict bullying. Conversely, we hypothesize that in children with significant conduct problems, empathy will slightly predict bullying, while aggression and anger control will strongly predict bullying.

Methods: Participants included 140 children ages 7-15 years ($M = 9.56 \pm 1.54$ years; 72.90% male; 73.60% White) who were enrolled in the Resilience Builder Program® (RBP) at a private psychotherapy practice. RBP is a 14-week, transdiagnostic group intervention for children with social deficits and problem behaviors (Alvord, Zucker, & Grados, 2011). Participants were divided into two groups, an ASD group of children diagnosed with ASD, and a CD group with children who presented with no autism diagnosis but “at-risk” or “clinical” levels of conduct problems as measured by the Behavioral Assessment System for Children (BASC-2). Data were collected prior to and at the conclusion of treatment. Measures included the BASC-2 (Reynolds & Kamphaus, 2004), and the Social Skills Improvement System (SSIS; Gresham & Elliot, 2008).

Results: Sequential regression analysis revealed empathy, aggression, and anger control together significantly predicted bullying for both groups, ASD group, $R2 = .10$, $F(3, 22) = .11$, $p = .010$; CD group, $R2 = .72$, $F(3, 63) = 54.88$, $p < .001$. For the ASD group, sequential regression analysis revealed empathy alone did not predict bullying, $\Delta R2 = .00$, $F(1, 24) = .11$, $p = .747$. However, empathy did significantly predict bullying in the CD group, $\Delta R2 = .04$, $F(1, 65) = 2.88$, $p = .094$.

Conclusions: While empathy was found to be predictive of bullying in children with conduct problems, it was not predictive of bullying in children with ASD. One possible interpretation is that children with ASD may lack the higher-level cognitive process required of empathy in the moments before bullying. Another possibility is that the effect of empathy may be smaller in children with ASD than in children with conduct problems, and that would have been identified in a larger, more diverse sample. Since aggression and anger control appear to be strong predictors of bullying in both populations, transdiagnostic treatments should target increasing anger control and decreasing aggression in children as a means of reducing bullying.

445.023 *(Poster)* Evaluating the Relation between ADHD Symptoms and Externalizing Behaviors in Children with Autism Spectrum Disorder

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Background: Children with autism spectrum disorder (ASD) are at increased risk for externalizing problems (Bos, Diamantopoulou, Stockman, Begeer, & Reiffe, 2018). This situation is further complicated by the high comorbidity between ASD and attention deficit hyperactivity disorder (ADHD), which has been linked to long-term negative outcomes (Factor, Ryan, Farley, Ollendick, & Scarpa, 2017). A recent study found that 78% of children presenting with ASD and parent-reported challenging behaviors also met criteria for ADHD (Brookman-Frazee, Stadnick, Chlebowski, Backer-Ericzen, & Granger, 2018). Given that early interventions for these disorders are most effective (Turner-Brown, Hume, Boyd, & Kainz, 2019), more research is needed on ASD, ADHD and externalizing symptoms in young children prior to diagnosis.

Objectives: This study investigated whether the relation between ASD status (ASD vs typical development, TD) and externalizing behavior would vary based on differences in ADHD symptoms.

Methods: Participants were 208 children between the ages of 3 years and 6 years and 11 months and their parents. Our sample included 127 TD children (47.7% female) and 81 children with ASD (16.7% female). Child’s diagnostic status was determined by diagnostic reports provided or medically released by parents. Additionally, parents completed the Autism Behavior Checklist (ABC; Krug et al. 1980) to confirm that TD participants did not exhibit symptoms that are commonly associated with ASD. Parent ratings from The Behavioral Assessment System for Children--Second Edition (BASC-2; Reynolds & Kamphaus, 2006) provided an estimate of externalizing problems whereas the ADHD subscale from the Conners estimated ADHD (CBRS, 1990).

Results: We used linear regression to test our moderation model. Continuous variables were centered for ease of interpretation. Our model included the covariate of sex, which explained 4.8% of the variance in externalizing problems. The main effects of developmental status and ADHD symptoms on externalizing were both significant, t(204) = 4.396, p = .0001; t(204) = .6.810, p = .0001, respectively, and jointly accounted for 35.3% unique variance in externalizing problems. The interaction between status and ADHD symptoms was also significant, t(203) = -3.438, p = .001, explaining an additional 3.3% unique variance. The overall model explained 43.3% of the variance in externalizing problems, F(1, 203) = 4.251, p < .0001. Externalizing problems were higher for the ASD and TD groups when ADHD symptoms were also high versus lower but this relations between ADHD and externalizing was stronger for the TD group.

Conclusions: Our findings are consistent with research showing that children with ASD and comorbid ADHD symptoms exhibit higher rates of externalizing behavior than children with low rates (Factor et al., 2017; Sprenger et al., 2013; Tureck et al., 2013). This study extended prior research by examining ADHD and externalizing behavior in a large young sample of children with ASD or TD and varying levels of ADHD symptoms. Our findings are limited by the cross-sectional nature of our study and the use parent report in lieu of observations of externalizing. Future research should verify these findings using a longitudinal design.

445.024 *(Poster)* Evaluating the Relation between Child Adaptability and Engagement in Children with Autism

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Background: Social engagement refers to the extent individuals involve themselves in interacting with others (Kasari et al., 2011) and is determined by various contextual factors, including familiarity with the setting, strength of relationship, and social-emotional functioning (Teh, Yap, & Liow, 2018). Challenges with social engagement, peer relationships, and social-communicative development are often present in autism spectrum disorder (ASD; Teh, Yap, & Liow, 2018) and have been associated with important outcomes in social development (Kasari et al., 2011). Effective engagement is linked with adaptability, the ability to independently complete tasks from self-care to social coping techniques during transitions (Sparrow, Cicchetti, & Balla, 2005). These skills can influence children's ability to independently initiate and participate in activities (Gardiner & Larocci, 2015). Given that children with ASD often have difficulties with flexibly adapting to unexpected changes in their environments (Mahan & Matson, 2011), this challenge may interfere with appropriate engagement (Kanne et al., 2011).

Objectives: We aimed to determine how child adaptability differentially impacts child engagement in ASD and typically developing (TD) populations. We hypothesized that child adaptability would moderate the relation between child developmental status (ASD vs. TD) and child engagement. We also predicted that decreases in child adaptability would be related to decreased engagement for both ASD and TD groups and that this effect would be greater for our ASD group.

Methods: Participants were 31 children between ages 3 years and 6 years, including 20 TD children (60% female) and 11 children with ASD (18% female). Parent ratings from The Behavioral Assessment System for Children--Second Edition (BASC-2; Reynolds & Kamphaus, 2006) measured child adaptability and the Social Skills Improvement System Rating Scales (SSIS; Gresham & Elliott, 2007) assessed child engagement.

Results: A moderated multiple regression analysis was conducted to investigate the degree to which adaptability moderated the relation between status and engagement. A significant main effect was found for developmental status on engagement (p = .04, B = .29, CI_{95} = .06 to .53), indicating that children with autism demonstrated less engagement behavior than the TD group. There was also a nonsignificant main effect for adaptability on engagement (p = .28, B = .082, CI_{95} = -.07 to .23), which did not support our hypothesis that higher adaptability would yield higher engagement. Finally, there was a significant interaction between developmental status and adaptability on engagement (p = .02, B = .1, CI_{95} = .06 to .53), indicating a significant effect for our overall model.

Conclusions: Results supported our hypothesis that the ASD group would exhibit less engagement than their TD peers. However, results were nonsignificant for adaptability on engagement, which did not support our hypothesis that parent-reported child adaptability overall would predict parent-reported child engagement. Considering these results together in our overall moderation model, the significant interaction suggests that the effect of child adaptability on child engagement is important, but specifically within our ASD sample. More research with larger samples is needed on the role of adaptability in the social engagement of young children with ASD.

445.025 *(Poster)* Examining Gender Differences in Social Interaction between Adults with and without Autism Spectrum Conditions: An Interpersonal Movement Coordination Approach.

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Background: Autism Spectrum Conditions (ASC) are diagnosed at a higher rate in males than in females (Fombonne, 2009). One possibility for this asymmetry is the female tendency to mask autism-related behaviours by presenting a qualitatively different phenotype than males (Lai et al., 2017). This has been noted in the communication domain, with females reporting fewer difficulties with social interactions than males (Attwood, 2006). Although research efforts characterizing gender differences of socio-communicative abilities are rapidly emerging, most investigations have examined within-group differences in autism without a neurotypical comparison sample (Hull et al., 2017). Here, we investigate whether interpersonal movement coordination, the tendency to move similarly in time, and a hallmark of successful communication, varies between males and females with and without ASC. Further, we examine whether movement coordination relates to autistic traits in both groups.

Objectives: 1) To determine whether interpersonal movement coordination varies between male and female adults with and without ASC and, 2) to examine whether movement coordination relates to autistic traits in both groups.

Methods: Fifty-two neurotypical (NT) adults (26 females; 18-29 years) and thirteen adults with ASC (3 females; 18-24 years) participated. Data collection for adults with ASC is ongoing. Participants were video-recorded while completing a semi-structured interview (sections of the ADOS-2). Using a novel video-based motion analysis method (Barbosa et al., 2012), movement coordination between participant and experimenter was quantified. Autistic traits in the participants with ASC were characterized using the ADOS, while NT participants completed the Broad Autism Phenotype Questionnaire (BAPQ).

Results: Movement coordination with the experimenter was calculated for adults with and without ASC. Results indicated a main effect of group for coordination, with adults with ASC coordinating significantly more than NT controls. Results also suggested a gender difference in coordination in the ASC group; specifically females tend to coordinate more than males, despite having greater symptom severity. This difference was not observed in the NT group. Further, no relationship between coordination and amount of autistic traits was found.

Conclusions: These findings suggest that females with ASC present differently in social interactions with no such gender difference found in our NT sample. Further, autistic traits in either group did not predict how much movement coordination was observed. However, it should be noted that we did not observe the prototypical gender differences in autistic traits where males score higher reflecting more symptoms on both the BAPQ (Ingersoll et al., 2011) and ADOS (Lai et al., 2017) than females. The reverse was true for our NT and ASC samples suggesting that either our samples may not be typical, or that complex nuances of social context (i.e., ADOS interview context for the ASC participants vs. questions asked in a conversational setting for the NT participants) and perception of conversational partners (i.e., potential differences between how the NT interviewer engages with an ASC vs. an NT partner; Morrison et al., 2019) influence nonverbal behaviour during social interactions. Taking consideration of such factors will ensure that future investigations unambiguously reflect socio-communicative gender differences in ASC.

445.026 *(Poster)* Examining the Visual Strategies Underpinning a Self-Processing Bias in Autistic Children: An Eye-Tracking Study Utilising an Ownership Paradigm

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Background: A plethora of research has shown self-awareness to be impaired in Autism Spectrum Disorder (ASD), particularly in regard to psychological rather than physical self-referential information (e.g., the 'absent-self' theory, Frith, 2003; Frith & Happé, 1999; Williams, 2010). Indeed, children with ASD demonstrate impairments in self- and other-referential cognition which may underpin social functioning and communication deficits.

Self-referential cognition is particularly reflected in the *self-reference effect* (SRE) in memory; the phenomenon whereby there is a memory advantage for information encoded in relation to the self than others (Rodgers, Kupier & Kirker, 1977; Symons & Johnson, 1997). Gillespie-Smith and colleagues (2018) showed that through an ownership paradigm, that SRE was superior among autistic children but was dependent upon measures of individual differences; SRE increased in those autistic children with milder ASD symptom severity and greater socio-communicative ability.

Objectives: The current study extends the research exploring SREs through ownership and specifically build upon the work of Gillespie-Smith and colleagues (2018) by examining eye gaze behaviour in autistic and TD children during a computerised version of a non-evaluative ownership task. In doing so, the extant study aimed to provide insight into the visual strategies utilised by autistic children during a self-other processing task. Moreover, this study sought to explore whether the SRE and visual strategies used are related to socio-communicative ability, ASD severity, ToM ability, chronological age (CA), and verbal ability (VA).

Methods: Using a non-evaluative ownership paradigm to assess self-other processing and eye-tracking technology with 12 autistic children (2 Female, 10 Male) and 10 chronological age- and verbal ability-matched typically developing (TD) (4 Female, 6 Male) controls (aged 5 to 12 years). Social communication ability was measured by the Social Communication Questionnaire (SCQ; Rutter, Bailey, Berument, Lord & Pickles, 2003), and autism severity was measured by the Asperger Syndrome Diagnostic Scale (ASDS; Myles, Bock & Simpson, 2001). Finally, Theory of Mind (ToM) was measured using three first-order false-belief litmus tests: two location-change tasks (Baron-Cohen et al., 1985; Wimmer & Perner, 1983), and one unexpected-contents task.

Results: The current study found both groups to accurately recall more self-owned than other-owned toys; a demonstration of the self-reference effect (SRE). Amongst autistic participants, the SRE was slightly superior and its magnitude significantly increased as socio-communicative ability decreased. ASD severity, ToM ability, chronological age and verbal ability did not influence the ASD group's SRE, contradicting some previous findings. Both groups fixated significantly longer on self- and other-owned images than borders and interestingly, the TD group fixated significantly longer on self-owned toy images than the ASD group who fixated slightly longer on self-owned coloured borders in comparison. Finally, only autistic children did not fixate on toys' faces and their fixation on self- and other-owned items significantly increased as socio-communicative ability decreased.

Conclusions: These findings suggest that autistic children can demonstrate a robust SRE despite lower social-communication skills, ASD symptom severity may not influence the SRE, and autistic and TD children select visual attention differently to encode self-referential information which may consequently underpin their SRE ability.

445.027 *(Poster)* Impact of Psychotropic Medication on Resting State EEG Alpha Power and Performance on VEP Task in Children with Autism Spectrum Disorder in the ABC-CT Study

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Background: It has been estimated that around 56% of children with autism spectrum disorder are taking at least one psychotropic medication, with 22% of these medications being in the stimulant class (Mandell et al., 2008). It is important to understand the implications of medications on EEG responses to better differentiate brain responses due to medication use from responses related to autism or associated conditions. Moreover, as new treatments are tested, many children will already be utilizing a medication and thus treatment effects and their impact on brain functioning will need to be understood above the baseline effects of medication.

Objectives: To investigate the potential impact of medication (broadly defined as acting on the CNS or non-CNS mechanisms) on EEG alpha power and Visual Evoked Potential (VEP) response in participants with and without ASD. Within the ASD group, to examine the effects of different types of psychotropic medication on EEG responses.

Methods: This study used data from the ABC-CT project, a five site, NIH funded project that aims to identify biomarkers that could be used to facilitate understanding of treatment effects in ASD. Participants, ages 6-11yrs completed 3 time points of data collection, each included high density EEG. Tasks were a (calm viewing) resting task that showed screensaver-like videos and a test of basic visual processing, where participants watched images of a checkerboard reversing each 500 msec. A detailed medication history was collected from participants at each time point. Participants were included in the analysis based on having valid derived data on both experiments, and a completed medical history. The preliminary sample includes 88 children with ASD (females=16, male=72) and 14 TD children (females=5, male=9).

Results: There was a significant main effect of CNS medication (ASD+CNSmed, ASD- noCNSmed and TD group) on both the Resting and VEP total number of attended artifact free EEG trials (Resting: $F(2,99)= 4.3$, $p<0.05$; VEP: $F(2,99)=3.8$, $p< 0.05$). No significant results were observed for EEG alpha power ($F(2,99)= 0.3$, p=ns) or VEP P1 amplitude ($F(2,99)= 2.5$, p=ns). As well, no significant effect was observed in the non-CNS medication group for either experiments (Resting alpha power: $F(2,99)= 0.4$, p=ns; VEP P1 amp: $F(2,99)= 2.1$, p=ns).

Within the ASD group, there were no significant differences in IQ in children on CNS medication and children not on CNS medication at T1 ($t[86] =-.59$, p =ns). No significant differences for either experiments were observed between groups (ASD-noMeds, ASD+CNSmeds, ASD+nonCNSmeds and ASD+CNS+nonCNSmeds (Resting alpha power: $F (3,84)= 0.8$, p= ns; VEP P1 amp: $F (3,84) = .57$, p = ns). There were no significant differences based on types of medication (stimulants, SSRIs, antipsychotics, antiepileptics and alpha agonists) as well.

Conclusions: Our preliminary analysis showed that there is an overall impact of CNS medications on the number of good trials obtained during EEG acquisition; however there were no effects of medication on the dependent variables. Additional analysis will examine if medication change or stability from Time-point 1 to Time-point 2 impacts test-retest values.

445.028 *(Poster)* Implicit Empathetic Sensitivity to Others' Pain in Children with Autism Spectrum Disorder: Evidence from Pupil Dilation and Eye Movements

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Background: Empathy is a fundamentally adaptive ability that emerges early in life and guilds our social behaviors (Decety, 2015). Deficits in empathy have been widely reported in individuals with Autism Spectrum Disorder (ASD) (Bons et al., 2013; Harmsen, 2019). The underlying mechanisms of their deficient empathy are still under controversy. Individuals with ASD are widely believed to be insensitive to others' pain (Chen et al., 2017; Thaler et al., 2018). However, an alternative explanation is that they could be over-sensitive to others' pain (Blakemore et al., 2006; Gu et al., 2015), so that they actively avoided looking at the scene.

Objectives: The current study investigates the implicit empathetic sensitivity in children with ASD and TD controls when they see other people in pain, using the eye-tracking technique. We aim to provide new evidence for the underlying mechanisms of the inappropriately empathetic reactions to others' pain in children with ASD in terms of their arousal level indicated by pupil dilation. Pupil dilation was found in responses to emotionally salient stimuli in typical developing (TD) people (Bradley et al., 2008), and has been used as an index of arousal level (Eckstein et al., 2016). We hypothesized that an over-sensitivity to others' pain would be reflected by more pupil dilation, while insensitivity to others' pain would be reflected by less pupil dilation.

Methods: We modified the moral reasoning task from that created by Cheng and colleagues (2014). The paradigm included two experimental conditions depicting an individual's limb in painful situations or non-painful control situations. Each condition consisted of 10 trials, and each trial lasted for 5 seconds for eye movements and pupil dilation data collecting.

Twenty-five 5- to 8-year-old children with ASD and twenty-seven TD controls saw static images depicting an individual's limb in pain or control situations. Their pupil diameters and eye-movements were recorded by a Tobii X3-120 eye tracker. Children were also asked to evaluate the pain intensity of the person and to report how sorry they feel about the individual's pain.

We defined the fixation durations on the painful/control situations as areas of interest (AOIs). Children's verbal evaluations, fixation durations, and pupil dilations were compared across group and condition using mixed-design ANOVAs.

Results: We found that (a) compared with TD children, children with ASD's pupils dilated more when they see others in pain; (b) children with ASD looked less to the pain situations than TD children, and the two groups displayed similar looking time in the control condition; and (c) children with ASD expressed less empathetic concern to the individuals in pain, even though they rated the pain intensity of those people in pain similarly to their TD peers.

Conclusions: Our study indicated over-arousal and eye avoidance toward others' pain in children with ASD. They also explicitly expressed less empathetic concern to those people in pain. These findings indicated that the impaired empathetic reactions in children with ASD may be explained by their hyperarousal and active avoidance to the pain stimuli, which interferes further cognitive processing and empathetic responses.

445.029 *(Poster)* Individual Differences in Social Motivation in Autistic Adults: The Role of Alexithymia and Social Anxiety

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Background: Social motivational factors have been suggested to explain difficulties in social functioning in Autism Spectrum Disorders (ASD) (Chevallier et al., 2012). However, neural and behavioural studies of social motivation in ASD have demonstrated mixed evidence, which might be partially explained by individual differences in other factors that can impact upon sociability and motivation (e.g. social anxiety, depression and alexithymia). Although a few studies have looked at individual differences in social motivation in children with ASD (Neuhaus et al., 2019; Swain et al., 2015), these factors have not been examined together in autistic and neurotypical adults.

Objectives: The objectives are to understand the role of individual differences (autistic traits, alexithymia, social anxiety, depression) in social motivation in both autistic and neurotypical adults (NT) using self-report measures and to examine whether there are subgroups in social motivation within ASD.

Methods: Seventy three adults with ASD (mean age = 29.77, 27 males) and 68 NT adults (mean age = 27.12, 27 males) completed an online study including the following self-report measures: social motivation was measured using the Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS; Gooding & Pflum, 2011); Toronto Alexithymia Scale (TAS; Bagbdy et al., 1994) was used to assess alexithymia; social anxiety was measured with the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998); the Depression Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond 1995) was used to measure depression; participants also completed the Autism Quotient (AQ; Baron-Cohen et al. 2001).

Results: Group comparisons on primary measures demonstrated a significantly lower experience of pleasure in social interactions, heightened alexithymia, social anxiety, and depression in autistic compared to NT participants. However, there was high variability of ACIPS scores within the ASD group and important overlap between the groups (Figure 1). Hierarchical linear regression showed that higher age, autistic traits, and alexithymia, but not social anxiety, were significant predictors of ACIPS scores in the ASD group (38.5% variance explained), while only age and autistic traits significantly predicted reduced social hedonic experience in the NT group (58% variance explained).

Subsequent model-based cluster analyses identified two clusters in the NT and three clusters in the ASD group. NT individuals in the first cluster (n=17) reported significantly less experience of pleasure in social interactions compared to the second cluster, however the clusters did not differ in terms of autistic traits and social anxiety. In the ASD group, the first cluster (n=25) had significantly higher ACIPS and lower AQ scores than the second (n=6) and third cluster (n=42) (Figure 2). The second and third cluster had similar ACIPS scores, however the third cluster had significantly higher alexithymia and social anxiety.

Conclusions: There are individual differences in social motivation among autistic and NT adults. In ASD these are associated with autistic traits and alexithymia. Existence of subgroups within autism based on social motivation, social skills, and social anxiety challenges the idea of social motivational factors as a primary deficit in ASD, and instead suggests that social behaviour is a result of complex interactions with multiple factors.

445.030 *(Poster)* Intermittent Theta Burst Stimulation over the Posterior Superior Temporal Sulcus Modulates Neural Response and Visual Attention to Faces in Autism Spectrum Disorder

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Background: The superior temporal sulcus (STS) plays an important role in the processing of faces and biological motion. The STS contributes to the generation of a face-sensitive event-related potential (ERP), the N170, the latency of which is a potential biomarker of autism spectrum disorder (ASD). The STS also regulates, in part, visual attention to the face, which is decreased in individuals with ASD. Intermittent theta burst stimulation (iTBS), an excitatory form of noninvasive brain stimulation, over the STS has not been effectively explored in individuals with ASD in conjunction with these recognized neural markers and patterns of visual attention.

Objectives: To investigate changes induced by iTBS over the right posterior STS (rpSTS) in N170 latency to faces and proportion of fixation (POF) to socially relevant facial features in adults with ASD compared to typically developing (TD) adults.

Methods: Preliminary data reflect two adults with ASD (mean age=29.9 years) and ten TD adults (mean age=26.9 years); data collection is ongoing. ASD diagnosis was based on DSM-5, ADOS and ADI-R criteria. All subjects underwent iTBS delivered over the rpSTS [mapped as T6 in the 10-20 electroencephalogram (EEG) coordinate system]. Stimulation was delivered in 2second (s) trains every 10s for a total of 190s (600 pulses) at an intensity of 80% of the active motor threshold. EEG and eye-tracking (ET) data were collected before and after a single iTBS session. Participants were instructed to look naturally at presented static faces and houses after initial fixation on facial regions of interest (left eye, right eye, nose or mouth) and corresponding house regions. The latencies of the N170 were extracted from selected occipitotemporal electrodes and segmented to onset of a face stimulus. POF to eyes on faces was calculated as the number of gaze samples within the eye-region of the face divided by the total number of on-screen gaze samples. Data was analyzed by group before and after iTBS stimulation.

Results: iTBS to the rpSTS decreased N170 latency to faces when eyes were presented at fixation by a mean change in face N170 latency of -2.3milliseconds (ms) [Standard Deviation (SD)=5.2ms] to right eye fixation and 0.5ms [SD=6.6ms] to left eye fixation in TD individuals and by a mean change in face N170 latency of -4.7ms [SD=1.6ms] to right eye fixation and -10.9ms [SD=9.6ms] to left eye fixation in individuals with ASD. After the iTBS session, TD individuals exhibited a mean increase in looking to the eyes of the face of 4.3% [SD=12.6ms] whereas individuals with ASD exhibited an average decrease in looking to the eyes of the face of 1.6% [SD=10.5%]. Results are preliminary, and analysis is ongoing.

Conclusions: This study supports the feasibility and potential utility of an iTBS protocol in participants with ASD. Results of this preliminary study suggest that iTBS over the rpSTS may enhance brain activity in individuals with ASD. A heterogenous response among TD individuals is noted and may reflect the heterogeneity of social perceptual brain systems in the general population.

445.031 *(Poster)* Looking at Me Anxiety: Facial Gaze and Anxiety in Autism

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Background: Anxiety and differing gaze behaviour are two common characteristics of individuals on the autism spectrum. In the neurotypical population facial gaze can ensure emotional regulation and social learning that may aid in reduced prevalence of anxiety. Many studies can be found for anxiety and autism, and gaze behaviour and autism however, few link the two. Moreover, only two qualitative studies regarding anxiety (Trembath et al., 2012; Robertson et al., 2018) and one regarding eye contact (Trevisan et al., 2017) can be found in the literature. None relating anxiety and eye contact could be found. Investigating how anxiety and gaze behaviour are related in autism may provide insights to this heterogeneous cohort. Consequently, qualitative studies are needed to provide inductive insights into this relationship.

Objectives: To explore the lived experience of those adults on the autism spectrum in relation to anxiety and eye contact.

Methods: A qualitative study was carried out with 16 adults on the spectrum and 7 supporters of adults on the spectrum. Data was collected from semi-structured interviews and analysed using Charmaz's Grounded Theory epistemology.

Results: Themes produced from the analysis show that individuals on the spectrum report having difficulties with gaze behaviour, with related anxiety effects. Themes show that those on the spectrum can change their gaze behaviour to appear “normal”, reduce anxiety in social situations, and allow other sensory modality processing (e.g. avoiding facial gaze to allow verbal language to be processed). Eye contact was found to relate to feelings of anxiety. However, anxiety themes showed that anxiety is caused more by social situations than eye contact alone. Participants reported symptoms of alexithymia and face blindness that affect their everyday social functioning.

Conclusions: Adults on the autism spectrum can be very informative about their gaze behaviours and causes of anxiety. However, data show that while most causes of anxiety are social in nature, specific aetiology and remediation of the anxiety is complex and well communicated by those on the spectrum.

445.032 *(Poster)* Measuring Social and Role Functioning in Adolescents & Young Adults with ASD

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Background: Impairments in social and role functioning are central components of autism spectrum disorder (ASD). Understanding intricacies of these impairments is vital for proper treatment; however, it is difficult to obtain a valid measure of functioning in young adults with ASD (Pallathra et al., 2018; Schmidt et al., 2015). Most social functioning scales used in adult research are not sensitive to social issues that occur in adolescence and fail to quantify the complex variability of functioning in ASD (Bolte et al., 2013; Chan et al, 2019). The Global Functioning: Social (GF:S) and Global Functioning: Role (GF: R) are two validated Global Assessment of Functioning (GAF) scales that are rated after administration of a semi-structured interview about daily living. These scales have been validated to assess age-appropriate social and role functioning in adolescents/young adults at clinically high risk for developing psychosis (Cornblatt et al., 2007). Here we report preliminary results of a validation study of these scales which have been updated and adapted for adolescents/young adults with ASD.

Objectives:

1. Examine whether adapted scales of global functioning (GF:S and GF:R) are sensitive to unique deficits of social and role functioning in the ASD adolescent/young adult population.
2. Investigate construct validity of the GF:S and GF:R by examining associations of GF:S and GF:R scores with other validated measures of functioning and clinical traits.

Methods: Participants with ASD (N=88, M_{age}=17 (SD=3.14), 16 female) were administered the modified GF:S/GF:R interview by a trained, reliable rater. These subjects also completed commonly used ASD assessments: Adaptive Behavior Assessment System-3 (ABAS-3) that assesses functional skills through 10 scales within 3 adaptive domains; Social Skills Performance Assessment (SSPA) that entails role-play scenarios to measure social aptitude (Patterson et al., 2001); Social Responsiveness Scale (SRS2) that evaluates autism symptom severity (Constantino et al., 2002); and Autism Diagnostic Observation Schedule-2 (ADOS-2). The original GF:S/GF:R interview and scoring guidelines were modified to further probe the true nature and depth of subjects’ relationships and daily activities. Questions regarding social interactions were adjusted to represent modern-day means of communication (texting, etc.). To assess construct validity, Spearman’s non-parametric correlation (ρ; rho) was used to identify associations between GF:S/GF:R scales and measures listed above.

Results: The GF:S scale is significantly correlated with SSPA, SRS2, ADOS-2-SA and ADOS-2-CSS. The GF:R scale is significantly correlated with ADOS-2-CSS, ADOS-2-SA, and SSPA but is not significantly correlated with SRS-2 score. All 3 ABAS adaptive domains, and total composite score are significantly correlated with the GF:S scale. The GF:R scale is significantly correlated with the ABAS total composite score and 2 adaptive domains (excluding the Practical Composite). The Communication, Community Use, Leisure, and Social sub-scales are significantly correlated with both GF scales.

Conclusions: The modified GF:S/GF:R interview holds promise as a valid indicator of social and role functioning in adolescents/young adults with ASD given its strong association with other commonly used assessments. In order to fully assess whether the modified GF:S/GF:R interview can serve to fill the knowledge gap, further analyses including longitudinal data and regression analyses are being conducted.

445.033 *(Poster)* Measuring Social-Communication Difficulties in School-Age Siblings of Children with ASD: Pragmatic Language Tests Versus Conversational Ratings

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Background: Younger siblings of children with ASD (high-risk siblings) who do not develop ASD themselves are at elevated risk for developing the broader autism phenotype (BAP) compared to siblings with no family history of ASD (low-risk siblings). The BAP has been linked to difficulties in social relationships and poor mental health outcomes in adulthood. Prospective studies of high-risk siblings provide an opportunity to characterize aspects of the BAP in childhood, though very few studies have followed children through school-age to evaluate later outcomes.

Objectives: To investigate school-age conversational and language skills in high- and low-risk children with BAP and ASD outcomes, as well as a comparison group.

Methods: Participants were assessed at school-age (*M* age=11.13 years, SD=2.43) and classified into one of three outcome groups: ASD (*n*=13; met *DSM-5* criteria and ADOS-2 cutoff), Broader Autism Phenotype (*n*=18; based on clinical best estimate), or Comparison group (*n*=122; did not meet ASD or BAP criteria). During the study visit, examiners engaged in conversation with participants for 7-10 minutes, beginning with an open-ended question (i.e., "What do you like to do for fun?") and responding naturally to the participant. Participants were then rated using the Conversational Skills Rating Scale (CSRS; Spitzberg, 1995), which contains 25 behaviors rated on a scale of 1 (inadequate) to 5 (excellent); these items were summed to create a total score for analyses. Participants were also administered the Pragmatic Language (PL) and Nonliteral Language (NL) subtests of the Comprehensive Assessment of Spoken Language (CASL-2; Carrow-Woolfolk, 2017).

Results: CSRS Total Score did not differ by risk group, p=.24, therefore analyses were conducted using only outcome group. Analysis of variance showed a significant effect of outcome group on CSRS Total Score, $F(2, 128)=60.36$, $p<.001$ (see Figure 1). Post hoc analyses indicated that the ASD group scored significantly lower than the BAP and Comparison groups. The BAP group scored significantly lower than the Comparison group. There was a significant effect of outcome group on CASL PL, $F(2, 149)=32.40$, $p<.001$, and on CASL NL, $F(2, 150)=33.24$, $p<.001$ (see Figure 1). Post hoc analyses for both CASL subtests indicated that the ASD group scored significantly lower than the BAP and Comparison groups, while the BAP group and Comparison group did not differ. Regression analyses showed that CASL scores did not predict CSRS Total Score when controlling for outcome group, verbal IQ, and age (see Table 1).

Conclusions: School-age children with BAP outcomes exhibited lower conversational skills with an examiner than comparison children, and children with ASD exhibited lower skills than both BAP and comparison groups. Standardized assessment of pragmatic language skills did not predict conversation skills when accounting for effects of outcome group. This suggests that naturalistic conversation—and measures incorporating subtle verbal and nonverbal aspects of communication—may be more sensitive than standardized language assessments in identifying social-communication difficulties in children with the BAP. Despite scoring in the average range on pragmatic tests, children with the BAP struggle implementing such skills moment-to-moment during interaction, making naturalistic settings crucial when assessing social-communication difficulties.

445.034 *(Poster)* Mechanisms of Emotion Understanding in Self and Others and the Role of Autistic Traits

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Background: Mindreading is an important prerequisite for successful social interactions. Current research suggests overlapping neural and mental processes for self and other related mindreading which supports so called one-mechanism theories. Investigating autism spectrum condition (ASC), studies on mindreading often propose alterations within this domain. If one-mechanism theories hold true, individuals with ASC should also demonstrate altered inference to their own mental states.

Objectives: We aim to investigate if self and other mindreading is one single, common process in individuals with and without ASC. Specifically, we are interested to which extend internal and external cues are used to infer own and others' mental states and if this varies with degrees of autistic traits. To equally address mindreading in self and others, we established a new paradigm using a gambling task in combination with internal and external cues.

Methods: Twenty-three participants (data collection ongoing) completed an allegedly interactive gambling game in which they rated their own or their partner's affective state in response to positive, neutral and negative outcomes of a wheel of fortune. The different outcome compartments of the wheels varied in size, thus changing the expectancy value of the wheels (external cue). Participants were further listening to an acoustic signal representing their own (or their partner's) realistic heart rate or a 10% accelerated signal (internal cues). We used autism spectrum quotient (AQ) scores to investigate the relation auf autistic traits and mindreading. We hypothesize that mainly individuals with lower autistic traits will use internal cues such as the heart rate to infer their own and their partner's affective states. Further, we expect that individuals with higher autistic traits focus more on external task properties, such as the deviance between expectancy value and actual outcome. Linear mixed-effect models were used to estimate the relations between affective rating and our independent variables feedback, target person (self vs other), AQ, and expectancy value deviance.

Results: As hypothesized, negative outcomes were rated significantly more negative in accelerated feedback trials compared to realistic trials (p = .017). There was no significant effect of AQ on ratings and no relation between AQ and feedback on ratings. However, the data revealed a significant interaction of AQ and expectancy value deviance on rating (p < .001), showing that the predictive value of the external cue was stronger in individuals with higher autistic traits.

Conclusions: Our results suggest that individuals use (alleged) physiological feedback to judge their partner's as well as their own mental states, at least for negative outcomes. These results provide supporting evidence for one-mechanism theories. Further, participants with higher autistic traits focused more on external cues to infer their own as well as their partner's affective mental states. This argues for different mindreading strategies in individuals with high and low autistic traits. The relation between autistic traits and mindreading will be further investigated in individuals with and without autism spectrum disorder diagnosis and the corresponding results presented at the conference.

445.035 *(Poster)* Moral Foundations Theory in Autism Spectrum Disorder: A Qualitative Investigation

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Background: Moral thinking is integral to how humans treat each other and non-human animals. Most research in this area has relied on rationalist accounts of moral psychology that posit hierarchical moral principles derived from taking the perspectives of others, i.e., applying commonsense psychology skills to social interactions. From this perspective, subtle differences in moral reasoning have been found between autistic and neurotypical individuals. Yet even autistic individuals, who sometimes differ in their development of commonsense psychology skills, show moral judgements similar to those by neurotypical individuals. Haidt's moral foundations theory posits a non-hierarchical account of moral psychology wherein moral judgements differ depending on such factors as culture, socioeconomic status, and political orientation.

Objectives: Haidt's theory, which relies less on perspective taking than do rationalist accounts, has not yet been investigated among autistic individuals. The current study was conducted as an initial foray into understanding how moral foundations theory fits with autistic moral thinking.

Methods: In this qualitative study, the first author conducted interviews with 6 autistic adults (female $n = 1$; male $n = 2$; gender non-binary $n = 3$). Participants were recruited via local autism organizations and clinicians. Autistic adults in the study ranged in age from 22 to 50 years. Participants' highest levels of education were: high school certificate ($n = 1$); trade school diploma ($n = 1$); bachelor's degree ($n = 2$); and master's degree ($n = 2$). Participants were relatively homogeneous in terms of political orientation in that all participants identified as either liberal, slightly liberal, or very liberal with regards to social and economic issues, except one participant who reported conservative views on economic issues. Interviews were conducted using Flanagan's (1954) critical incident technique and analyzed with thematic analysis (Braun & Clark, 2006). Analytic auditing was conducted by the second author to strengthen the integrity of themes. Member checking (Tracy, 2010) was completed to ascertain whether participants' views were accurately reflected in the analysis.

Results: All five moral foundations were represented in the interviews. However, emotions posited to be related to moral decision making in neurotypical individuals did not feature prominently in moral justifications offered by these participants.

Conclusions: Moral foundations theory appears to offer a framework that captures some individual variation in decision making, and the qualitative research approach revealed a potential additional source of variation associated with autism spectrum disorder. Responses to morally salient contexts may not be as emotionally driven among autistic compared with neurotypical individuals. In ongoing research, quantitative methods are being used to compare groups of autistic and neurotypical individuals to clarify similarities and differences in moral thinking between the two groups.

445.036 *(Poster)* Multifaceted Empathy Differences in Autism: Negative but Not Positive Emotion Recognition Impairment

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Background: Individuals with autism spectrum disorder (ASD) have historically been described as lacking empathy (Kanner, 1943). Considered a social 'glue', empathy is a multifaceted construct involving both an understanding of self and other's feelings (cognitive empathy, CE) and the experience of shared feelings (emotional empathy, EE) (Shamay *et al.,* 2009). Empathy research in ASD has traditionally used emotionally charged stimuli as a press for empathic responses with a focus on either CE, EE, or both. Notably, there is evidence that suggests differential gaze and neural activity patterns in response to faces depicting negative versus positive emotion. While the cognitive and emotional dichotomy of empathy is beginning to be well understood in ASD, differences related to valence have not been well documented in ASD, nor is it known how valence-specific phenomena relate to behavior.

Objectives: Our study aimed to explore the effects of autism diagnostic status and emotional valence on task-based 1) emotional and 2) cognitive empathy responses, and 3) correlations between empathy and autism symptomatology.

Methods: 62 individuals (ASD = 29, typically developing (TD) = 38) of varied ages ranging from 8-38.30 years performed the multifaceted empathy test (MET) (Dziobek, 2008) consisting of 32 static images depicting people in emotionally charged conditions. Cognitive empathy was assessed by multiple choice emotion recognition and emotional empathy was assessed by self-rating on a 0-9 scale. Group comparisons for empathy scores were calculated using the non-parametric effect size Cliff's delta statistic. Spearman rank correlations were calculated between empathy and Social Responsiveness Scale scores.

Results: There were no significant group differences found in age ($\delta = 0.169$, $p = 0.24$), sex ($= 0$, $p = 1$), verbal IQ ($\delta = 0.233$, $p = 0.12$), performance IQ ($\delta = 0.028$, $p = 0.847$), or full scale IQ $\delta = 0.124$, $p = 0.405$). Groups differed significantly in their cognitive ($\delta = 0.405$, $p = 0.002$) but not emotional empathy ($\delta = 0.046$, $p = 0.761$). Secondary analyses separated by valence revealed that the group difference present in the cognitive empathy comparison was driven by the negative ($\delta = 0.368$, $p = 0.008$) but not the positive images ($\delta = 0.237$, $p = 0.09$). No significant correlations were found between SRS scores and empathy measures.

Conclusions: Findings from this study suggest that there is intact emotional empathy but impaired cognitive empathy in children and adults with autism and corroborated previous findings of emotion recognition deficits in this clinical group (Dziobek, 2008). We also extend previous knowledge by reporting an effect of valence in which cognitive empathy deficits occur for portrayals of negative but not positive facial expressions.

445.037 *(Poster)* Neuropsychological Mechanisms Underlying Deception Detection in Autism Spectrum Disorder

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Background: Despite extensive research on topics of social cognition in autism spectrum disorder (ASD), investigations targeting the vulnerability of this population to deception have received rather limited attention. While a portion of the current literature indicates a deficit in deception detection in ASD, evaluating it has largely been peripheral to lie-detection (e.g., false-belief tests) and/or rely mainly on assessment of Theory of Mind and nonverbal communication[1-5]. The role of executive function (EF) skills in detecting deception is even less understood in both typically developing (TD) and ASD populations. The dearth of current research and the social implications of poor deception detection exemplify the need to better understand the mechanisms that underlie this nuanced form of social interaction.

Objectives: This study investigates the cognitive mechanisms underlying deception detection, an important skill in navigating the interpersonal world, and the extent to which autism symptomology impacts detecting deception.

Methods: Twenty-three adults ages 18-30 (data collection is ongoing; current sample includes 5 ASD, 18 TD, mean FSIQ = 108) completed a previously established deception detection task (Levine et al. 2010) along with a battery of neuropsychological assessment and questionnaires. The deception detection task involved participants watching video-taped interviews of individuals telling a lie or telling the truth and judging each individual's veracity (truth-telling). These tapes spanned across veracity *matched* (sincere truth-tellers and insincere liars) and veracity *mismatched* (insincere truth-tellers and sincere liars) conditions. Hierarchical multiple regressions were conducted to control for age, sex, and IQ, using the Autism Spectrum Quotient (AQ) Total Score and Behavior Rating Inventory of Executive Function (BRIEF) Global Executive Composite T-Score as predictors and percent accuracy across conditions of deception detection (total, matched, and mismatched) as outcome variables. Data collection is ongoing. Final analyses will allow for TD/ASD group comparisons.

Results: The full model predicting total accuracy of deception detection was statistically significant, $F(5,22)=2.89$, $p<0.05$; the addition of AQ and BRIEF scores to the model accounted for 30 percent of variability in deception detection accuracy ($R^2=0.3$). Within the veracity matched condition, BRIEF score was uniquely predictive of accuracy rates such that those with decreased executive dysfunction achieved higher accuracy rates ($\beta=-0.612$, $p<0.05$). Conversely, within the veracity mismatched condition, AQ Total Score was most predictive of accuracy rates such that those with higher self-rated autism symptoms demonstrated higher accuracy ($\beta=0.859$, $p<0.01$).

Conclusions: Preliminary analyses indicate that self-rated autism symptomology and EF skills within ASD and TD uniquely impact deception detection ability across different demeanor-based conditions. Results suggest that EF skills are most important for lie-detection when the accompanying social cues are consistent with the individual's veracity. On the other hand, greater autism symptom severity predicted higher accuracy rates when the individual's social cues are misleading and not indicative of their honesty. These initial findings are inconsistent with research presented by Williams et al. (2018), which suggested that ASD performed similar to TD on mismatched conditions of deception detection. With ongoing data collection, this research will propel the understanding of how individuals with ASD process nonverbal cues in interpersonal domains.

445.038 *(Poster)* No Preference for Direct Versus Averted Gaze in Autistic Adults

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Background: Diminished attention to others' faces and eyes is one of the most documented clinical features among the characteristic behaviours encompassed by the deficit in socio-emotional reciprocity that defines autism. However, eye-tracking studies in social attention in autistic adults without intellectual impairment have yield contrasting results.

Objectives: This study aims to assess autistic adults' spontaneous attention to faces, wondering (1) whether a preference for mouths and/or (2) an eye contact avoidance might be observed, and (3) whether patterns of social attention might be influenced by social anxiety, alexithymia and/or gender.

Methods: We have conducted a new reinforced preferential looking paradigm in an autistic group (n = 43, 23 women; age range: 19-55 years, mean: 35,79) paired on age and intellectual quotient to a neurotypical group (n = 43, 21 women; age range: 21-58 years, mean: 35,56). Participants watched two 5 seconds long videos (28 pairs) displayed at the same time on a screen equipped with a remote eye-tracker. The two videos were showing a person uttering a sentence with a neutral expression and only differed from each other in eye gaze direction (direct or averted). The direct gaze videos were reinforced using a brief rewarding animation after a short anticipation window.

Results: Both the neurotypical and the autistic groups fixated significantly less the mouth region than the eye region ($\beta= -0.03$, $se= 0.01$; $t(91.88)= -2.9$, $p=.004$), with no effect of group, gaze direction or gender ($ps>.1$). As shown in Figure 1, neurotypical participants displayed a higher amount of fixations on the stimuli with a direct gaze ($\beta= 0.14$, $se= 0.03$; $z= 5.5$, $p<0.001$), while no such preference emerged in the autistic group ($p=.97$). Accordingly, neurotypical participants fixated more the stimuli with direct gaze than autistic participants ($\beta= 0.1$, $se= 0.03$; $z= 3.3$, $p<0.005$). No group difference emerged relative to the amount of fixation on stimuli with averted gaze ($p=.71$). As suggested by Figure 2, after an initial exploration of both types of stimuli, neurotypical participants quickly focus on the face with a direct gaze, at much greater extent than autistic participants ($\beta= 0.03$, $se= 0.01$; $t(83.03)= 3.35$, $p=.001$). In both groups, a higher alexithymia score correlated with a lower fixation on the stimuli with direct gaze (neurotypical: $\beta= -0.005$, $se= 0.002$; $p=.032$; autistic: $\beta= -0.005$, $se= 0.002$; $p=.012$). The same correlation was found in the neurotypical group for the social anxiety score ($\beta= -0.002$, $se= 0.0008$; $p=.006$), but not in the autistic group.

Conclusions: Those results suggest that, contrary to what is generally assumed, there is no difference in face exploration in autistic adults, compared to neurotypical adults. As expected though, autistic adults fail to display the direct eye gaze preference shown by the neurotypical adults. However, alexithymia seems responsible of the amount of fixation on the stimuli with direct gaze in both groups: alexithymia, and not autism, might predict direct gaze preference.

445.039 *(Poster)* Nonverbal Emotional Expressive Behaviours in Children with Autism: A Meta-Analytic Review

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Background: Children with autism spectrum disorders are often faced with difficulty in expressing their emotions, resulting in associated social communication deficit. Children with autism spectrum disorders have impaired use of multiple nonverbal social communication behaviours. Deficits in gestural communication are characteristic of children with autism spectrum disorders. Nonverbal behaviour impairments may include decreased eye contact, restricted affect, limited visual tracking and eye-gaze, and reduced social smiling. This study was a meta-analysis review of emotional expressive behaviour in children with autism spectrum disorders. It evaluated nonverbal social affective cues such as; gestures, gaze behaviour, eye-contact, body posture in emotion expression in children with autism spectrum disorders.

Objectives: The goal of this meta-analysis was to a) summarize what is known about nonverbal social communication behaviour in autism spectrum disorders, b) evaluate how children with autism spectrum disorders make use of nonverbal behavioural cues as part of their emotion expression, and c) identify impairment of nonverbal social behaviour in children with autism spectrum disorders.

Methods: A systematic search was performed in PubMed (MEDLINE), ProQuest (Psychology Database), ScienceDirect (Elsevier) + (Springer-Link; Journal of Autism and Developmental Studies) for papers published between 1998 to 2018. Studies included were those examining social-emotional affective behaviour in the form of any nonverbal action/cues/signals such as; eye-gaze, body posture, gestures and facial affect expression were examined for their effect sizes. All the quantitative data analysis was performed using the Comprehensive Meta-Analysis software program.

Results: 13 studies which tested 331 participants were included. Results show an overall standardized random effects mean effect size grand standard mean deviation of Hedges's *g* 0.357. This medium effect size influence indicates that children with autism have difficulty in the use of nonverbal social communication behavioural cues in their emotion expression. A 95% confidence interval with limits ranging from 0.207 standard deviation to 0.507 standard deviation. The heterogeneity analysis showed that a 95% of the variance in SMD was true and could be attributed to the differences in the ASD group and TD group, Q (13) = 92.847, $I^2 = 87.076$, p = 0.000 means *p-value* < 0.0005 and a T^2 (Tau-squared) value of 0.562. Heterogeneity was $I^2 = 87.076$, indicating considerable greater heterogeneity.

Conclusions: This meta-analysis took a broad review of nonverbal social communicative behaviour. Results show that social communication behaviour; nonverbal cues present challenges to children with autism spectrum disorders. The measures of random effect size show no significance in the relationship between expressed emotion and the use of nonverbal cuessuch as; eye-gaze, body posture, gestures and facial affect expression. Study results and findings support the assertion that children with autism show specific deficits in acquiring convectional social communication or more general deficits that affect cognitive and symbolic functioning especially use of nonverbal emotive cues.

445.040 *(Poster)* On Motor Prediction in Autism Spectrum Disorder

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Background: There is ongoing debate on whether people with autism spectrum disorder (ASD) can use their motor system to make sense of people's behavior. The most popular way to test this ability is by using imitation tasks, in which participants are either explicitly required to repeat an action, or presented with an opportunity to imitate a partner spontaneously. The results are mixed (Hamilton, 2013; Williams, Whiten, & Singh, 2004). The hypothesis that explicit imitation may be reduced in ASD, while implicit imitation is intact or even enhanced (Sowden et al., 2016) is gaining traction, along with requests for more studies on implicit imitation in ASD (Bird et al., 2007).

Yet imitation is not the only way to assess motor mirroring. We often us our motor system to predict and respond appropriately to the behavior of others (Kilner et al., 2004; Rizzolatti, 1996). A motor prediction task is less constraining than an imitation task, lending itself to a wider variety of responsive actions by the observer. This can be leveraged to investigate not only the accuracy of motor prediction, but also sensitivity to whether the observed actions are controlled internally (i.e., freely chosen) or externally (i.e., directed from outside). For example, Pesquita et al. (2016) used a motor prediction task to show that neurotypical adults are sensitive to whether an action is freely chosen or directed. They also showed that, in neurotypical population, autistic traits are negatively associated with sensitivity to action control. Here we use this paradigm to test, for the first time, motor predictions in children with ASD.

Objectives: The present study examines whether ASD is associated with decreased ability to predict others' motoric actions.

Methods: 20 ASD and 22 typically developing children participated in the study. Participants were presented with videos of an actor who was pointing to the right or to the left, and their task was to predict where the actor would point. Unknowingly to the participants, on half of the trials the actor was directed as to where to point, while on the other half of the trials the actor was choosing the target freely. Accuracy of responses and reaction times (RT) were recorded.

Results: Participants' RT and accuracy were not affected by their diagnostic status (ASD vs. TD). Moreover, both neurotypical and ASD children were responding faster to freely chosen actions than to those directed externally. A 2 x 2 ANOVA revealed a main effect of action control, but neither the interaction with ASD status, nor its main effect were significant.

Conclusions: The present study suggests that children with ASD can predict others' actions just as well as their neurotypical peers. We propose follow-up studies and discuss this finding in context of what is known to date about availability of mirroring mechanisms in ASD.

445.041 *(Poster)* One Year Language Trajectories in Newly Diagnosed Preschoolers with ASD

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Background: One of the most prominent features in children with ASD under 3 years of age is delays in language development (Sachak, 2016). Early childhood represents a critical time window for language interventions in order to support functional/adaptive skills and create greater positive outcomes for children with ASD.

Objectives: (Aim 1) To examine language development in the first year after diagnosis in a sample of preschool children with ASD. (Aim 2) To examine family and child demographic characteristics that account for variability in language development. (Aim 3) To explore the relation between emotional control and language growth.

Methods: Preschool aged children with ASD (N=59; 7 female; M=40.8 months SD 8.6 [28-59] and a matched sample of TD children (N=48; 10 female; M=43.0 months SD 8.6 [29-55]) were enrolled in a study of attention and emotion regulation. Children with ASD were primarily recruited from a wait-list at a regional autism clinic; all children received a first-time diagnosis within the research protocol. At enrollment, autism was confirmed using the ADOS module 1 (no words n=9; some words n=29) or 2 (n=20) and standardized assessments were done to quantify communication ability (Vineland Adaptive Behavior Scales Communication Domain/ VAB), nonverbal (visual) reasoning (Mullen Scales of Early Learning), expressive (EC) and receptive (AC) language (Preschool Language Scale IV/ PLS), and self regulation and executive functioning (Behavior Rating Inventory of Executive Functioning/ BRIEF). The PLS, VAB and BRIEF were repeated at +6 months and +12 months. Difference scores (Time 3 minus T1) were calculated for standard scores; raw and age equivalent difference scores were divided by the time interval (in months).

Results: Preliminary analysis comparing ADOS module scores from T1 to T3 showed that 84% of children who received module 1 progressed to a higher module by T3, confirming an improvement in functional language. For the PLS, standard scores from T1 to T3 demonstrated a >0 change for receptive language with the ASD group showing an increase (M=8.3 SD 12; p<.001) and the TD group showing a decrease (M=-3.4 SD 11.4; p=.05). The ASD group had similar expressive language scores over time (M=2.7 SD 11.7; p=.1); while the TD group showed a decrease (M=-5.0 SD 12; p<.01). The PLS age equivalent change scores showed a similar pattern with an increase in both groups (ASD: AC=1.06, SD .48 [0-2.15]; ASD: EC=.84, SD .56 [-.33-2.13]; TD: AC=.90, SD .51 [-.08-2.3]; EC=.99, SD .58 [-.12-2.2]; *p*s =.10 to .21).

Conclusions: Our preliminary results show that children improved in their functional language skills over the first year after diagnosis, with similar to (or greater than) growth compared to TD children. Our next analysis step (Aim 2) will focus on additional factors that might impact the amount of change, specifically factors such as household income and parental education, which have shown a significant influence on early language development. Lastly, (Aim 3) we will examine the role of emotional control and growth in language development.

445.042 *(Poster)* Operationalizing Compensation in ASD Using Alternative Measures of Social Behavior and Social Cognition

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Background: Compensation is a new framework that proposes the use of alternative behavioral and cognitive strategies to explain discrepancies between levels of social cognition and expected social behavior within individuals with autism spectrum disorders (ASD; Livingston et al., 2017). Compensation research has operationalized behavioral symptoms and social cognition using the Autism Diagnostic Observation Schedule-2 (ADOS-2; Lord et al., 2012) and a Theory of Mind (ToM) task, respectively, with discrepancies between the two factors representing four patterns of compensation ("deep," "high," "low," and "unknown"; Livingston et al., 2018). However, it is unclear whether these variables properly map onto one another (i.e., whether ToM *should reliably* result in lower ADOS-2 social scores), and whether they accurately represent "real-world" social behavior. Utilization of measures which may more accurately capture the compensation construct is a needed step in advancing understanding of this nascent construct.

Objectives: 1.) Examine how use of measures that more directly assess complementary social cognitive and behavioral constructs to operationalize compensation map onto the previously proposed four patterns of compensation in youth with ASD.

2.) Examine whether age, gender, and IQ (Lai et al., 2017) differentiate these patterns of compensation.

Methods: Positive social interaction scores (SIOS-PSI) obtained from videotaped unstructured play coded using the Social Interaction Observation Scale (SIOS; Bauminger, 2002) represented participants' social behavior in "real world" interactions with peers (Table 1A). Composite social cognition (CSC) scores calculated from the self-report Children's Assertive Behavior Scales (CABS; Michelson & Wood, 1982) and self-report Test of Adolescent Social Skills Knowledge (TASSK; Laugeson and Frankel, 2006) represented participants' "real-world" social cognition (i.e., knowledge of what to do in social situations; Table 1A). Moderation models were run to assess differences in compensation patterns based on age, gender, and IQ.

Results: A scatterplot (Figure 2A) was created to map the distribution of "real-world" social behavior versus "real-world" social cognition, resembling the previous compensation scatterplot (Livingston et al., 2018). A significant interaction was found between SIOS-PSI and CSC in predicting age of participants, with "deep" compensators found to be older than "unknown" compensators (Figure 2B), and "deep" compensators also found to be older than "high" compensators.

Conclusions: Findings suggest patterns of compensation in ASD can be operationalized using more direct, complementary measures that may more accurately represent "real-world" social behavior and cognition in ASD by leveraging reliable observations of peer interaction, and utilizing measures of social cognition that more closely parallel those interactions. Using this model, "deep" compensators were older than other groups, but did not differ in IQ or gender. Therefore, some individuals with ASD may gain compensation skills through experience (similar to observations regarding camouflaging; Lai et al., 2017), rather than simply via greater cognitive capacity (i.e., IQ). Results may therefore help explain why older individuals with ASD remain less likely to obtain a formal diagnosis.

445.043 *(Poster)* Perceptions of and Behavior Toward University Students with Autism

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Background: With more ASD-diagnosed young adults attending university than ever before, understanding the challenges they face in the university environment is of critical importance (Adreon & Durocher, 2007). Among these is the presence of negative attitudes toward students with ASD in the student population. Up until now, the research has painted a mixed picture of overall explicit bias toward adults with ASD, with Dickter, Burk, Zeman, and Taylor (2019) identifying evidence of overall implicit bias against individuals with ASD. Research has not, however, examined how explicit and implicit biases toward individuals with ASD predict peer behavior in campus social interactions.

Objectives: This study aimed to create an ecologically valid interaction paradigm for examining neurotypical college students' (n =116) perceptions of and behavior towards college student confederates they believed to have ASD or not. The relationship between explicit and implicit bias was analyzed, as well as the relationships between both of these constructs and interaction behaviors, verbal and non-verbal. In addition, the design sought to account for the differential effects of stereotypically autistic behavior and a publicly-visible ASD diagnosis, as well as their interaction, on peer perceptions.

Methods: Participants completed the study in two separate half-hour sessions. In Session 1, participants completed measures of explicit and implicit bias toward individuals with ASD. In Session 2, participants engaged in a three-minute social interaction with a confederate, centered on a neutral prompt. Confederates were labeled by either membership in an ASD student organization, behavior stereotypical of ASD, both, or neither. Participants' perceptions of the confederate, verbal and non-verbal behavior towards the confederate, and attitudes towards individuals with autism were measured.

Results: Participants who interacted with someone they believed to have ASD had more negative perceptions of their partner's social ability (t = -4.58, p < .001), while self-ratings of discriminatory behavior depended on the interaction of behavior and label (F = 5.52, p = .021). Additionally, the frequency of certain behaviors such as smiling (t = -2.25, p = .027) and fidgeting (t = -2.207, p = .030) depended on whether the participant believed their interaction partner had ASD, and whether this was indicated by a label of ASD diagnosis or the presentation of behaviors consistent with ASD. Finally, participants demonstrated implicit bias against autistic individuals (t = 12.26, p < .001), which had a marginally significant association with explicit bias (r = .12, p = .087), although neither explicit nor implicit bias predicted overall behavior.

Conclusions: The present study found evidence of implicit bias against individuals with ASD, mixed evidence on explicit bias, and a positive, marginally significant relationship between implicit and explicit bias toward individuals with ASD. In general, ASD-consistent behavior tended to elicit more negative judgments of peer behavior, while an ASD label seemed to prompt a compensatory response from participants. Our findings suggest that the means by which students in the general population learn that their ASD peers have ASD has the potential to make a difference.

445.044 *(Poster)* Performance on the Benton Face Recognition Task Demonstrates a Persistent Correlation with ADOS Social Affect across Age, Sex, and IQ in Multiple NDAR Datasets

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Background: Autism Spectrum Disorder (ASD) consists of deficits in two domains: impaired social communication/interaction and restricted/repetitive patterns of behavior, interests, or activities. The severity of these symptoms, however, varies widely in different patients, and there is often poor correlation between symptom severity and impairment in function. Co-morbid symptoms, such as intellectual delay, language deficits, impaired attention, face processing deficits, aggression, anxiety, and depression can also often have a greater impact on function than the core ASD symptoms themselves. Face processing difficulty, one of the numerous co-morbid conditions mentioned above, affects a majority of patients with ASD. While not part of the DSM-5 criteria for ASD, difficulty in recognizing or utilizing facial information is thought to have significant effects on social skill deficits and can be apparent as early as 2 years of age. Thus, research is needed to characterize the relationship between abnormalities in face processing task performance and social affect scores.

Objectives: Although face processing tasks have long been used to study ASD, the importance of face recognition in ASD is still debated. Here, we assess the relationship between the Benton Face Recognition Task (BFRT) and ADOS Social Affect score in the NIMH Data Archive (NDAR).

Methods: We constructed multivariate linear models sequentially adding age, gender, and IQ for three independent NDAR collections: #2179 [n=97], NDAR #6 [n=236], and #2312 [n=135]. We assessed for consistent findings across dataset, generalizability of our models, and the relative effect of BFRT performance, age, gender, and IQ on social affect.

Results: BFRT performance was negatively correlated with social affect score in all three datasets, and persisted after controlling for age, gender, and IQ. Using all available subjects, the relationship between BFRT task performance and social affect (r=-0.37, p<0.00001) persisted across age groups, with the interesting exception of adolescence (ages 12-18), while males generally demonstrated worse social affect as compared to females (9.58 vs. 7.04, p-value<0.00001). Finally, the correlation between BFRT and social affect was stronger in subjects with higher IQs and lowest in those with the lowest IQs. To assess the generalizability of this finding, models were generated from each dataset and used to predict scores in the other datasets. These models were consistently able to explain a small but significant portion of the variance in social affect score in the other, test, datasets (avg r=0.37, all p<0.05).

Conclusions: Across 468 subjects, face recognition task impairment is both common and consistently negatively correlated with social affect. This large cohort finding informs interventional trials targeting face processing, the utility of face recognition tasks as possible early behavioral biomarkers for ASD.

445.045 *(Poster)* Predicting Camouflaging of Autistic Traits with Social Competence in a Neurotypical Undergraduate Sample

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Background: Social communication and interaction difficulties are a defining feature of Autism Spectrum Disorder (ASD). In social settings, individuals with ASD often develop techniques to "camouflage" so that their social behaviours appear similar to that of their non-autistic peers (Hull, Petrides, Allison, et al., 2017). Although camouflaging may help individuals navigate social environments, it has also been shown to result in negative psychological outcomes (Hull et al., 2017). However, it is unclear whether camouflaging is a social strategy specific to autistic individuals, or if it is a strategy that is also adopted by individuals without ASD but who have social difficulties.

Objectives: This study explored whether a relationship exists between social competence and camouflaging behaviours in a non-autistic sample.

Methods: A total of 247 participants between the ages of 17 and 34 years old (M_{age}=20.03; 176 female; 71 male) participated in this study. Participants were recruited from introductory psychology classes at Simon Fraser University. Participants completed the Wechsler Abbreviated Scale of Intelligence 2nd Edition (WASI-II; Wechsler, 2011), a demographic questionnaire, and three self-report questionnaires, including the Multi-Dimensional Social Competence Scale (MSCS; Yager & Iarocci, 2013), the Camouflaging Autistic Traits Questionnaire (CAT-Q; Hull et al., 2019), and the Brief Rating Inventory of Executive Function – Adult Version (BRIEF-A; Roth, Isquith, & Gioia, 2005).

Results: Using a hierarchical multiple linear regression, we found that in addition to gender, IQ, and executive functioning scores, participant's social competence (MSCS) scores predicted the extent to which non-autistic individuals camouflaged behaviours in social environments (F(4, 242)=22.518, p<.001; R^2=.271). Social competence (MSCS) scores accounted for 16% of the variance in camouflaging (CAT-Q) scores (R^2=.157, F(1, 242)=52.196, p<.001).

Conclusions: The current study found that lower social competence scores were associated with increased camouflaging behaviours in non-autistic participants. These results, in conjunction with results of previous studies, suggest that autistic individuals (Hull et al., 2017; Hull et al., 2019; Lai et al., 2019), as well as non-autistic individuals use camouflaging to hide or minimize undesirable behaviours when engaging in social situations in an attempt to "fit in" with others. Although camouflaging may be more prevalent in individuals with ASD whose social difficulties are clinically significant, the results of the current study suggest that camouflaging is a strategy used by many individuals who have difficulty with social interactions. Addressing the negative psychological effects of camouflaging should consider both autistic and non-autistic participants with social difficulties. In addition, given that camouflaging behaviours are being performed in an attempt to adapt one's social behavior in line with that of others', these results also highlight the importance of conceptualizing the social challenges that autistic people face within a broader relational context of interactions that include bi-directional influences and not simply a matter of reducing the stigmatization associated with the person's autistic traits.

445.046 *(Poster)* Pro-Social and Empathic Behaviors of Adolescents with ASD in Response to Others' Distress

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Background: Empathy, defined as the ability to tune into others' emotional states and to provide an appropriate affective response, has been long described as an area of difficulty for individuals with Autism Spectrum Disorder (ASD). Difficulties with the expression of empathy have been described in ASD from early childhood. However, the transition to adolescence, which requires more sophisticated empathic and prosocial behaviors, has received little empirical attention. Moreover, despite its central role in social behavior, empathic ability has been mostly assessed through self-report questionnaires rather than behaviorally. A behavioral assessment may be more sensitive in examining change following interventions that tap on empathic behavior in adolescents, such as social skills training groups.

Objectives: The current study had two objectives: (1) to behaviorally examine the empathic and pro-social responses of adolescents with ASD following a friendly stranger's distress; and (2) to test the sensitivity of this behavioral assessment to change, following social skills training.

Methods: Sixty-three adolescents aged 12-18 (M=14.13, SD=1.69), diagnosed with ASD (confirmed by ADOS-2), with no intellectual or language impairments were tested using the Pro-Social and Empathic Behavioral Assessment (PEBA) - a semi-structured interaction, which involves a 3 minute friendly conversation with an unfamiliar confederate who, on the 4th minute, expresses distress after receiving a text message. The confederate then returns to a friendly conversation on the 5th minute. Assessments were videotaped and participants were rated separately for minutes 3, 4, and 5 by blind, reliable raters, on 10 scales of nonverbal synchrony, pro-social, and empathic behavior. PEBA was administered to participants again after 8 months, with different distress manipulations, and different confederates. In between assessments, participants took part in a 16-week PEERS® (Laugeson & Frankel, 2010) intervention. In addition, participants, their parents, and their teachers filled out the Social Responsiveness Scale (SRS-2, Constantino & Gruber, 2012).

Results: Significant differences between PEBA's three coded segments (minutes 3,4,5) were found for participants' comments, synchrony of vocal intonation and facial expressiveness, and appropriate emotional reaction. During PEBA's distress manipulation minute (4), participants' emotional reaction and prosocial behavior correlated with ADOS-2 scores; participants' interest in the confederate, appropriate emotional reaction, pro-social behavior, and social understanding correlated with SRS-2 self-reported social awareness subscale; participants' synchrony of posture with the confederate correlated with parents' and with teachers' overall SRS-2 scores, and participants' appropriate emotional reaction correlated with teachers' overall SRS-2 scores.

Significant changes on PEBA scores before and after the PEERS® intervention indicated intervention-related increased interest in the confederate, synchrony of facial expressions, eye-gaze, and posture, and decreased anxiety.

Conclusions: Our results showed that the PEBA can distinguish between friendly and distressed social contexts, allowing to behaviorally measure empathic and pro-social behavior in adolescents with ASD. Different aspects of empathic and prosocial behavior were associated with adolescents' vs. parents' and teachers' report on the SRS-2, suggesting the PEBA successfully captures both perspectives. Finally, our findings on PEBA scores pre and post the PEERS® intervention support its sensitivity in measuring intervention-related changes in empathic and pro-social behavior.

445.047 *(Poster)* Resting-State EEG Asymmetry and Irritability in Children with ASD: The Autism Biomarkers Consortium for Clinical Trials.

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Background: Autism Spectrum Disorder (ASD) is a developmental disorder characterized by difficulties with social communication and behaviors. Frontal alpha asymmetry power (FAA) in resting-state EEG has been investigated as a biomarker for ASD (for review, Wang et al., 2012). Right FAA is a marker of behaviors associated with withdrawal and other negative temperament characteristics, which may contribute to trajectories in ASD. Irritability commonly occurs in ASD and has been one of the primary targets of medication clinical trials. It is unclear if irritability is linked to approach or withdrawal motivation and corresponding asymmetrical activity in the brain.

Objectives: To examine irritability as measured by the Aberrant Behavior Checklist (ABC) in relation to diagnosis, symptoms, cognition, and verbal ability, and frontal alpha asymmetry in children with ASD.

Methods: The Autism Biomarkers Consortium for Clinical Trials (ABC-CT) is a NIH funded multicenter study that investigates potential biomarkers for use in clinical trials. Parents completed the ABC-Irritability Scale (ABC-I; Fung et al., 2016), as part of a clinical battery; additional measures of clinical symptoms include the ADOS calibrated severity score and the DAS-II nonverbal and verbal IQ (to measure cognition and verbal abilities).

A high-density EEG multi-experiment battery was administered, starting with a Resting State (calm-viewing) experiment in which participants watched screen saver-like videos. EEG was processed as in Levin et al. (2018) and FAA was calculated (Sun, Peräkylä, & Hartikainen, 2017) between left and right regions. ANOVAs were conducted to compare ABC-I by group and sex; and then to examine FAA in children with and without clinical levels of irritability.

The ABC-CT interim sample consisted of 225 subjects of which 139 ASD (males=112) and 62 TD (males=40) aged 6 to 11 years had both ABC-I and valid resting-state EEG data.

Results:

There was a significant difference between groups in irritability symptoms, with TD participants (raw M=0.94 SD=1.75) reporting less symptoms than ASD (raw M=11.67 SD=9.12) ($F=84.29$, $p<.001$). There was also a sex difference with male children (raw M=8.98 SD=9.48) scoring higher than female children (raw M=6.43 SD=4.24)($F=2.94$, $p=0.09$).

Based on a clinical cutoff of 18 on the ABC-I (Brown, Aman, & Havercamp, 2002), participants were divided into high (+I) and low (-I) groups (105 ASD-I, 34 ASD+I, 62 TD-I). Because there were no TD children with high irritability, we did not include the TD children in this preliminary phase of the analysis. For the ASD children with and without clinical levels of irritability, FAA was not significantly different (ASD+I M=0.05 SD 0.28; ASD-I M=0.03 SD 0.25; $F=0.22$, $p=0.64$).

Conclusions: While ASD children were reported as having more irritability behaviors that TD children, our preliminary analysis do not suggest a relationship between clinical levels of irritability and resting-state EEG FAA. As a next step, we will examine categorical descriptions of FAA (right frontal bias, left frontal bias, and no bias) and rates of clinical irritability. We will also compare FAA to ABC-Social Withdrawal as a contrasting parent report metric of approach/withdrawal behaviors.

445.048 *(Poster)* Self-Determination in Adolescents with Autism: Findings from a Nationally Representative Sample

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Background: Self-determination refers to one's ability to cause things to happen in one's life. It has been shown to be associated with employment and postsecondary outcomes among students with Autism. Research has shown lower levels of self-determination in adolescents with Autism compared to other disability groups (Chou et al., 2017; Wagner et al., 2014), yet these studies have methodological constraints. They either used convenient sample, thus may not be representative of the Autism population or used a representative sample from the National Longitudinal Transition Study-2, which were collected more than a decade ago. Using data from the National Longitudinal Transition Study-2012, a more recent data of national representative sample, this study aims to compare self-determination in high school students with Autism to other disability groups.

Objectives: This study addressed two questions: (1) Can measurement invariance be established among the seven disability groups? (2) If so, what are the latent differences (i.e., means and variances) in the autonomy, psychological empowerment, and self-realization in youth across these disability categories? We hypothesize that students with ASD have lower level of self-determination compared with students with other disabilities**.**

Methods: We included students with IEP under the 12 disability groups described in IDEA who have completed the youth survey (n=7,150). The average age of this sample is 15 years of age,

Following measurement invariance testing, we further examined differences among latent means, variances and correlations across the disability groups (Little, 1997). We used effects coding in conjunction with the mean and covariance structures (MACS) model, allowing us to make direct comparisons on latent parameters across groups using nested chi-square tests.

Results: We applied constraints across loadings and intercepts and did not find significant differences across the disability groups. At each stage of invariance testing, CFI changes were less than .01 and/or nested models fell within 90% CI of RMSEA for each nested model comparison, so we assumed invariance. Subsequently we established a structural model to test the differences in autonomy, psychological empowerment, and self-realization. Likelihood ratio tests showed that the autism group is significantly lower than all other disability groups in autonomy. We have also found a high correlation between psychological empowerment and self-realization among autism group ($r= 0.815$), cognitive Disabilities group ($r= 0.924$), and orthopedic Impairments ($r=0.886$), suggesting that these two constructs may not discriminate from each other. Of the three subscales associated with self-determination (autonomy, self-realization, and psychological empowerment), autonomy subscale showed the greatest variability, suggesting other variables may contribute to the variability among students with Autism.

Conclusions: Consistent with previous research, the results from the current study demonstrate that adolescents with Autism continue to lag behind their peers with disabilities in self-determination. Researchers have proposed that providing support in the area of social skills may be one strategy to enhance self-determination in this population. Future research needs to further examine the contextual factors associated with low levels of self-determination in students with Autism.

445.049 *(Poster)* Sex Differences in Early Language Milestones and Later Language Functioning in Youth with ASD: The ACE Gendaar Network

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Background: Autism Spectrum Disorder (ASD) is characterized by disruptions in social, behavioral, and communication behaviors. Recognizing risk factors at a young age is important for more accurate and earlier diagnosis and timely intervention (Kover et al., 2016). Meeting early language milestones has been identified as a strong predictor of positive language outcomes individuals with ASD (Mayo et al., 2013). Females compared to males show better early cognitive and language functioning, including high risk infants with and without ASD outcomes (Messinger et al., 2015). Less is known about language trajectories in females with ASD, as they often make up a minority of research participants. In previous work, we had reported similar achievement of motor milestones (e.g., age of first walking); however meeting early language milestones did not predict the age of initial concerns, nor time to diagnosis (Harrop et al., 2019).

Objectives: To evaluate the relationship between early language milestones (age at first words, age at 3-word phrases) and youth language (CELF formulated sentences; CELF recalling sentences) and communication (Vineland communication domain) ability in a sex balanced sample with ASD.

Methods: This study used data from the ACE GENDAAR network, a four site NIH funded project examining sex-based genetic and neural differences in children with ASD. The project included 137 youth (female=60, male=77) ages 8-18 years with ASD. ASD diagnosis was confirmed via ADOS-2, ADI, and DSM-V criteria. All children scored a ≥70 on the Verbal Domain on the DAS-II to measure cognitive abilities.

To assess language, parents reported age at first words and age at 3-word phrases on the ACE Medical History (and confirmed with the ADI which includes similar items). Participants completed the CELF-4 (with analysis focusing on the subdomains Recalling Sentences and Formulating Sentences as these were available on the most participants), and parents completed the Vineland Adaptive Behavior (Communication Domain).

Results: Independent t-tests showed no sex difference in age (t[135]=0.15, p=ns) and verbal IQ (t[135]=0.38, p=ns). For females with ASD, age at first words was correlated with recalling sentences and formulating sentences (RC: r=-.36, p<.01; FS: r=-.31, p<0.05). The Communication Domains on the Vineland Adaptive Scale showed significant correlations with age at first words for females (r=-.26, p<0.05). There were no relations between age at first words and later language or communication abilities in males with ASD (RC: r=-.02, p=ns; FS: r=-.04, p=ns; communication: r=.1, p=ns)

Age at 3 words was related to recalling sentences for females (r=-.28, p<0.05) and males (r=-.25, p<0.05). Age at 3 words and formulated sentences showed correlations for males (r=-023, p<0.05). Age at 3 words and Vineland Communication scores showed no significant relation for females (r=-.13, p=ns) and males (r=-.01, p=ns).

Conclusions: Our preliminary analysis demonstrated significant differences by sex in early language milestones and relation to later language ability as a youth. Age at first words related to later language only in females with ASD; while age at 3 words was related to later outcomes for males and females. Additional analyses will explore the specificity of these relations with group of TD controls and siblings of children with ASD.

445.050 *(Poster)* Situational Use of Camouflaging in an Everyday Social Context: An Interpersonal Process Recall Study

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Background: Social camouflaging is defined as 'the use of strategies by autistic people to minimise the visibility of their autism in social situations' (Hull et al., 2019, p. 819). Many autistic adults report that, despite personal costs, they engage in camouflaging in a range of everyday social contexts such as in interactions with work colleagues, friends, and the general public (Cage & Troxell-Whitman, 2019). Whilst existing research has attempted to quantify autistic adults' camouflaging during a clinical situation (Lai et al., 2017), to date, no study has examined autistic adults' camouflaging during an everyday social situation.

Objectives: This study had two aims:

Firstly, to identify the specific behavioural and cognitive camouflaging strategies used by autistic individuals during a quasi-everyday social situation.

Secondly, to explore the process and experience of camouflaging in autistic individuals during this quasi-everyday social situation.

Methods: For the first time in autism research, this study employed Interpersonal Process Recall (IPR: Kegan, 1969, 1975; Kagan, Krathwohl, & Miller 1963a, 1963b) methodology. IPR is a qualitative, video-assisted recall interview approach designed to explore individuals' conscious yet unspoken experiences as they occurred during a specific interpersonal interaction. 17 autistic adults (8 female, 6 male, and 3 who were agender/gender neutral) participated in a ten-minute controlled social task designed to replicate a common everyday social situation. Participants then watched a video of their interaction with a researcher, actively identifying instances of camouflaging and discussing their experiences of the interaction with the aid of a semi-structured interview guide.

Results:

Results demonstrated that autistic adults use a diverse range of behavioural and cognitive camouflaging strategies during social interactions; internal and external factors modulate the use of these camouflaging strategies; and the use of camouflaging strategies combined with internal and external factors effect individuals' experience of social interactions.

Conclusions: Autistic adults report common experiences, related to both internal and external factors, in using camouflaging strategies in an everyday social context. This research can contribute to the current understanding of camouflaging and in turn improve the day to day well-being of autistic adults.

445.051 *(Poster)* Social Approach and Visual Scanpaths in Autism Spectrum Disorder and Williams Syndrome: The Role of Biographical Information

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Background: Neurodevelopmental disorders such as Autism Spectrum Disorder (ASD) and Williams syndrome (WS) provide a unique insight into the mechanisms that underpin social behaviour. Past research indicates: social avoidance in ASD (Kim et al., 2015) and elevated social approach in WS (Frigerio et al., 2006); reduced fixation towards faces in ASD (Chita-Tegmark, 2016) and increased gaze towards the eye region of faces in WS (Porter et al., 2010). While prior research in neurodevelopmental disorders has focused on perceptual information (faces displaying emotional expressions) when examining social approach and eye gaze patterns, this study investigated whether top-down biographical information could influence approach decisions and gaze patterns. Faces were primed with trustworthy or untrustworthy biographical information.

Objectives: The aims were to investigate: (a) how biographical knowledge influences social approach decisions and (b) whether ASD and WS individuals exhibit differences in gaze patterns towards faces as a function of prior biographical knowledge.

Methods: Participants included 15 individuals with high-functioning ASD, 15 individuals with WS, and 30 neurotypical controls - 15 matched to the clinical groups on chronological age and 15 matched to the WS group on mental age. All participants memorised biographical vignettes depicting trustworthy or untrustworthy characters, paired with faces displaying neutral expressions. Social approach ratings and eye movements were then recorded.

Results: Approach ratings: The only significant between group difference observed was for untrustworthy characters, which showed that ASD and WS individuals rated untrustworthy characters as significantly more approachable compared to chronological age matched controls. Within-group analyses revealed that all groups displayed the expected rank order of approach, with trustworthy characters being rated as significantly more approachable than untrustworthy characters. **Eye gaze patterns:** Significant between-group differences were observed, with the ASD group spending significantly less time looking at the eye regions of trustworthy characters relative to chronological age matched controls. WS individuals spent less time looking at the eye region of untrustworthy characters relative to chronological age matched controls. Within-group analysis showed that ASD individuals spent significantly more time looking at the eye region of untrustworthy characters compared to trustworthy characters, whereas the opposite pattern was observed in the WS group. WS individuals looked at the eye region of trustworthy characters for longer durations relative to untrustworthy characters.

Conclusions: Results suggest that both approach ratings and eye gaze patterns are influenced by prior biographical knowledge. For ASD and WS individuals, the type of biographical knowledge associated with a face determined the amount of time spent looking at the eye region. The theoretical and practical implications of this study, including the contrasting eye gaze patterns observed in ASD and WS are discussed.

445.052 *(Poster)* Social Challenges in School-Age Children with Sensory Differences, ASD, and Typical Development

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Background: Social challenges, such as making friends, engaging in play with peers, and understanding social cues and rules, are not exclusive to children with Autism Spectrum Disorder (ASD). Children with sensory differences (e.g., sensory seeking behavior, sensory sensitivities, difficulties with sensory integration, etc.) without autism (SD) also experience social challenges. Compared to typically developing peers (TD), SD children experience more conflict during play with peers and respond less frequently to the social cues of their playmates (Cosbey, 2012). Research also suggests that SD children have worse overall social adaptive behaviors compared to children without SD (Ben-Sasson, 2009). However, there is very little research investigating the differences in the social challenges of SD children compared to ASD and TD children.

Objectives: To examine differences in social challenges among school-age SD children, ASD children, and TD children.

Methods: Participants were 8-12 years old with SD (n=47), ASD (n=43), and TD (n=47) who participated in a larger study focused on understanding the biochemical, brain, and behavioral correlates of social challenges and sensory sensitivity in children with ASD (Social and Sensory Processing Study). All children in the ASD group met clinical best estimate (CBE) diagnosis using the ADI-R, ADOS-2, and DSM-5. Children in the SD group had at least one sensory difference ("more than others") on the Sensory Profile 2 (SP-2; Dunn, 2014) and did not meet CBE diagnosis for ASD. Children in the TD group did not have sensory differences on the SP-2 and did not meet CBE for ASD. Social challenges were measured using the Peer Social Contact Questionnaire (PSCQ; Estes et al., 2018), SRS-2 Total Score (Constantino, 2012), and the Social Affect Calibrated Severity Score on the ADOS-2 (ADOS-SA-CC; Hus, 2014). PSCQ scores included number of friends (max=5) and two composite scores (conflict with peers [Conflict] and parent support needed during play with peers [Parent Support]). Full Scale IQ was assessed with the WASI (there were no significant group differences).

Results: The SD group differed from the ASD group on number of friends ($F(1,88)=5.65$, $p<0.05$) but did not differ from the TD group. The ASD and TD group differed on number of friends ($F(2,134)=9.49$, $p<0.01$). The SD group and ASD group differed from the TD group in Conflict ($F(2,123)=7.31$, $p<0.01$), Parent Support ($F(2, 121)=18.22$, $p<0.01$), SRS-2 Total Score ($F(2, 134)=116.84$, $p<0.01$), and ADOS-SA-CC ($F(2, 134)=86.70$, $p<0.01$). Further, the SD group differed from the ASD group on SRS-2 Total Score ($F(1, 88)= 5.59$, $p<0.05$) and ADOS-SA-CC ($F(1, 88)=61.65$, $p<0.01$). Means and standard deviations are presented in Table 1.

Conclusions: School-age SD children have a similar number of friends as TD children but have more challenges getting along with these peers and require more parent support during play interactions. SD children also demonstrate more general social difficulties than TD children but less than ASD children. Interestingly, SD children experience as much conflict with peers and need for parent support during play as ASD children, suggesting that social skill development and intervention targeting social problem-solving could be beneficial.

445.053 *(Poster)* Social Competence, but Not Autism Knowledge or Experience, Predicts Negative Judgments of Autistic Adults

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Background: Autistic individuals struggle to develop friendships, leading to social isolation and a high risk of victimization (Sterzing et al., 2012). The social challenges faced by autistic people arise in part from the behaviors of their non-autistic peers. Individuals have negative first impressions of autistic people, without knowledge of their autism diagnosis (Sasson et al., 2017). This may occur because people notice signs of poor social competence in autistic individuals and because they lack knowledge about the meaning of autistic behaviour. Interventions aimed at educating individuals about the characteristics and behaviours associated with autism may promote more positive judgements of autistic people (Gillespie et al., 2015).

Objectives: (1) Assess whether an educational intervention can promote more positive judgements of autistic individuals, and (2) whether one's previous experience with autistic individual and social competence can predict judgments and behavioural intent towards autistic people.

Methods: 148 high school students without autism participated. Condition 1: Students (n=74, M_{age}=17.23, SD=0.65) watched a live 50-minute educational presentation covering core characteristics associated with autism before completing an autism stigma task, where they judged 10-second videos of adults with (n=20) and without autism (n=20). Condition 2: Students (n=74, M_{age}=17.30, SD=0.56) completed the autism stigma task before receiving the educational intervention. Following each video in the stigma task, participants answered 10 questions that rated the perceived traits of the individual in the video and the participant's own behavioural intentions towards that individual using a four-point scale. Participants also completed the Multidimensional Social Competence Scale (MSCS) to assess social competence, and the Level-of-Contact Report (LoC) and the Quality of Past contact (QoC) to assess previous experiences with autistic individuals.

Results: A bias score was calculated by subtracting the ratings of autistic adults from those of the non-autistic adults. Autistic adults were rated more negatively regardless of the participant's condition (F(1,146)=263.607, p<.001). A hierarchical linear regression indicated that when condition (R^2=.003, p=.556) and LoC and QoC scores (R^2=.020, p=.298) were entered into the model, variance in bias scores was not accounted for. However, when MSCS scores were added (R^2=.058, F(1,134)=5.355, p=.022), a significant amount of variance in bias scores was accounted for.

Conclusions: Participants held negative judgments towards autistic individuals, replicating previous findings. Overall, the educational intervention did not reduce negative perceptions of autistic individuals. However, higher social competence predicted negative judgments, suggesting that the negative bias may involve a perception of difference between one's own and the other's social competence. Recently acquired autism knowledge (educational intervention) or previous experiences with autistic individuals (QoC and LoC) did not influence judgments of autistic individuals; further investigation is required to determine the factors that influence negative first impressions of autistic people

445.054 *(Poster)* Social Contagion Shows Distinct Patterns in Individuals with Autistic Versus Psychopathic Traits.

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Background: Contagious yawning is observed more frequently in individuals with high levels of empathy (Platek, Critton, Myers, and Gallup, 2003) and less frequently in individuals with Autism Spectrum Disorder (ASD) (Giganti & Esposito-Ziello, 2009; Helt et al., 2010; Senju et al., 2007) and individuals with high levels of psychopathic traits (Rundle, Vaughn, & Stanford, 2015).

Objectives: Although ASD and psychopathy have both been broadly referred to in previous literature as "empathy disorders," the current study aimed to investigate whether distinct processes underlie the reduced contagious yawning in these groups.

Methods: Trinity College Students (n = 73) were presented stimuli of individuals yawning or scratching on an Applied Science Laboratories (ASL) desktop eye tracking system. Participants' eye movements were tracked and analyzed for time, and percent of time fixated on the eyes of the people in the stimuli videos. Participants were administered the Interpersonal Reactivity Index (IRI) (Davis, 1980), a multidimensional assessment of empathy, the Autism-Spectrum Quotient (AQ) (Baron-Cohen, et al. 2001), The Psychopathy Personality Inventory Revised (PPI-R) (Lillienfield et al., 2005), and the Adolescent and Adult Sensory Processing Disorder Checklist.

Results: Higher empathy, lower psychopathy and lower ASD traits were all initially positive predictors of contagious yawning. However, the relationship between ASD traits and contagious yawning was mediated by eye gaze. Furthermore, ASD traits were not significantly associated with overall levels of empathy on the IRI. In contrast, psychopathic traits were significantly and inversely related to overall empathy levels. In addition, participants with high levels of psychopathic traits showed low levels of contagious itch, whereas individuals with high levels of ASD traits showed typical levels of contagious itch, and this was mediated by differences in levels of personal distress (a subscale of the IRI) between the two groups.

Conclusions: These behavioral differences between groups are consistent with the hypothesis that individuals with high levels of psychopathic traits show reduced contagion due to primary deficits in emotional empathy, whereas individuals with high levels of autistic traits show reduced contagion secondary to the avoidance of direct eye gaze and unrelated to background deficits in emotional empathy.

445.055 *(Poster)* Social and Non-Social Attention in Autism Spectrum Disorder: Stimulus Complexity and Gender-Congruence Matter

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Background: Converging evidence across methodologies suggests that females with a diagnosis of Autism Spectrum Disorder (ASD) are phenotypically distinct from males. Two areas of particular interest that have been found in both behavioral and eye-tracking studies are differences in social motivation and typical/gender-normative interests.

Objectives: We capitalized on existing eye tracking data from participants who completed three eye-tracking paradigms varying in social complexity and the *gender-typicality* of objects. Aggregating data across studies, we (a) describe the distribution of attention across each paradigm and (b) estimate the effectiveness of different stimuli for distinguishing between (1) diagnostic groups (ASD vs. TD) and (2) biological sex (male vs. female).

Methods: 67 children (6-10 years) completed three eye tracking paradigms (39 ASD, 28 TD; Table 1). The paradigms included (1) *Social vs. Object Paired Preference Paradigm* (Sasson & Touchstone, 2014)*;* (2) *Interactive Visual Exploration* (Chevallier et al., 2015); and (3) *Interactive Visual Exploration–Gendered* (Fig.1)*.* Analyses focused on common variables across paradigms; overall attention and social attention. We used a Receiver Operating Characteristic (ROC) to examine how the different paradigms differentiated based on (1) diagnosis and (2) sex.

Results: Controlling for MA and CA, we ran repeated measures GLMs examining the effects of diagnosis and sex on attention. For overall attention, there was a marginal effect of paradigm and significant main effect of diagnosis. TD groups sustained greater visual attention across all paradigms (F=7.45, p=.008). Attention was greatest to the *Interactive Visual Exploration–Gendered* paradigm. There was an interaction between paradigm and diagnosis (F=4.67, p=.03); TD groups attended to both Visual Exploration paradigms more. For social attention, only diagnosis differentiated groups (F=5.77, p=.02), with TD groups attending more to social stimuli across paradigms.

ROC-Diagnosis: For overall and social attention, the area under the ROC curve was greatest for the Social vs. Object Paradigm (Overall: .40; 95% CI=.19 - .46; Social: .46, 95% CI=.22 - .49) suggesting this paradigm most sensitively differentiated diagnostic groups.

ROC-Sex: Substituting diagnosis for sex, the area under the ROC curve was greatest for overall attention in the Visual Exploration–Gendered Paradigm (.58, 95% CI=.44 - .72). The area under the curve did not differ for social attention across paradigms.

Conclusions: Our dynamic and more ecologically valid paradigms produced the largest differences between diagnostic groups. That is, as paradigms increased in socially complexity and better approximated real life, differences between groups increased. Attention was greatest to the paradigm that included *gender* in its design. However, our ROC analyses were less conclusive than those reported by Chevallier et al (2015); despite group differences, visual exploration paradigms were not the most accurate in distinguishing between diagnoses. Instead, the simplest paradigm – Social vs. Object – had the greatest sensitivity. However, the Visual Exploration–Gendered Paradigm that considered gender in its design was the most accurate for distinguishing between males and females based on overall attention. Overall our findings suggest the design of experimental paradigms, the inclusion of greater number of ASD females and the consideration of gender within paradigm design is important for future research.

445.056 *(Poster)* Social and Non-Social Self-Assessment in Autistic Adults

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Background: Research into the cognitive mechanisms underlying social impairments in autism has largely focused on social cognitive differences, but autism is also characterized by differences in metacognition, or the awareness of one's own cognitive abilities and processes. One aspect of metacognition that may relate to functioning in autism is self-assessment, or the ability to accurately evaluate one's own ability in various domains. Self-assessment errors have been found to relate to functioning in other clinical conditions such as schizophrenia and depression but have been largely unexamined in autism.

Objectives: This study compares self-assessment in autistic and non-autistic adults for both social-cognitive and neurocognitive tasks and assessed their relations to social functioning.

Methods: 35 autistic adults and 37 non-autistic controls comparable on age (M_{ASD} = 24.49, SD_{ASD} = 5.10, M_{TD} = 23.48, SD_{TD} = 5.00) and IQ (M_{ASD} = 110.08, SD_{ASD} = 10.62, M_{TD} = 112.03, SD_{TD} = 7.47) completed three measures of social cognition and three measures of neurocognition in a randomized order. The three social-cognitive tasks were: 11) the Penn Emotion Recognition task (ER-40); 2) the short-form Benton Facial Recognition Test (BFRT); and 3) The Awareness of Social Inference Test, Part 3 (TASIT). The three neurocognitive tasks were: 1) the Line Orientation Task; 2) the Digit Span; and 3) the Matrix Reasoning Task. Following each task, participant self-assessment was measured in two ways. First, participants were told how many items there were on the task and asked to enter in the number that they thought they answered correctly. Next, participants were asked to enter the number of questions they believed the average person answered correctly. Finally, participants completed the Birchwood Social Functioning Scale (SFS).

Results: Objective and self-assessed performance on each task was standardized by computing proportion scores for each task to allow for comparison across tasks varying on total number of items. Self-assessment was then evaluated using multi-level modeling along with the Truth and Bias Model (West & Kenny, 2011).

Objective performance by autistic adults was significantly lower than TD adults on all three social-cognitive tasks and the Digit Span, but did not significantly differ on the other two neurocognitive tasks. Self-assessment did not differ between autistic and TD adults across the neurocognitive tasks, but did on the social cognitive tasks, with autistic adults exhibiting less accurate self-assessment than non-autistic controls (p = 0.039). Additionally, whereas non-autistic controls' objective performance corresponded to how they believed an average person would perform on the task (p < 0.001), this was not significant for autistic adults (p = 0.08). Autistic adults had lower scores than non-autistic adults on the SFS, but contrary to hypothesis, no relationship was found between social-cognitive self-assessment scores and SFS scores (ps > 0.22).

Conclusions: These results suggest that the discrepancy often found in autism between neurocognitive and social cognitive ability extends to self-assessment. Whether these findings have meaningful clinical or functional implications, as has been found for other conditions, warrants further study.

445.057 *(Poster)* Special Interests Play Differential Roles in Stigmatization of Autistic Compared to Non-Autistic College Students

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Background: About 35% of autistic young adults attend college within six years of graduating high school (Shattuck et al., 2012). Autistic individuals interact differently than non-autistic individuals and may be ignored or avoided by non-autistic peers--a manifestation of stigmatization and associated with fewer social relationships and mental health challenges (Link, Struening, Rahav, Phelan, & Nuttbrock, 1997). The stigmatization of autistic individuals is a growing research area, but there is limited work investigating what specific components differentially influence this stigmatization.

A majority of Autistic people report a special interest (SI) in a particular domain (e.g. music; Grove, Hoekstra, Wierda, & Begeer, 2018). It is possible the frequency and intensity with which they talk about their SI may contribute to the stigmatization they experience.

Objectives: This study examined how non-autistic college students' interest in interacting with peers was impacted by the peer's social behavior and SI.

Methods: Two cohorts of college students (cohort 1: $n = 243$; cohort 2: $n = 102$, collection ongoing) reported interest in interacting with peers. In a series of vignettes, characters were described as behaving in ways characteristic of the diagnosis Autism Spectrum Disorder (or not; American Psychological Association, 2013) and additionally described as having an SI (or not). After reading each vignette, participants indicated on a modified Social Distance Scale (SDS; Bogardus, 1933) how much they would like to engage with the peer in various activities (e.g., going to the movies). Participants also reported knowledge of autism and their relationships with autistic people.

Results: Participants reported wanting increased social distance from autistic than from non-autistic characters, $F(1.71, 406.83) = 487.06$, $p < 0.001$, $\eta 2p = 0.67$, and from characters described as having an SI than characters without, $F(1.91, 453.35) = 33.24$, $p < 0.001$, $\eta 2 = 0.12$. However, the SI effect must be considered in light of a significant interaction between diagnostic status and SI, $F(4, 952) = 11.02$, $p < 0.001$, $\eta 2p = 0.04$. Having an SI resulted in a desire for increased social distance only for non-autistic characters; for autistic characters, having an SI did not increase desired social distance (Figure 1).

Ongoing work is extending these findings by exposing a second cohort of college students at two universities to different SI topics than cohort 1 and manipulating SDS presentation method. Participants are exposed to the SDS using a traditional Likert scale and to a forced choice version (e.g., "You are going to the movies. Would you prefer to go with vignette character A or vignette character B?"). Results are being examined as in cohort 1, with additional considerations of participant knowledge of autism and relationship quality with an autistic person.

Conclusions: Findings give further insight into specific factors impacting the stigmatization of autistic college students. Stigmatization is highly influenced by social behaviors; the presence of an SI may not further stigmatize those whose social behaviors are unconventional. These findings highlight the importance of considering how to prepare neurotypical students to think inclusively about those who are different from them.

445.058 *(Poster)* The Broad Autism Phenotype and Child Functioning in Autism Spectrum Disorders: A Replication Study

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Background:

Autism spectrum disorder (ASD) is a developmental disorder that affects communication and behavior. Broad autism phenotype (BAP) traits are milder expressions of social and communication impairments than seen in those with ASD. The BAPQ is a self-reported questionnaire that assesses aloof personality, rigid personality, and pragmatic language problems - all proposed features of BAP traits. Previous studies found higher endorsement of BAP traits in parents of children with ASD than compared to parents of typically developing children (TDC). Further, greater BAP traits in parents were related to elevated autism traits in their children.

Objectives:

This study used data from the ACE GENDAAR network, a multisite NIH-funded project aimed to examine sex-based differences in children with ASD. We used this data to replicate the Maxwell et al. report and extend this to include a more balanced male:female sample. Our aims were to examine if parents of ASD children exhibit more BAP traits compared to parents of TDC, assess the relation between severity of autism in children and BAP traits in their parents, and identify if there are greater associations between paternal characteristics and child traits.

Methods:

Participants (IQ>70) included 55 ASD children (female=22) with 55 mothers and 44 fathers, and 60 TDC (female=31) with 60 mothers and 51 fathers. All participants completed a demographics questionnaire, the BAPQ, and the Social Responsiveness Scale (SRS), which measures autism traits in children. ASD diagnosis was confirmed via ADOS-2 and ADI-R.

Results:

Independent t-tests showed no significant differences in age of children between diagnostic groups (t[113]=-1.18, p=ns). Chi-squared tests found no significant differences in rates of BAP traits for either fathers (X2[95]=0.0, p=ns) or mothers (X2[115]=2.61, p=ns). Within BAPQ domains, higher rates of maternal social aloofness (X2[115]=4.94, p=0.03), pragmatic language deficits (X2[115]=10.39, p<0.01), and rigidity (X2[115]=9.77, p<0.01) were found in the ASD group. For paternal subscales, however, no significant differences were found in any of the BAPQ domains (social aloofness (X2[95]=0.768, p=ns); pragmatic language deficits (X2[95]=0.101, p=ns); rigidity (X2[95]=0.447, p=ns)).

In TDC, paternal BAPQ scores accounted for 1.8% of variance in child SRS scores (p=ns), while maternal scores accounted for 17.2% (beta=0.43, p<0.01). Higher maternal BAPQ scores related to higher child SRS scores (r=0.589, p<0.001). For ASD youth, the results were similar; paternal BAPQ scores accounted for 0.0% of variance in child SRS scores (p=ns) while maternal scores accounted for 15.5% (beta=0.39, p=0.009).

Conclusions:

Preliminary analysis showed higher rates of BAP in TD fathers compared to ASD fathers, failing to replicate Hurley. Mothers of ASD children, compared to mothers of TDC, had greater BAP subscale scores; and maternal, but not paternal, BAP traits were associated with their child's autism behaviors. As a next step, we will explore the role of reporter concordance and the female protective effect, since most child SRS ratings were provided by mothers; given our focus on females with ASD, mothers of females with ASD could possibly display more subclinical-level autism traits.

445.059 *(Poster)* The Cass: Utility of an Observational Social Skill Assessment As a Measure of Social Cognition

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Background: Impaired social skill in Autism Spectrum Disorder results, in part, from social cognitive impairments and leads to loneliness and decreased self-esteem. Social cognition and social behavior must be studied in tandem in order to assess and intervene on social competence in individuals with ASD. Unfortunately, there are few sensitive and valid clinical instruments for assessing social skill. The Contextual Assessment of Social Skills (CASS; Ratto, Turner-Brown, Rupp, Mesibov, & Penn, 2011) is a laboratory-based assessment of conversation ability consisting of two videotaped conversations with trained confederates sequentially acting interested (CASS-I) and bored (CASS-B). Trained raters code participants' social behavior, and the ecologically valid design of the CASS allows for generalization to real-world social skills. Participants' perceptions of confederate behavior might offer clinical utility to supplement this rich behavioral data but has yet to be analyzed as a metric of social cognition.

Objectives: 1) Examine CASS confederate behavior (adherence to administration instructions); 2) Examine internal and external validity of the CASS as a measure of social cognition.

Methods: Fifty adolescents with ASD participated as part of a federally funded, multi-site randomized clinical trial. Assessments included the *Social Responsiveness Scale, Second Edition* (SRS-2); *NEPSY-II* Affect Recognition, Theory of Mind, Memory for Faces, and Memory for Faces Delayed subtests; CASS; and accompanying five-item *Conversation Rating Scale* (CRS), capturing perceptions of confederate behavior (larger values reflect more perceived engagement), completed by participants and a trained rater.

Variables of interested included participants' report of perceived change in confederate behavior between CASS-I and CASS-B (CRS-Change); and the Social Ability Index (SAI), capturing differences in participants' behavior between CASS-I and CASS-B (larger SAI values indicate more normative social adaption/ greater social effort demonstrated in CASS-B), completed by trained raters. Trained raters also completed a novel, behaviorally-based, four-point scale of confederate behavior (larger values reflect more engagement), and a binary rating of confederate adherence to their assigned conversation was computed for each conversation (1= yes; 0= no).

Results: Adherence ratings were consistent across gender and site, though CASS-I confederates performed better than CASS-B ($\chi^2(100)=17.42$, $p<.001$). Participants rated CASS-I confederates as significantly more engaged than CASS-B, and participants' ratings of confederates were more neutral than the trained rater's (Figure 1). Only the CRS-Change score was positively associated with SAI, CASS-I, FSIQ, and NEPSY social cognition tasks (Table 1). Partial correlations controlling for confederate behavior did not significantly alter associations (Fisher r to z transformations; $p>.05$).

Conclusions: Findings demonstrate strong internal validity of the CASS and partially corroborate external validity via comparisons to extant social cognition measures. Though participants adjusted their behavior in CASS-B, this shift (SAI) was not related to measures of social cognition, emphasizing the nuanced differences in social behavior and social cognition. Moreover, the CASS measure appeared robust to inconsistent confederate behavior; relationships between insight (CRS-Change) and social cognitive measures were not affected by relatively interested CASS-B confederates. The CASS shows promise as an outcome measure for clinical interventions and should be incorporated into a multi-methodological battery to assess social competence in individuals with ASD.

445.060 *(Poster)* The Convergent and Divergent Validity of a New Assessment for Preschoolers' Theory of Mind - the Brief Preschool Theory of Mind Assessment.

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Background: Theory of mind (ToM) is the ability to infer the mental states of others and oneself to predict other's behaviors and generate interactions accordingly. The construct of ToM has been found to be developmental and multidimensional, including cognitive and affective dimensions. A new computerized ToM measure, the Brief Preschool Theory of Mind Assessment (BP-ToMA), has been developed to measure ToM ability in preschoolers with a developmental and multidimensional ToM construct. The reliability of the BP-ToMA has already been examined, but its convergent and divergent validities remain unsupported.

Objectives: The aim of the present study was to assess the convergent and divergent validity of the BP-ToMA by applying multidimensional item response theory models.

Methods: Typically developing children aged from 3 to 6 years were assessed with the Verbal Comprehension Index (VCI) of the Wechsler Preschool and Primary Scale of Intelligence-IV (WPPSI-IV), BP-ToMA, Theory of Mind Inventory-2 (ToMI-2), and Vineland Adaptive Behavior Scale (VABS) respectively for their verbal comprehension ability, ToM ability, ToM performance, and adaptive function. A multidimensional latent regression of the Rasch model was used to examine the relations the BP-ToMA scores with the VCI, all the subscale scores of the ToMI-2, and the standard scores of all the VABS subscales.

Results: A total of 205 typically developing children aged from 3 to 6 years old (mean = 58.91 months, SD = 11.49 months, range = 37–79 months), including 101 boys and 104 girls, were enrolled in this study. Among these 205 typically developing children, a subgroup of 141 children's caregivers completed the VABS and ToMI-2. Regarding the convergent validity, children's age, VCI, basic subscale scores of the ToMI-2, and standard scores of the communication and socialization subscale of the VABS positively and significantly predicted the two dimension scores of the BP-ToMA (all $p < 0.001$). As regards the divergent validity, the standard scores of the daily living skills subscale and motor skills subscale of the VABS significantly predicted the two dimension scores of the BP-ToMA (both $p < 0.001$).

Conclusions: In this study, the BP-ToMA has been evidenced to have good convergent validity but limited divergent validity. The BP-ToMA scores were correlated with the VCI, basic subscale scores of the ToMI-2, and surprisingly, the daily living skills and motor skills subscales of the VABS, possibly due to the synchronous rapid development of ToM ability, daily living skills and motor skills in the preschool period. The results of the present study show that the BP-ToMA is a valid measure of preschoolers' ToM ability. In future studies, an appropriate measure should be selected to examine the divergent validity of the BP-ToMA.

445.061 *(Poster)* The Correlation between Restricted and Repetitive Behaviors and Socialization in Autism Spectrum Disorder.

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Background: The core features of autism spectrum disorder (ASD) are deficits in social communication and interactions and restricted and repetitive behaviors (RRBs). RRBs include repetitive motor movements, limited interests and difficulty with changes in routines among many others. Research shows RRBs may be one factor which impairs an individual's ability to socialize (Lord, 2010).

Objectives: It is hypothesized that individuals with more severe restricted and repetitive behaviors, as determined by a licensed clinical psychologist, would score lower on the Socialization domain of the parent report measure, the *Vineland Adaptive Behavior Scales, Second and Third Edition, Parent/Caregiver Rating Form (Vineland-II, 3)*.

Methods: Participants included 156 individuals diagnosed with ASD (males n = 125, females n = 31) and data was collected over a three-year period from a community-based developmental assessment clinic. Ages of the participants ranged from 19 to 253 months ($\mu = 68.65$). The sample consisted of 30.8% Caucasian, 28.2% Latino, 16.7% Black, 10.9% Biracial, and 3.2% Asian participants. It is important to note 1.9% selected 'other' in relation to ethnicity. Individuals were assessed using the *Autism Diagnostic Observation Schedule, Second Edition (ADOS-II) and the Vineland-II and 3*.

Results: As hypothesized, there was a significant negative correlation ($r=-.317$, $p<.001$) found between the severity of restricted and repetitive behaviors and parent reported socialization skills.

Conclusions: The results suggest children who demonstrate more severe RRBs appear to have greater difficulties socializing, according to their parents. This relationship may be explained by the potential impediments RRBs may have on socialization. These impediments may include but are not limited to, restricted interests negatively impacting social interactions, repetitive motor movements drawing negative attention towards the child, and difficulty completing unstructured activities.

445.062 *(Poster)* The Effect of Bilingualism on Cognitive and Affective Perspective Abilities in Autistic Adults.

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Background: Research in neurotypical people has described a positive influence of bilingualism on the development of specific cognitive and social skills such as cognitive and affective perspective taking. However, an understanding of the cognitive influence of bilingualism in autism is lacking, especially in social processes, a recognized source of challenge for autistic people.

Objectives: This study aims to describe the influence of bilingualism on cognitive and affective perspective taking skills in autistic adults.

Methods: We recruited 39 autistic adults living in the U.K., who knew more than one language. Participants completed a language history and demographics questionnaire, an executive function task, a standardised non-verbal IQ test, and a video-based task, the Adult-Theory of Mind – extended (AToMe) task, measuring level 1 ("What does Jess think?", one-step perspective taking), level 2 ("What does Jess think Billie thinks?", two-steps perspective taking), and general cognitive and affective perspective taking processes. This task involved 6 social videos each followed by 5 questions (general, level 2 cognitive, level 2 affective, level 1 cognitive, level 1 affective), and 6 control videos, each followed by a non-social question. The videos lasted 30 to 60 sec, and participants had 30 sec to answer each question. Answers were given 0, 1, or 2 points based on their accuracy. Points were summed to obtain the following 9 scores: Control, Social, General, Cognitive, Affective, Cognitive Level 1, Cognitive Level 2, Affective Level 1, Affective Level 2. Further details regarding the methods are available at https://osf.io/vjfnh.

Results: The final sample includes 39 participants (41% female), aged between 16 and 61 ($M = 33.2$ years, $SD = 12.9$ years), with a Perceptual Reasoning Index between 101 and 145 ($M = 119.8$, $SD = 10.4$). Nine participants reported knowing 2 languages, 15 reported 3 languages, 15 reported 4 languages or more, with a wide range of ages of acquisition (for example, ages of acquisition for the second language ranged from 0 to 58 years, $M = 7.5$ years, $SD = 6$) and a wide range of proficiencies in all their languages. We will analyse the continuous relationship between three markers of bilingualism (i.e. number of languages, age of acquisition or the second language, proficiency in the second language) and perspective taking ability scores from the AToMe, using a multiple linear regression analysis.

Conclusions: This study is the first to measure the influence of various bilingualism features on the cognitive and affective perspective skills of autistic adults. This deepens our understanding of the ability of the autistic mind to approach and respond to language learning, in terms of non-linguistic social processes. This will contribute to an evidence base for families and practitioners to support autistic people in their language learning journey and autistic people in a bilingual setting.

445.063 *(Poster)* The Impacts of Social and Coping Skills on Real-Life Social Participation of Adolescents with Autism Spectrum Disorder in Taiwan

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Background: Individuals with autism spectrum disorder (ASD) who are not cognitively impaired commonly report social isolation and negative experiences in social participation even though they are high functioning. Given the increased social expectations and complexity in social scenarios compared to childhood, adolescents with this diagnosis may be more aware of their social difficulties and require better coping strategies to manage stress-evoking social situations in real life. To address their specific social needs, knowledge of how social and coping skills influence their social experience is crucial to identify targets for intervention and support their social participation.

Objectives: The purpose of this study was to explore how adolescents with ASD who were not cognitively impaired perceived their rea-life social participation and identify the impacts of ASD symptoms and social and coping skills on their perceptions of social engagement.

Methods: Fifty-six Taiwanese with ASD who were not cognitively impaired (49 males; aged 10-16 years) participated in the study. They carried an iPhone that prompted them randomly, 7 times/day during their free time for 7 days, to record what they were doing and the perceptions in the involved situation including the levels of interest, involvement and perceived difficulty. Multilevel modelling was conducted to analyse the perceptions in social engagement. In addition, we examined the moderating effects of ASD severity measured by Social Communication Questionnaire, and social and coping skills evaluated by the Social Skills Improvement System Rating Scales and Coping Inventory, respectively, on their social experience.

Results: Participants were more likely to have high levels of interest but perceived difficulty while they were engaged in social activities than other activities (ORs= 10.85, 2.45; 95% CIs=3.53-33.35, 1.06-5.67; p's<0.05). Those with higher levels of social and coping skills were more likely to be more interested in social activities (OR=17.77, 1.06; 95% CIs=5.10-61.93, 1.02-1.11; p's<0.05). More importantly, participants with better coping skills had lower changes to perceive difficulty during social engagement (OR=0.13; 95% CI=0.02-0.81; p<0.05). However, those with more ASD symptoms were more likely to have higher levels of interest in social engagement (OR=1.29; 95% CI=1.10-1.52, p<0.01), but less likely to be involved and perceive difficulty while engaging in social activities (ORs=0.85, 0.78; 95% CIs=0.77-0.94, 0.62-0.98; p's<0.05).

Conclusions: Findings highlight the importance of coping skills in managing difficult social interactions among adolescents with ASD who are not cognitively impaired. Further, those with less ASD symptoms may have greater insights in social impairment, leading to a fear of social interactions. In addition to social skills training, intervention services should target developing adaptive coping strategies and promoting self-perceptions of social competence to enhance their experience in real-life social participation.

445.064 *(Poster)* The Problem-Solvers: Moderating Effects of Social Cognition on the Relation between Identifying and Solving Social Problems in Youth with ASD

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Background: Socially appropriate interpretation and response are important skills to implement during situations involving social problems (i.e., a child needs to determine how to get her social needs/desires met); ample research has shown that children with autism spectrum disorder (ASD) struggle with social problem solving (SPS; Channon et al., 2001; Stichter et al., 2012; Russo-Ponsaran et al., 2015). Some children with ASD can *identify* the presence of a social problem but cannot come up with an appropriate *solution*; others may be able to identify an appropriate solution *without* naming the problem. It may be, then, that some youth can leverage the ability to read the emotions (emotion recognition; ER) and intentions (Theory of Mind; ToM) of others to facilitate solution identification. Youth with ASD struggle with each of these, but evidence suggests considerable heterogeneity within the population (Pelphrey et al., 2011). Given these difficulties in ASD and the commonality of social problems, it is important to understand how social cognitive skills affect the process of SPS, particularly the relationship between problem identification and correct solution identification; however, little research has examined social cognition's effect on this relationship in youth with ASD.

Objectives: The current study examined the moderating effect of ER and ToM skills on the relation between problem identification and correct SPS in children with ASD.

Methods: 58 children (44 male; M_{age}=8.53, SD_{age}=1.33) with IQ≥80 (M_{IQ}=103.72, SD_{IQ}=14.33) and ADOS-2 confirmed ASD diagnosis completed SELweb, a computerized, self-administered assessment of social cognition (McKown et al., 2015; Russo-Ponsaran et al., 2019). SELweb includes several tasks testing various aspects of social cognition, including SPS (Figure 1), ToM, and ER. To test the hypothesis that ER and ToM ability moderate the relationship between social problem identification and correct SPS, moderated multiple regression analyses were conducted.

Results: ER ability marginally moderated the relationship between problem identification and solution identification, such that the relation was present only when ER skill was low or moderate (Figure 2A). ToM skill significantly moderated the relationship between problem identification and solution identification, such that the relationship was present only when ToM skill was low or moderate (Figure 2B).

Conclusions: Social problem identification was found to predict correct solution preference when ToM skills were low or moderate. A similar relationship was found when ER skills were low or moderate. This suggests that identification of a social problem may only relate to better solution preference in children with ASD and low or moderate ER and ToM skills. Interestingly, those with average ToM skills, whether they identified the presence of a social problem or not, selected more competent solutions. Thus, perspective-taking ability can facilitate selection of effective social solutions; however, consistent with the compensatory account of ASD social cognition (Livingston et al., 2018), even at lower levels of this ability, youth with ASD may be able to deduce effective solutions so long as they can identify the presence of a problem. This provides guidance for social interventions, highlighting which individuals may benefit from training in identifying social problems.

445.065 *(Poster)* The Role of Reciprocity in Interaction Success in Naturalistic Conversations of Autistic and Neurotypical Peers

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Background: Difficulties in reciprocal communication in ASD are well documented. Although it is assumed that reciprocity plays a large role in social-interactive success, few studies have directly tested the extent to which the reciprocity of a face-to-face conversation impacts the success of the interaction. Furthermore, most previous observational studies of conversational behavior in ASD have employed structured interactions with clinicians, friends, or family members. Thus, few studies capture the everyday scenario that autistic individuals typically find most challenging: unstructured conversation with an unfamiliar peer. Finally, while most prior research has examined social-interactive behavior at the level of the individual, a more complete understanding of dyadic interaction may require analysis at the level of the dyad.

Objectives: In dyads of unfamiliar children and adolescents engaging in unstructured social interaction, we examined the effect of conversational reciprocity on participant-reported interaction success.

Methods: Participants were paired within 1 year of age (age range: 9 to 16 years). The current sample includes 26 same-gender dyads: 15 homogeneous dyads (both partners neurotypical; 3 female dyads) and 11 heterogeneous dyads (one partner neurotypical, one autistic; 2 female dyads). Data collection is ongoing; based on current testing rates, by the time of presentation we expect the sample to have roughly doubled and to include homogeneous autistic dyads.

Video recordings of 5-minute unstructured peer interactions were coded by multiple raters for the following indices of reciprocity: (1) ratio of time talking, (2) ratio of questions asked about each other, and (3) observer ratings of conversational efficacy (including appropriate turn-taking and ability to maintain the flow of conversation; Usher et al., 2015) averaged within dyads. Interaction success was assessed via self-report (Berry & Hansen, 1996); dyadic interaction success was defined as the product of scores from each dyad member.

We performed multiple regression analysis to determine the amount of variance in dyadic interaction success explained by the above reciprocity variables, as well as verbal IQ (product of each dyad member's score), average age of dyad, and dyad type (homogeneous or heterogeneous).

Results: Conversational efficacy predicted dyadic interaction success with marginal significance ($t(19) = 2.08$, $p = .05$); the two variables were significantly positively correlated ($r = .42$, $p = .03$). No other predictors had a significant effect on dyadic interaction success. Dominance analysis revealed that conversational efficacy uniquely explained 17% of the variance in dyadic interaction success.

Conclusions: Preliminary results show concordance between observer ratings of participants' ability to engage in reciprocal conversation and participants' subjective experience of the interaction. Thus, we provide direct support for the widely held assumption that reciprocal communication plays a meaningful role in the success of peer interactions among autistic and neurotypical individuals alike, regardless of pair type. More broadly, we demonstrate the feasibility of using naturalistic, unstructured paradigms to study social-interactive behavior in children and adolescents with ASD. Future analyses will examine the role of reciprocity in interactions between two autistic individuals. We will also explore other measures of reciprocity such as more quantitative measures of turn-taking and exchanges of congruent information.

445.066 *(Poster)* Theory of Mind and Broad Autism Traits in Young Adults

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Background: Autism spectrum disorder (ASD) involves difficulties with theory of mind (TOM) capacity. Some evidence suggests that TOM abilities might vary within the general population (Baron-Cohen et al., 2001), as part of a broader trend of variability in ASD traits within the population. This study investigates whether differences in TOM are unique to the diagnosis of ASD, or whether such differences vary as a function of ASD traits more broadly. This information is useful for understanding the underlying mechanisms of ASD symptoms.

The present study assessed both verbal and nonverbal tasks thought to tap into theory of mind abilities, as a function of ASD traits. *Verbal tasks* were the Reading the Mind in the Eyes Test (RMET; Baron-Cohen et al., 2001), to assess emotion recognition and mentalizing processes, and a Mental State Verbs (MSV; Schwanenflugel et al., 1998) task. The MSV task tests an individual's tendency to assign mental verbs to groups based on the activities they describe, for example grouping 'reason' and 'estimate' together as mental processes. The *nonverbal task* was the Social Attributions Task (SAT; Johannesen et al., 2013), which assesses the tendency to attribute social characteristics to animated geometric shapes.

Objectives: This study probed how multiple aspects (verbal and nonverbal) of TOM capacities relate to broader ASD traits in a non-clinical sample.

Methods: A total of 106 undergraduate students participated (see Table 1 for demographic details). Participants completed the tasks, along with the Autism Spectrum Quotient questionnaire (AQ), via an online survey platform within a laboratory environment under supervision of an investigator.

Results: Correlations between task scores and the AQ are shown in Table 2. The RMET was positively correlated with both the MSV and SAT, suggesting that these disparate aspects of TOM "hang together". The RMET was negatively correlated with total AQ scores, as well as AQ Communication and Imagination subscales. Thus, poorer performance on the RMET was associated with higher levels of ASD traits. MSV performance was not related to total AQ scores, but was related to the AQ Attention to Detail and Imagination subscales. Nonverbal SAT performance did not correlate with total AQ or any subscales.

Conclusions: These findings replicate and extend prior research with the RMET (Baron-Cohen et al., 2001), demonstrating that emotion recognition and mentalizing skills relate to other verbal and nonverbal TOM capacities. The ability to group mental state verbs into mental categories appears to be specifically related to higher attention to detail and imagination abilities. This finding suggests a nuanced interaction between ASD traits and verbal TOM, such that the ASD trait to attend more to details relates to higher verbal TOM, while the ASD trait of poorer imagination ability relates to lower verbal TOM. Nonverbal theory of mind, as tested with the SAT, appears unrelated to broader autism traits. Findings suggest that there are some variations in verbal TOM abilities in the general population as a function of ASD traits, but not in nonverbal abilities. Although, differences in task difficulty should be considered.

445.068 *(Poster)* Video Game Use and Its Association with Aggression and Social Satisfaction in Adolescents with Autism Spectrum Disorder

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Background: Adolescents with autism spectrum disorder (ASD) play video games more often and for a greater amount of time than those with typical development (TYP) (Mazurek & Wenstrup, 2013). Studies in those with TYP suggest an association between aggression and video games (Saleem et al., 2018), although this has been disputed (Kühn et al., 2018). While those with ASD exhibit increased rates of aggression compared to their TYP counterparts (Mays et al., 2011) (Kim et al., 2000), few studies have specifically looked at associations between video game playing and aggression in ASD (Mazurek & Engelhardt, 2013). Video game players with ASD may struggle to interact and engage with other peers, both in person and over social media (Mazurek & Wenstrup, 2013).

Objectives:

1. Compare the frequency and amount of video game playing in adolescents with ASD and TYP.
2. Examine the association between video game playing and aggression in adolescents with ASD.
3. Examine the association between video game playing and social satisfaction in adolescents with ASD.

Methods: 42 adolescent participants with ASD, assessed using the Autism Diagnostic Observation Schedule (ADOS) (Lord et al., 2000) and Social Communication Questionnaire (SCQ) (Rutter et al., 2003) (Age = 14.92 (1.77); FSIQ = 100.69 (14.73)) and 47 with TYP (Age = 15.13 (1.81); FSIQ = 109.81 (12.46)) completed the Youth Self Report (YSR) and the Child Behavior Checklist (CBCL; parent report) questionnaire (Achenbach System of Empirically Based Assessment (ASEBA) (Achenbach & Rescorla, 2001; 2003)). The YSR and CBCL include reports of favorite hobbies and time spent on them compared to others of the similar age, as well as assessments of aggressive behavior.

Social functioning was assessed using an adaptation of the Global Functioning: Social (GF:S) scale which is a clinician administered semi-structured interview that examines peer relationships and focuses on age appropriate interactions, social withdrawal, and isolation (Cornblatt et al., 2007).

Results: Participants were categorized into three groups: don't play/play less than average, average, and more than average. Results from YSR (X^2 (2, n = 89) = 7.196, p < .05) and CBCL (X^2 (2, n = 89) = 5.091, p < .1) indicated a significant group (ASD, TYP) by video game play category interaction. Post-hoc testing showed significant diagnostic group differences between the don't play/less than average categories in the YSR and the more than average categories in both the YSR and CBCL (Figure 1a,b). No significant differences were found in CBCL Aggression scores between those with ASD who play video games versus with those who do not (Table 1). Participants with ASD who play video games (CBCL) had higher GF:S scores than those who do not play video games (X^2 (2, n = 42) = 7.13, p < .05).

Conclusions: While adolescents with ASD play more video games than their TYP peers, video game playing in ASD is not associated with increased aggression and is associated with greater social abilities. Future analysis will be done on the same cohort at a second time-point to analyze aging through adolescence into early adulthood.

445.069 *(Poster)* Visual Attention Modulated By Dialogue during Dynamic Naturalistic Scenes

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Background: Studies have shown that people with Autism Spectrum Disorder (ASD) visually attend to social elements (i.e. heads and bodies) less than Non-ASD peers (Chita-Tegmark, 2016). Work using eye tracking has also shown that differences in visual patterns within ASD are more pronounced in socially dynamic stimuli when compared to static stimuli (Speer et. al., 2007). It is unclear if this reduced social attention is an independent pattern of ASD or if it is related to communication deficits, making social elements less tolerable during scenes high in dialogue.

Objectives: To investigate if visual attention to social and non-social information within ASD and non-ASD populations is modulated by the presence of dialogue.

Methods: Participants were 50 children with ASD (*Mean Age*=7.08 years, SD=2.16) and 75 children without ASD (Non-ASD; *Mean Age*=6.84 years, SD=2.09). Stimuli included two 1-minute long commercially produced movie clips (*Eloise* and *The Little Princess*) depicting highly emotional social scenes. Clips were broken into 9 scenes based on natural scene cuts and categorized into two conditions: Dialogue or Action (i.e. no or minimal dialogue). Valid looking time was calculated for each region-of-interest (ROI): (a) %Head (including eyes, mouth, and outerhead regions), (b) %Body, and (c) %Background (all non-social elements). Linear mixed models were used to examine effects of group, condition, and their interaction.

Results: Two-way ANOVA for each ROI revealed the following: For %Head: group (p<.001) and condition (p<.001) effects, with no interaction (p=.557), with the ASD group looking less at heads than Non-ASD (d=-.612). %Head was lower during Action scenes as compared to Dialogue (d=-1.92). %Body: group (p=.011) and condition (p<.001) effects, with no interaction, with the ASD group looking more at bodies. %Body was higher during Action scenes than Dialogue scenes. %Background: group (p<.001) condition (p<.001) effects, and their interaction (p=.048) were observed (ASD: Action M=30.4%, Dialogue=15.7%; Non-ASD: Action M=23.0%, Dialogue=10.8%), with greater between-group differences in Action (d=.709) than Dialogue (d=.462), and greater between-condition differences in ASD (d=1.40) as compared to Non-ASD (d=1.16).

Conclusions: Contrary to expectations, children with ASD showed consistent visual attention patterns while watching dynamic naturalistic scenes regardless of dialogue. Although both groups showed similar patterns, valid looking time for each ROI differentiated the groups, with the ASD group looking at the Background more and Heads less than the Non-ASD group for both conditions. This suggests that atypical visual attention in ASD is pervasive with or without a speech component. It is important to note that Action scenes depicted highly-emotional and suspenseful situations. Thus, despite the lack of dialogue, Action scenes may have engendered empathetic or social referencing responses in Non-ASD children, effects not usually apparent within ASD. Further work will investigate relationships between scanning patterns and phenotypic characteristics at an individual level.

445.070 *(Poster)* Visual Scanning Patterns Predicting Theory of Mind Performance Using Static and Dynamic Stimuli

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Background: Impairments in mentalizing represent a key deficit in social cognition for children with autism spectrum disorder (ASD). Explicit mentalizing tasks, such as the Reading the Mind in the Eyes Test, have shown promise as an outcome measure in social intervention studies. However, performance on explicit mentalizing tasks can be variable, even as individuals with ASD continue to struggle with applying mentalizing skills within everyday contexts. One hypothesis is that overall accuracy measures on explicit mentalizing tasks may not fully capture underlying social cognition; children with ASD may be utilizing alternate, compensatory strategies and may be solving mentalizing problems in a different way than typically-developing peers.

Objectives: To help clarify the underlying mechanisms of children's mentalizing performance, we developed a computerized battery of social-cognitive measures co-registered with eye-tracking. By examining visual scanning patterns as participants completed mentalizing tasks, we aimed to measure not just whether children were accurate in their social attributions, but also how they were attempting to make social attributions on a moment-by-moment basis. Because mentalizing impairments tend to be most apparent in everyday contexts, we compared visual scanning patterns predictive of mentalizing performance and social disability across tasks using increasingly naturalistic stimuli, including still images and dynamic facial expressions and gestures.

Methods: Participants included 20 verbally-fluent children with ASD (16 male, 4 female) between the ages of 8 and 11 years old who represented a broad range of severity in ASD symptomatology (ADOS-2 Calibrated Severity Score: mean=8.4 [3.4]). Participants were enrolled in a randomized clinical trial of a combination behavioral-pharmacological treatment targeting social cognition and social behavior; the current study focused only on data at baseline, pre-treatment.

Eye-tracking data were collected while participants completed a battery of computerized social cognitive measures, including an adapted version of the child Reading the Mind in the Eyes Test (RMET; Figure 1A-B) and a dynamic emotion recognition test developed from the Geneva Multimodal Emotion Portrayals (GEMEP; Figure 1C-D) database.

Results: Accuracy on mentalizing tasks ranged from 25 to 89% correct responses. Visual attention to nonsocial regions was positively correlated across still images and dynamic stimuli ($r=0.60$, $p<0.05$) and higher than attention to social regions ($t=2.00$, $p=0.05$). Children who exhibited higher visual attention to the eyes region of faces tended to have less severe ASD symptomatology ($r=-0.50$, $p=0.03$) and higher mentalizing accuracy ($r=0.52$, $p=0.02$). Ongoing analyses are utilizing more temporally-sensitive measures to identify visual scanning patterns that may mediate the relationship between attention to eyes and mentalizing performance.

Conclusions: The computerized social-cognitive battery yielded a broad range of mentalizing performance in our pilot sample of school-age children with ASD and identified consistent visual scanning patterns contributing to mentalizing accuracy. This new approach holds promise as a tool sensitive to change both in mentalizing performance and in underlying social-cognitive processes.

Social Neuroscience

POSTER SESSION — **SOCIAL NEUROSCIENCE**
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446.001 *(Poster)* A Meta-Analysis of Differences in Pupillary Measures between Individuals with and without Autism Spectrum Disorder

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Background: Core ASD symptoms may result from deficits in attention and arousal systems. Eye-tracking allows for objective, non-invasive examination of pupillary response, a sensitive assay of autonomic arousal and an indirect indicator of attentional allocation. Dozens of studies have examined tonic (resting), phasic (response to stimuli), and pupillary light reflex (PLR) responses in ASD. However, results of these studies have been contradictory.

Objectives: The primary aim was to conduct a comprehensive meta-analysis of the pupillary literature in ASD to determine whether and to what degree pupillary responses differ in ASD. The secondary aim was to explore whether methodological or stimulus factors influence ASD-control differences in pupillary responses.

Methods: A comprehensive search was completed using PubMed and PsychInfo. Four hundred forty-one publications were identified for closer inspection. Inclusion and exclusion criteria were applied and only studies that compared ASD to neurotypical (NT) or developmental disability (DD) controls were included. A wide range of demographic, clinical, methodological, and stimulus characteristics were coded. A blinded second rater coded 5 studies and inter-rater reliability was excellent (absolute agreement=96%). Analyses used multivariate mixed-effects meta-regression models with maximum likelihood estimation. Hypotheses were tested by estimating models separately for tonic, phasic, and PLR measures. Outliers were examined and, if findings were robust to outliers, meta-regression models with sample and methodological factors were estimated to examine whether these variables influence effect magnitude. A priori directional hypotheses, procedures, and analyses were pre-registered (osf_pupillometry_meta-analysis).

Results: Thirty-two studies (2006-2019), containing 218 effect sizes (tonic=15 studies, 27 effect sizes; phasic=23 studies, 121 effect sizes; PLR=5 studies, 70 effects sizes) were identified that met inclusion/exclusion criteria. Studies comprised a total of 1,828 participants (ASD=780; NT=813; DD=235) between 9.5 months and 37.8 years old, with a broad range of ability levels (IQ range=64-117). Tonic pupil size was significantly larger in ASD (g =+.22, Figure 1). Phasic pupil changes to *non-social* stimuli were significantly larger in ASD, while phasic pupil responses to *social* stimuli were non-significantly smaller in ASD (Figure 1 top). Within social stimuli, responses to social scenes were significantly smaller in ASD (g = -.42), but this was not observed for faces or other social stimuli. Analysis within face stimuli identified significantly smaller responses to fearful faces in ASD (g = -.45). Significant, medium-sized decreases in PLR constriction time and amplitude were observed in ASD (Figure 1 bottom). PLR latency was significantly longer in ASD, with a medium effect size. No significant effects were observed for constriction or redilation velocity or redilation time. All significant effects (*p<.05, ^p<.001) were consistent with pre-registered directional predictions.

Conclusions: Pupillary responses in ASD suggest elevated tonic arousal, relatively greater arousal and attentional allocation to non-social than social stimuli, and slower and weaker automatic responses to light flashes. These data support heightened autonomic arousal and aberrant selective attention and processing as mechanisms contributing to ASD, and suggest that tonic, phasic, and PLR responses may be useful biomarkers for screening and diagnosis. It will be important to determine the specificity and predictive value of these findings in future research.

446.002 *(Poster)* Correlating fNIRS-Based Cortical Activation during a Social Cooperation Task with Motor and Social Performance in Children with and without Autism Spectrum Disorder (ASD)

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Background:

Children with ASD present with significant impairments in social-perceptual skills and visuo-motor coordination that might affect their ability to adjust their actions to others during social cooperation tasks (Liebal et al., 2008; Fitzpatrick et al., 2017). In the past, using functional near-infrared spectroscopy (fNIRS) we have reported on lower cortical activation and poor social cooperation performance during a Lincoln Log cooperative building task in school-age children with ASD compared to those without ASD (Culotta et al., 2018).

Objectives:

In the current study, we examined the relationship between fNIRS-based cortical activation and behavioral errors in a cooperative building game as well as social functioning, autism severity, and motor performance.

Methods:

Fifteen school-age children with ASD and 15 typically developing (TD) children without ASD wore an fNIRS cap embedded with a 3x11 probe set covering bilateral middle frontal gyrus (MFG), pre/post-central gyri (PCG), inferior frontal gyrus (IFG), superior temporal sulcus (STS), and inferior parietal lobule (IPL). The children sat at a table across from an adult tester to complete the building game involving four conditions: a) Lead (L): child leads the building and adult partner follows as they build own structures, b) Compete (C): each partner builds their own structure, c) Follow (F): child follows the adult partner in building as they build own structures, and d) Turn-take (T): child and partner alternate turns to build a common structure. The caregivers of the children completed the Vineland Adaptive Behavioral Scales (VABS) and Social Responsiveness Survey (SRS) questionnaire. We also administered the manual dexterity and the upper-limb coordination subtests of the Bruininks-Oseretsky Test of Motor Proficiency, (BOT) to assess children's manual coordination skills. Parametric (Pearson's) and non-parametric (Spearman's) correlations were conducted to investigate associations between magnitude of cortical activation (average oxy-hemoglobin values) and behavioral errors in the task, social and motor performance scores, and autism severity.

Results:

In terms of behavioral errors, greater IFG activation in TD children was associated with fewer planning errors (rs= -0.28 to -0.49, $p<0.05$) whereas greater IPL and PCG activation in children with ASD was related to more planning errors (rs=0.27-0.3, $p<0.05$). In terms of motor/BOT performance, greater right MFG and STS activation in TD children was associated with better motor performance (r=0.30-0.395, $p<0.05$) and such relations were not seen in children with ASD. In terms of VABS social functioning, greater left/right STS, left/right MFG, and right IFG activation was linked to better socialization (rs= 0.32 to 0.41, ps<0.05) in TD children. Based on SRS scores, children with ASD with greater right IFG activation had better social performance (rs=-0.33 and -0.49, $p<0.05$) whereas lower left IPL activation was associated with better social performance (r=0.37, $p<0.05$).

Conclusions:

We identified multiple brain-behavior correlations in children with and without ASD, specifically greater IFG, MFG, and STS activation and lower IPL activation is associated with better motor and social performance in children with/without ASD. We plan to use these objective neurobiomarkers to examine effects of therapies targeting social cooperation skills of children and adolescents with ASD.

446.003 *(Poster)* Face Specialization in 12-Month-Old Infants at High-Risk for Autism Spectrum Disorders

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Background: The current study utilized a multimethod approach to develop a holistic perspective of face specialization in etiologically-distinct, 12-month-old infants at high-risk for autism spectrum disorder (ASD). Electrophysiology, neuroimaging, and behavior were examined in infant siblings of children with ASD (ASIBs) and infants diagnosed with fragile X syndrome (FXS). Infants with FXS and ASIBs have demonstrated different patterns of event-related potential (ERP) responses at the face-sensitive N290 component (Guy et al., 2018). Relative to low-risk control (LRC) infants, infants with FXS demonstrated greater amplitude N290, while ASIBs demonstrated an attenuated response.

Objectives: Patterns of neural activation and behavior were examined in relation to N290 amplitude in high-risk infants. Cortical source analysis was completed to investigate activation in brain regions most closely linked to specialized face processing and surrounding areas. Results from the Autism Observation Scale for Infants (AOSI) identified emerging symptoms of ASD.

Methods: Twenty-one ASIBs, 15 infants with FXS, and 21 LRC infants were recruited at 12 months of age. Realistic head models were created from structural MRIs from a subset of participants and group-specific average head models. Current density reconstruction (CDR) was calculated to examine activation in regions of interest (ROIs) believed to be relevant to face processing. The AOSI was used to assess early ASD symptoms in the areas of visual attention, social and motor behaviors. Analyses focused on the N290 ERP component, which has been most closely associated with infant face processing and is believed to be the precursor to the adult N170 (Guy et al., 2016).

Results: Results revealed different patterns of neural and behavioral characteristics associated with N290 amplitude across infants with FXS and ASIBs. CDR analyses revealed a significant main effect of stimulus type, $F(1, 55)=21.47$, $p<.0001$, and an interaction of group, stimulus type, and ROI, $F(34, 935)=1.45$, $p=.0465$. All participants demonstrated greater activation to faces than toys. LRC infants demonstrated greatest activation to faces in areas believed to reflect specialized face processing (i.e., middle and anterior fusiform gyrus, parahippocampal gyrus, and lingual gyrus). ASIBs demonstrated reduced activation in these areas, while infants with FXS displayed high levels of activation to faces across all ROIs examined. AOSI results revealed an interaction of group, electrode cluster, and electrode hemisphere, $F(8, 102)=2.49$, $p=.0164$. Infants with FXS with high-AOSI scores had the most negative N290 amplitude responses at left electrodes.

Conclusions: High-risk infant groups demonstrated unique patterns of neural activation, which may be associated with emerging behavioral characteristics of ASD, and which did not reflect typical development of specialized face processing. Infants with FXS demonstrated greater N290 amplitude, which was reflected through broad neural activation, and which was especially pronounced for infants scoring high on the AOSI. ASIB's attenuated N290 response was reflected in a muted pattern of neural activation, and was not associated with AOSI scores. This indicates that greater amplitude N290 in infants with FXS may be driven by increased ASD risk in a subset of the participants, but questions remain regarding the behavioral correlates of ASIBs' neural responses to faces in infancy.

446.004 *(Poster)* Gamma Oscillations and Visual Evoked Potentials Relate to Face Processing in Children with ASD

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Background: Considerable evidence indicates that GABAergic interneuron development and connectivity are disturbed in the prefrontal and temporal cortices in autism spectrum disorder (ASD) (Casanova *et al*., 2002), contributing to excitatory-inhibitory disruption (Levitt, 2005). Previous electroencephalography (EEG) studies report that increased spontaneous gamma power at rest and attenuation of P100 amplitude in visual evoked potential (VEP) tasks reflect excitatory-inhibitory imbalance (Cornew *et al*., 2012; Orekhova *et al*., 2007; Siper *et al*., 2016). Very few EEG studies have investigated the relationship between this imbalance and impaired face processing deficits associated with ASD (Kang *et al*., 2018).

Objectives: The current study examines the neural indices of excitatory-inhibitory imbalance and face-related brain activity in children with ASD.

Methods: EEG was recorded from 106 children with ASD (85 male and 21 female) and 54 typically-developing (TD) children (35 male and 19 female) using a 128-channel HydroCel Geodesic Sensor Net. The sample was matched on age (ASD: M=8.94, *SD*=1.60; TD: M=8.53, *SD*=1.74; p>.05), but differed on full-scale IQ (ASD: M=101.14, *SD*=17.53; TD: M=116.30, *SD*=13.44; p<.01) and the NEPSY-II: Memory for Faces Scaled Score (ASD: M=8, *SD*=4; TD: M =11,*SD*=4; p<.01). Participants were presented with videos of non-social abstract stimuli (resting-state EEG), checkerboard pattern-reversals (VEP), as well as digital images of upright faces, inverted faces, and houses on a computer monitor (N170). Dependent variables of interest were whole-scalp gamma power, P100 amplitude extracted from the occipital region, and N170 latency derived from the right occipitotemporal area, respectively. ASD symptomatology was measured using the Autism Diagnostic Observation (ADOS-2), and clinical diagnosis was determined by a licensed psychologist.

Results: There was a statistically significant difference in N170 latency for upright faces between groups ($F(1,159)=4.420$, $p=.037$; ASD: M=207.96 ms, *SD*=30.15 ms; TD: M=197.41 ms, *SD*=29.77 ms). Additionally, resting-state gamma power was correlated with VEP P100 amplitude ($r(160)=.216$,$p=.006$) and negatively correlated with the Memory for Faces subscale on the NEPSY-II ($r(160)= -.157$, $p=.048$). Finally, a linear regression was conducted to determine if P100 amplitude and gamma power predicted N170 latency for upright faces. Contrary to our hypothesis, the model was not found to distinguish between different N170 latencies for upright faces ($p>.05$).

Conclusions: Consistent with previous research, individuals with ASD exhibited longer N170 latencies to upright faces than TD individuals. Our findings also indicated that visually-evoked P100 amplitude was related to spontaneous gamma-power, suggesting that VEPs and gamma oscillations are generated by similar neuronal pools. Additionally, spontaneous gamma power was found to predict a behavioral measure of facial recognition. Nonetheless, the results suggest that gamma power and P100 amplitude may not be enough to contribute to observed differences in N170 latency. Examination of interneuron marker distributions in the general population may provide biological insight into resting-state and visually-evoked cortical signals that may explain variability in face processing.

446.005 *(Poster)* How Does Engagement Alter the Activity of Social Brain Systems?

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Background: Hypoactivation of social brain circuitry in response to social stimuli, such as faces, has been widely reported in Autism Spectrum Disorder (ASD) (Schultz, 2005*, Int. J. Dev. Neurosci.)*. However, whether hypoactivation reflects reduced engagement with social stimuli (a hallmark of ASD) or recruitment of atypical brain systems remains unknown. Here, we combine functional magnetic resonance imaging (fMRI), eye-tracking measures of visual fixation, and a novel measure of engagement - eye-blinking (Shultz, Klin, & Jones, 2011, *PNAS*) - in order to examine brain activity at moments when children with ASD look at faces that *they themselves* perceive as highly engaging—a critical control missing from prior studies. If activation of face processing systems increases to normative levels when children with ASD look at faces that they perceive as highly engaging, then previous reports of hypoactivation reflect reduced interest in the faces presented. By contrast, if face processing systems remain hypoactive, *even when children with ASD look at faces that they perceive as highly engaging,* then children with ASD may be processing those stimuli using atypical brain circuitry.

Objectives: To investigate whether children with ASD recruit the same or different neural systems as typically-developing (TD) children when looking at faces that *they themselves* perceive as highly engaging.

Methods: Simultaneous fMRI and eye-tracking data were collected while 8- to 12-year-old TD (n=8) and ASD (n=12) children viewed movie scenes of children interacting in naturalistic contexts. Children were trained in a mock scanner until movement was <3mm for 3 8-minute periods. fMRI data were collected using a T2-weighted EPI sequence (TE=25s, TR=2.15s, flip angle=90°, voxel size=3.5mmx3.5mmx3.5mm, 37 axial slices without gap). Eye-tracking measures were used to identify events-of-interest: faces perceived by viewers themselves as 'highly engaging' or 'less engaging' (Figure 1). For fMRI analyses, events-of-interest were modeled with a boxcar function. Group-level analyses were performed using FSL's 2-stage procedure to correct for multiple comparisons.

Results: Preliminary whole-brain analyses (z=2.3, cluster corrected) reveal that TD and ASD groups recruit different brain systems when looking at faces perceived, by the viewers themselves, as 'highly engaging' compared to 'less engaging' (Figure 2). TD children showed increased activation in bilateral occipital cortex, left middle temporal gyrus, bilateral posterior cingulate, left frontal orbital cortex and inferior frontal gyrus, right angular gyrus, and right fusiform gyrus. In contrast, ASD children showed increased activation in temporal occipital cortex.

Conclusions: Results provide the first understanding of brain activity when TD and ASD populations look at faces that *they themselves* perceive as engaging, suggesting that previous reports of hypoactivation in ASD were unlikely to be driven solely by attenuated engagement with presented faces. Even when children with ASD look at faces that they perceive as engaging, they process those stimuli using atypical neural circuitry – regions typically involved in object perception. Since engagement is a strong predictor of learning, understanding how engagement influences social brain circuitry can inform interventions for social learning. Immediate next steps include replicating findings in a larger sample, performing between-group contrasts, and performing region-of-interest analyses in canonical face-sensitive regions.

446.006 *(Poster)* Investigating Genetic Influence on Social Visual Engagement: Patterns of Concordance between Twins Discordant for MECP2 Duplication Syndrome

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Background: Recent evidence indicates that social visual engagement – how infants preferentially attend to their surrounding social environment – is strongly influenced by genetic variation (Constantino et al., 2017; Kennedy et al., 2017). Monozygotic twins show high concordance in levels of eye- and mouth-looking (~0.9), while dizygotic twins show reduced concordance (~0.4). Here, we present longitudinal data from a dizygotic twin pair discordant for *MECP2*, the X-linked gene encoding methyl-CpG-binding protein 2 (MeCP2): one twin is unaffected and typically-developing, while the other has *MECP2* duplication syndrome. This syndrome is characterized by moderate to severe intellectual disability and delayed development of motor skills. Children with *MECP2* duplication syndrome share many phenotypic features with ASD and are often diagnosed with ASD (Ramocki et al., 2009). By examining concordance in social visual engagement in twins discordant for *MECP2* duplication, we hope to illuminate specific genetic factors that influence behaviors relevant to the early ontogenesis of autistic social disability.

Objectives: To investigate concordance in social visual engagement between twins discordant for *MECP2* duplication syndrome using longitudinal eye-tracking-based measures of eye- and mouth-looking together with developmental assessments of cognitive and language abilities.

Methods: A twin pair discordant for *MECP2* duplication syndrome was followed for the first two years of life. Longitudinal eye-tracking sessions measured developmental trajectories of social visual engagement. Twin-twin concordance analyses quantified degree of similarity in social visual engagement between siblings. Additionally, *Mullen* and *ADOS* assessments measured expressive and receptive language, motor skills, and degree of social disability.

Results: Each twin showed distinct trajectories of social visual engagement regarding faces: in the affected twin, face-looking declined dramatically in the first 2 years, from greater than 90% to ~10%, offset by markedly increased body- and object-looking; in contrast, face-looking in the unaffected twin increased, from ~70% to ~90%, with diminishing body- and object-looking (Figure 1). For eye- and mouth-looking specifically, *MECP2* duplication clearly disrupts twin-twin concordance (Figure 2). Notably, the disruption is in absolute levels of eye-looking; when magnitude differences are accounted for, twins' *relative* levels of eye-looking are surprisingly concordant (ICC=0.64, p=0.04). This effect is specific to eye-looking: relative levels of mouth-looking are uncorrelated and remain so even when magnitude differences are corrected (ICC=0).

Conclusions: In twins discordant for *MECP2* duplication, concordance in social visual engagement is markedly disrupted. This disruption appears to be specific to the active seeking of social information in the eyes: during the first two years of life, the child with *MECP2* duplication syndrome looks progressively less at other's eyes, but when results are corrected for magnitude differences, we see that twins' relative levels of eye-looking are correlated. In addition, while prior results suggested similar levels of genetic influence on both eye- and mouth-looking, the current comparisons indicate that that influence is separable and likely driven by genetic influence on eye- more than mouth-looking. Together, these results reveal a means by which a specific genetic alteration may impact social visual engagement and the emergence of autistic social disability.

446.007 *(Poster)* Neurobiological Correlates of Biological Motion Perception and Executive Function Ability: An Exploratory Study

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Background: Executive function (EF) deficits are well-documented in many children with Autism Spectrum Disorders (ASD). Because EF is critical for planning and executing goals, deficits in EF can significantly affect daily living skills, negatively impacting quality of life and socio-communicative deficits of ASD (Hill, 2004; Lopez et al., 2005; Faja et al., 2016). Similarly, research has shown that biological motion perception (BMP) is altered in ASD, and some have argued that these alterations signal more profound deficits impacting social cognition, motivation, and perception at a fundamental level (Freitag et al., 2008). Yet, little is known about the interaction, if any, between EF deficits and neural activity supporting BMP. Understanding this interaction may facilitate the discovery of better biomarkers and leading to the development of more targeted therapies addressing both domains.

Objectives: Explore the relationship between EF ability and hemodynamic response measured by functional near infrared spectroscopy (fNIRS) in ASD and typically developing (TD) participants while they watch point-light displays of biological motion varying in emotional content.

Methods: Participants were typically developing children (TD; n=17, *Mage*=6.83 years) and children with ASD (n=28, *Mage*=7.00). Participants wore a fNIRS EasyCap (Gowerlabs) that covered prefrontal and temporal cortices while viewing five blocks of eight interleaved BMP and rotation trials. Blocks were separated by 15s children's video clips to re-engage participants. Data processing was conducted using a modified Homer2 software with low pass filtering (0.50 Hz) and motion artifact removal. Data were processed for outliers and z-scored within and across participants for comparability. EF was measured using the parent-report Behavior Rating Inventory of Executive Function-Preschool (BRIEF-P) and BRIEF-2.

Results: Three channels revealed significantly different hemodynamic response between condition (BMP and rotation) and group. Pearson's correlations were calculated between those channels and BRIEF scores, partialling for IQ. Correlations were observed in the left inferior frontal gyrus (IFG) (r_{all} = -.406, p = .026), where greater activation was associated with lower BRIEF scores (indicating better EF skills). An exploratory analysis revealed two additional channels associated with the left IFG were significantly correlated with BRIEF-P scores (r_{pre} = -.464, p = .01; r_{pre} = -.541, p = .002). Finally, we looked at channels where activation was significant only in the TD group. Correlations were found in the right orbito-frontal cortex (OFC) (r_{all} = .448), and right superior temporal gyrus (anterior: r_{all} = -.415, p = .023; posterior: r_{all} = -.431, p = .017)

Conclusions: This work suggests that there may be a link between EF and perception of biological motion. Relationships between EF and activation were found in two regions associated with semantic processing and emotional decision making, the OFC and left IFG. Previous studies have implicated the superior temporal gyri in social cognition, which was significantly activated in TD children watching BMP videos. This region was correlated with parent-reported EF ability, suggesting overlapping networks responding to executive function and basic social information processing needs. Further work is necessary to delineate the contributions of regional brain activation in EF ability and social cognition as measured by BMP paradigms.

446.008 *(Poster)* Neurogenetics of Female Autism Spectrum Disorder: Evidence for Striatal Impacts from Fmri Response and Rare CNV Size in the ACE Gendaar Cohort.

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Background: Males (ASDm) versus females (ASDf) are diagnosed with autism spectrum disorder (ASD) at rates of ~4:1. Here, we integrate functional magnetic resonance imaging (fMRI) and genetic data in a sex-balanced sample of ASD and neurotypical youth to characterize female-specific pathways of ASD risk.

Objectives: 1) Characterize the neurofunctional profile of ASDf response to socially meaningful motion, defined as brain regions in which typically developing female youth (TDf) display a stronger fMRI response to coherent versus point-light displays of human motion (BIO > SCRAM) than ASDf. **2)** Integrate genetic and fMRI data to evaluate the hypothesis that ASDf, versus ASDm, would show larger median size of rare CNVs containing gene(s) expressed in early life in brain regions comprising the fMRI-based ASDf profile.

Methods: We analyzed data drawn from Wave 1 of our longitudinal ACE Network project focused on ASDf (the "GENDAAR" cohort). ***For objective 1,*** we examined fMRI data from N = 90 (45 ASDf) girls aged 8-17y matched on age, estimated full-scale IQ, and head motion to determine regions where TDf > ASDf for the BIO > SCRAM contrast ($p_{corrected}$ < .05 using FSL's randomise; 10k permutations; threshold-free cluster enhancement). ***For objective 2*****,** we examined genetic data from N = 127 (61 ASDf) probands from the GENDAAR cohort. Using the BrainSpan Developmental Transcriptome, we identified genes positively expressed between 10 postconceptual weeks (pcw) and 2y within brain regions identified in our fMRI-defined ASDf profile (the *candidate gene set*). We assessed the significance of the ASDf minus ASDm difference in median size of rare copy number variants (CNVs) containing at least one of these genes via permutation testing with 10k iterations. The reproducibility of effects was assessed among N = 2,075 probands (291 ASDf) from the Simons Simplex Collection (SSC).

Results: ***fMRI results.*** TDf showed stronger BIO > SCRAM response than ASDf in widespread, primarily parietal, posterior temporal, and posterior frontal regions; largest effect sizes were observed in right ventral premotor cortex, primary motor cortex, right putamen of striatum, and right central operculum. ***CNV results.*** The ASDf-ASDm median difference in size of CNVs containing at least one candidate gene was 81,597 base pairs (bp; p = .0487); this difference was driven primarily by CNVs containing gene(s) positively expressed in right or left striatum (R/L-STR). Considering only CNVs containing R/L-STR-expressed gene(s), the ASDf-ASDm median size difference was 89,999 bp (p = .0293). Additional tests indicated that this size difference was greater than that found when considering CNVs containing any genes (p = .0178), or CNVs containing any BrainSpan-characterized genes (p = .0048). In the SSC replication, we found an ASDf-ASDm median size difference in CNVs that contained at least one R/L-STR-expressed gene of 45,133 bp (p = .0041).

Conclusions: fMRI data reveal that ASDf, versus TDf, response to human motion is characterized by decreased involvement of regions including striatum. Further, in ASDf versus ASDm, we observe larger median size of CNVs containing gene(s) expressed in early striatal development, suggesting that impacts to striatum may contribute to pathways of risk in ASDf.

446.009 *(Poster)* Occipital Resting-State Alpha Lateralization As a Predictor of Social Responsiveness in Adults with Autism Spectrum Disorder (ASD)

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Background: Abnormalities in electroencephalography (EEG) alpha-band (8-13 Hz) oscillations have been proposed as a potential biomarker for autism spectrum disorder (ASD). Research using whole-brain analyses of EEG alpha power shows that increased resting-state alpha power in the occipital region is associated with low social responsiveness. However, much of this research has ignored potential alpha power asymmetries across hemispheres and the effect of alpha lateralization on social responsiveness. The present study examines resting-state alpha power in the context of lateralization and its relationship to social responsiveness in ASD. Additionally, few studies have explored the relationship between resting-state alpha power and social responsiveness while controlling for anxiety, a disorder that appears in 40% of individuals with ASD. As anxiety has been associated with increased alpha power, it is critical to examine anxiety as a possible confounding variable.

Objectives: To understand lateralized resting-state alpha power as a predictor of social responsiveness, controlling for anxiety, in adults with ASD and typically developing (TD) controls.

Methods: Participants were 22 adults with ASD (18 male) and 37 TD controls (21 male) aged 18-38. ASD diagnoses were confirmed using the Autism Diagnostic Observation Schedule (ADOS-2) and DSM-5 clinical criteria. Participants completed the Social Responsiveness Scale (SRS-2) to measure social impairment in natural settings and the Beck Anxiety Inventory (BAI) to assess physical symptoms of anxiety. Eyes-closed resting-state EEG was recorded continuously at 500Hz with a 128-channel net. Alpha lateralization was quantified as the log of left alpha subtracted from the log of right alpha in central, frontal, and occipital electrode clusters over both hemispheres. Absolute alpha power in each region was also calculated.

Results: Linear regression analysis revealed that higher alpha lateralization over occipital scalp regions significantly predicted lower SRS T-scores in individuals with ASD (R^2=.306, F(1,20)=8.798, β=-.553,p=.008). When controlling for scores on the BAI, occipital lateralization still predicted SRS T-scores (R^2=.417, F(2,17)=6.081, β=-.453, p=.033). However, alpha lateralization did not significantly predict SRS T-scores in frontal or central regions. Lateralization did not significantly predict SRS T-scores in any regions in the TD group. An analysis of variance revealed a significant difference in absolute alpha power between ASD and TD groups in the left occipital region (p=.023) and a marginally significant difference in the right occipital region (p=.050). However, absolute alpha power from neither hemisphere independently predicted SRS T-scores.

Conclusions: Greater resting-state alpha lateralization in the occipital region predicted social responsiveness in adults with ASD, even when controlling for anxiety, a common comorbidity associated with alpha activity. While occipital resting-state alpha lateralization predicted social responsiveness, absolute alpha power in the left occipital and right occipital regions did not independently predict social responsiveness. This data suggests the importance of considering hemispheric difference in alpha power analyses of resting-state EEG.

446.010 *(Poster)* Regional Alteration of Inhibitory and Excitatory Neurometabolites in Autism Spectrum Disorder (ASD) and Its Relationship to Social Cognition

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Background: The anterior cingulate cortex (ACC) has been postulated to have a role in multiple cognitive functions including decision-making, motivation, cost-benefit analysis, and social information processing (Apps et al., 2016; Zhou et al., 2016). It serves as a crucial hub for multiple social cognition networks and has recently been found to be involved in the regulation of social behavior in mouse models of ASD (Guo et al., 2019). Neuroimaging studies have found reduced functional connectivity (Zhou et al., 2016) and altered white matter development (Barnea-Goraly et al., 2004; Zikopoulos et al., 2010) of the ACC in individuals with ASD. However, neurochemical alterations within the ACC and its relationship to ASD symptomatology has yet to be explored.

Objectives: The goal of the current study is to examine the concentration of inhibitory and excitatory neurometabolites in the ACC in youth with ASD and its role in general cognitive abilities and social cognition.

Methods: Magnetic resonance spectroscopy data were acquired using MEGA-PRESS sequences on a 3T Siemens scanner in 25 youth with ASD aged 12-21 years, and 12 age-matched typically developing controls (TD). LCModel was used for fitting of the MEGA-PRESS Spectra. In addition to offline lipid removal, post-processing included spatial- and spectral FT, B_0-correction, eddy current correction, prior-knowledge spectral fitting (GAVA), quality control (rejection of spectra with linewidth >10 Hz, signal-to-noise <8 or obvious artifact and of peaks with CRLB >20%), metabolite quantitation relative to unsuppressed water, and CSF-correction. Endpoints included estimates of GABA (inhibitory neurometabolite) and Glutamate (Glu; excitatory neurometabolite) concentrations in the ACC. Additionally, participants were administered the Weschler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Weschler, 1999) to obtain estimates of general cognitive abilities, and The Awareness of Social Inference Test (TASIT; McDonald, 2003) to measure social cognition skills

Results: Results showed that the ASD group demonstrated significantly lower Glu concentrations in the ACC than the TD group (t=-2.16, p=.04). Within the ASD group, lower Glu concentration was also associated with lower overall IQ (r=.46, p=.03). There were no significant differences observed for GABA concentration in the ACC between groups (p=.74). However, lower GABA concentration in the ACC was associated with lower TASIT scores (r=.502, p=.02) as well lower WASI-II Vocabulary scores (r=.48, p=.03) in the ASD group.

Conclusions: Our findings suggest regional alterations in key neurometabolite concentrations in the ACC in youth with ASD. It is likely that the expression of excitatory neurometabolites in the ACC plays a broader role in cognitive functioning. However, the expression of inhibitory neurometabolities in this region appears to be more closely related to social cognition and expressive communication– both areas that are known to be affected in individuals with ASD. Together with prior findings of disrupted functional and structural connectivity of the ACC, our results provide further support for neurochemical alterations in the ACC and the crucial role of this "social brain hub" in the pathophysiology of ASD.

446.011 *(Poster)* Sex Differences in the Association between Neural Response to Emotional Faces and Reciprocal Social Interaction in Adults with ASD

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Background: Sex differences in autism spectrum disorder (ASD) are well documented. For example, research has shown female advantage in facial emotion recognition. However, studies of neural response to facial emotions using event-related potentials (ERP) in ASD have often failed to consider sex differences. The N170, a face-sensitive ERP, is reliably atypical in ASD and may help to characterize sex differences in the neural processing of facial emotions. The current study compares the relationship between reciprocal social interaction and neural response to facial emotions in male and female adults with ASD.

Objectives: To assess sex differences in the association between reciprocal social interaction and N170 amplitude in response to facial emotions in male and female adults with ASD.

Methods: Participants were 24 adult males with ASD and 7 adult females with ASD. Independent samples t-tests revealed no significant differences in the age of males (M = 25.02, SD = 5.60) and females (M = 22.50, SD = 4.50). Participants completed the Wechsler Abbreviated Scales of Intelligence (WASI-II), which revealed no significant differences in cognitive ability between males (M = 103.25, SD = 19.00) and females (M = 109.29, SD = 15.27). Participants also were administered the Autism Diagnostic Observation Schedule, Module 4 (ADOS-4); the total score from the Reciprocal Social Interaction section (ADOS-RSI) is used in the current study. During EEG recording, participants were presented with faces with neutral emotions. When participants fixated directly on a face, as measured by eye-tracking, the facial expression changed to happy or fearful. N170 peak amplitude was extracted from left and right occipitotemporal electrodes. N170 peak amplitude from happy faces was subtracted from N170 peak amplitude from fearful faces to create a difference score.

Results: Linear regression analyses were used to determine whether scores on ADOS-RSI, controlling for WASI-II, predicted N170 amplitude difference scores. Among females with ASD, there was a significant negative association between ADOS-RSI and N170 difference scores in the right hemisphere, R^2=.851, F(2,4)=11.430, p=.012 (Figure 1). However, there was no significant association between these two measures among males with ASD, R^2=.157, F(2, 21)=1.949, p=.856. ADOS-RSI was not significantly associated with N170 amplitude difference scores in the left hemisphere for either males, R^2=.222, F(2,21)=2.994, p=.449 or females, R^2 =.126, F(2,4)=.289, p=.762. ADOS-RSI scores were not examined in typically developed adults due to insufficient variation caused by floor effects.

Conclusions: Our findings highlight sex differences in the relationship between neural activity and reciprocal social interaction in adults with ASD. Among females, but not males, decreased sensitivity to the difference between fearful and happy faces associated with behavioral deficits in reciprocal social interaction. These data hold significant promise for understanding the neural mechanisms guiding sex differences in the development of facial emotion processing in adults with ASD. Furthermore, this research helps to clarify when the N170, in the right hemisphere specifically, may be best used for diagnosis and stratification of ASD. Given the small number of females in our study, we plan to conduct similar analyses in a larger sample of females in the future.

446.012 *(Poster)* The Cerebellum Modulates the Acquisition of Social Information in Autism

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The cerebellum modulates the acquisition of social information in autism

Background:
Atypical social communication is a core feature of Autism Spectrum Disorder (ASD), but the neural bases of these social challenges remain unclear. The cerebellum is one candidate neural substrate: cerebellar structural and functional differences are well-characterized in ASD, and the cerebellum is engaged during a range of social tasks. More specifically, right cerebellar lobule VII shows reduced grey matter in autism, is activated during mentalizing tasks, and inhibition of this region in a mouse model yields atypical social behaviors and increased repetitive grooming. The cerebellum is thought to support various aspects of cognition through building and honing internal models of behavior. We hypothesize that cerebellar dysfunction in autism may disrupt the acquisition of social information, and that cerebellar neuromodulation may alter both performance and neural activation patterns on a social learning task.

Objectives:
The present study uses concurrent neuroimaging (functional MRI [fMRI]) and cerebellar transcranial direct current stimulation (tDCS) to investigate the impact of cerebellar neuromodulation on behavioral performance and neural activation patterns during a social ball toss game (Cyberball).

Methods:
Neurotypical adults (NT; n=16, 21.9±2.5 yrs) and adults with autism (n=10, 24.9±9.0 yrs) performed a social ball toss game, during which participants implicitly learn patterns of social reciprocity to improve their performance. Either excitatory (anodal), inhibitory (cathodal), or sham tDCS targeting right lobule VII was administered to participants prior to the game (20 min, 1.5 mA), and each participant completed all three tDCS conditions separated by one week. fMRI data was collected during task performance, pre-processed with fMRIPrep, and analyzed statistically with SPM12. The behavioral response variable was the proportion of tosses to the good reciprocal player over the course of the game, and linear mixed effects modeling was used to assess the effect of tDCS condition, session, task stage, and group.

Results:
Without modulation, participants with autism showed less social learning during the task compared with NT adults and showed reduced cerebellar activation, specifically in bilateral Crus I. Anodal cerebellar tDCS disrupted social learning in both groups, suggesting a role for the cerebellum in the acquisition of social information. While cathodal tDCS did not change performance in NT adults, adults with autism showed improved social learning following cathodal tDCS. Preliminary imaging analyses suggest that the autism group engaged bilateral Crus I following cathodal modulation, which may provide a mechanism for the improved performance in this condition.

Conclusions:
These results suggest that the cerebellum is involved in social learning, potentially playing a role in the acquisition of social information. Furthermore, preliminary results suggest that cerebellar neuromodulation may impact social behaviors in autism, through increasing activation in cerebellar regions that support successful task performance in neurotypical adults.

446.013 *(Poster)* To Mirror or Not to Mirror? the Effect of Oxytocin on Socially Adaptive Mirror System (dys)Functioning in ASD.

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Background: Individuals with ASD experience persistent difficulties during social interaction and communication. Both the Broken Mirror Theory (Ramachandran & Oberman, 2006), advancing abnormalities in the mirror system as an important neural substrate, and the STORM-account (Wang & Hamilton, 2012), proposing an impaired social top-down control of the mirror system by the mentalizing system according to the demands of the social context, provide an explanation for the social deficits in ASD.

Objectives: We investigated the feasibility of both accounts by examining interpersonal motor resonance in ASD and typically developing (TD) participants under various social conditions. A second objective was to investigate the effect of a single dose of intranasally administered oxytocin, a prosocial neuropeptide known for its therapeutic potential, on the putative mirror deficits in ASD.

Methods: To date, the data of 23 young adult men with ASD (mean age: 22 years 5 months) and 19 age- and IQ-matched TD participants (mean age: 22 years 4 months) has been collected (of the envisaged 35 in each group). Interpersonal motor resonance, as assessed by transcranial magnetic stimulation (TMS), was investigated during (a) baseline corticospinal excitability while at rest, (b) during observation of simple hand movements, and (c) during movement observation in combination with various gaze cues (direct vs. averted) from the actor. The BMT would anticipate deficits in motor resonance already when observing simple hand movements, whereas the STORM-account (based on the difficulties with eye contact in ASD) would predict a difference only in the relative effect of eye contact on motor resonance. Furthermore, ASD participants completed a randomized, placebo-controlled clinical trial with cross-over protocol to investigate the effect of a single dose of oxytocin (24 IU) herein.

Results: Preliminary results indicate no group difference between ASD and TD participants in terms of baseline corticospinal excitability when at rest, nor when observing simple hand movements (i.e. not embedded in a particular social context). Although tentative, the preliminary data indicated a more pronounced mirror response in TD participants when observed actions were combined with eye-to-eye contact compared to averted gaze from the actor, whereas for the ASD participants mirror responses were equal across both gaze conditions. After a single dose of intranasal oxytocin however, the ASD group showed a similar effect of observed gaze condition on interpersonal motor resonance as TD participants

Conclusions: Based on a preliminary analysis, we propose that people with social difficulties (such as individuals with ASD) may have an intact mirror system, but unlike social proficient participants, fail to modulate mirror system functioning according to the social context. Furthermore, although the mechanisms behind oxytocin-related improvements on social behavior are still unknown (increasing social saliency, increasing social motivation or decreasing over-arousal), a single dose of oxytocin enabled participants with ASD to show more socially adaptive interpersonal motor resonance, highlighting its therapeutic potential.

446.014 *(Poster)* fNIRS-Based Cortical Activation during a Charades Game in Children with and without Autism Spectrum Disorder (ASD)

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Background: Children with ASD have difficulties using and interpreting various forms of communicative gestures (deictic, symbolic, descriptive, etc.). In the past, we have reported on cortical activation patterns using functional near-infrared spectroscopy (fNIRS) as children with and without ASD performed/observed simple communicative gestures such as thumbs up, come, go away, etc. (Su et al., 2018). Children with ASD had lower cortical activation over the Observation-Execution Matching System (OEMS) regions of inferior frontal gyrus (IFG) and superior temporal sulcus (STS) along with increased inferior parietal lobule (IPL) activation when observing and synchronizing the gestures with an adult. In this study, we further developed an engaging charades game involving a variety of everyday, bimanual, object-related actions. We will compare gestural accuracy and synchrony as well as associated fNIRS-based cortical activation within the charades game between children with/without ASD and an adult tester.

Objectives: To compare the accuracy of gestural understanding, gestural performance, and gestural synchrony as well as associated cortical activation between children with and without ASD as they observed, performed solo, and copied various symbolic gestures during a charades game.

Methods: Fifteen school-age children with ASD and 15 typically developing children (TD) participated. An fNIRS cap embedded with a 3x11 probe set covering middle frontal gyrus (MFG), IFG, STS, pre- and postcentral gyrus (PCG) and IPL were placed on the children's head to collect cortical activation data (average oxy-hemoglobin values). The child was seated across from an adult tester. Picture cards with 18 different symbolic gestures such as brushing teeth, hammering a nail, etc. were shown to the child or the adult tester depending on the condition: a) *Watch:* child observed the adult perform an action shown to the adult only; b) *Do*: The child performed an action shown on a picture card; c) *Together*: The child was asked to copy the adult's actions as the adult performed the actions shown on a picture card to her. For the Watch and Together conditions, we asked the child to guess the performed action and the accuracy of their understanding was assessed. Additionally, during the Do and Together condition, we also assessed the time to initiate and performance accuracy. Lastly, in the Together condition we assessed the synchrony between the child and the adult.

Results: We are in the process of collecting data. Our pilot data suggest greater time to initiation and more errors in gestural understanding and performance accuracy as well as poor interpersonal synchrony in children with ASD compared to TD peers. We also expect to see atypical patterns of OEMS activation in children with ASD compared to their TD peers (lower STS and IFG and greater IPL activation).

Conclusions: Our findings elucidate the various gestural impairments in children with ASD and how that might be mediated by poor cortical activation in various OEMS regions important for gesture production and understanding. We will identify multiple fNIRS-based neurobiomarkers that could be used to assess objective neural changes following a prolonged bout of gestural training.

Statistical Genetics

POSTER SESSION — **STATISTICAL GENETICS**
447 - Statistical Genetics Posters

447.001 *(Poster)* Comparing the Genetic Architecture between High and Low-Functioning Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is one of the most highly heritable complex diseases. Hundreds of ASD genetic risk alleles have been identified, yet most are associated with the severe low-functioning forms of the disorder. The variants that mediate ASD risk in individuals with high-functioning ASD (HFA) remain largely unknown. Previous literature suggests that individuals with HFA may have a genetic architecture that is distinct from other ASD subtypes. A 2014 Iossifov *et al*. study identified an enrichment of FMRP-associated and chromatin modifier genes in all ASD cases, except in those with a higher IQ. Chang *et al*. revealed the burden of truncating mutations to be two-fold higher in ASD individuals with low IQ, compared to those with a normal to high IQ.

Objectives: This study aims to test the theory that individuals with high-functioning ASD (HFA) have a distinct genetic architecture from their low-functioning ASD (LFA) counterparts, and to elucidate unestablished genetic risk factors that contribute to HFA.

Methods: Individuals with ASD from the Simons Simplex Collection (SSC) were grouped into HFA (n = 783; M:F = 9:1; mean age = 9.2 3.6 years; NVIQ = 112.3 10.7) or LFA (n = 1789; M:F = 5:1; mean age = 9.0 3.6 years; mean NVIQ = 72.2 21.3) subgroups based on a NVIQ of at least, or less than, 100, respectively. Firstly, copy-number variants (CNVs) were called from SNP-microarray data using PennCNV and QuantiSNP algorithms, and quality controlled and annotated using methods described in Huguet *et al*. 2018. Genes present in unique CNVs in HFA and LFA groups were selected for gene-set enrichment analyses. Secondly, an individual-level polygenic risk score (PRS) was computed using the largest published ASD GWAS summary statistics through the PRSice software. Single linear regressions modeled the association between PRS for ASD and HFA status to determine whether HFA could be predicted according to respective ASD polygenic risk.

Results: Preliminary analyses identified 136 copy-number deletions and 404 duplications unique to individuals with HFA. Gene-set enrichment analyses revealed the JAK-STAT signaling pathway to be uniquely enriched in the HFA cohort (p = 3.711×10-3). The JAK-STAT pathway includes inflammatory cytokines that are implicated in glia and neuron development and may enhance brain-derived neurotrophic factor expression. The olfactory transduction pathway was uniquely enriched in the LFA group (p = 8.479×10-10). Impaired olfactory perception and ASD has been previously been linked. No significant correlation (p = 0.335) between ASD PRS and HFA status could be established, suggesting that the HFA phenotype may be mediated by other genetic risk factors than ASD-associated common genetic risk variants.

Conclusions: In this study, we shed light on, and suggest the unique, genetic architecture of HFA. Unique CNVs in LFA and HFA groups were enriched in distinct molecular pathways. However, we did not identify a correlation between ASD risk and HFA status. Future analyses will test the difference of PRS for other psychiatric traits (intelligence, ADHD, bipolar disorder, schizophrenia, depression) between HFA and LFA.

447.002 *(Poster)* Genomic Association Study of Diffusion MRI-Based Autism Endophenotypes

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Background: Autism is a multifactorial, heterogeneous syndrome that defies a simple genetic test for diagnosis. However, autism has been considered a disorder of brain connectivity. This fact suggests that different patterns of altered connectivity may be used to identify specific endophenotypes under the umbrella of the autism spectrum. If any of these more narrowly defined endophenotypes have genomic markers, it opens the door to personalized diagnosis and targeted therapy in at least a subset of ASD cases.

Objectives: We performed an exploratory retrospective study on the association of metrics of brain connectivity with genomic variation (i.e., SNPs) in people with ASD. The objective was to identify genomic loci linked with different patterns of altered connectivity.

Methods: Data comprised diffusion tensor imaging (DTI) data obtained from the NIMH Data Archive. When available, genomic variant information in the form of Illumina microarray files were obtained from the same source. DTI scans of ASD (N=123) and typically developing (TD: N=115) individuals were parcellated according to the Johns Hopkins University white matter (WM) atlas. Feature extraction identified the pairwise correlation between WM tracts in terms of their microstructural quantities (FA, mean diffusivity, etc.). Descriptors that most significantly distinguished the ASD and TD classes were used to group the ASD cases into clusters for subsequent genomic association analysis. Genes containing one or more SNPs associated at $p \leq 10^{-6}$ were selected for enrichment analysis.

Results: Cluster analysis using PAM with different numbers of clusters produced best intracluster coherence and intercluster separation for $k = 3$. Cluster 1 was associated with SNPs in 79 genes. Enrichment analysis found significant protein-protein interaction (PPI) within this set ($p = 0.0147$). There was no functional enrichment with respect to GeneOntology (GO) terms, but seven genes were associated with “neurodegeneration” in UniProt (false discovery rate/FDR = 0.0275), and three of them in particular with ”spinocerebellar ataxia” (FDR = 0.0298). Cluster 2 was associated with 715 genes with more than chance PPI ($p < 10^{-7}$) with functional enrichment in several GO concepts, most significantly “synapse”, “synapse part”, and “postsynapse” (FDR = 4×10^{-9}, 6×10^{-8}, and 8×10^{-8}, respectively). Cluster 3 was linked with eight genes and had no significant PPI ($p = 0.149$) with significant functional enrichment for GTPase activator activity: *ASAP3*, *ADGRB3*, and *DOCK4*. According to UniProt, *ASAP3* promotes cell proliferation. *ADGRB3* and *DOCK4* both interact with the Rac pathway, promoting cell migration, dendrite spine formation, and synaptogenesis. There was some overlap between the association results for cluster 2 and those for clusters 1 (13 genes) and 3 (one gene).

Conclusions: The association with spinocerebellar ataxia-related genes (cluster 1) along with the enrichment of synaptic genes (Cluster 2) and GTPase activator activity-related genes (cluster 3) are all involved in brain growth with obvious relevance to ASD as a disorder of brain connectivity. In summary, these preliminary results suggest that unique biologically relevant genes in distinct clusters drive the white matter connectivity in ASD.

447.003 *(Poster)* Rare Transmitted Variants Identify Novel Genes and Pathways Contributing to Autism Spectrum Disorder

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Background: Autism spectrum disorder (ASD) is a highly heritable disorder that affects communication, learning, and behavior. It is estimated that hundreds of genes contribute to ASD through a wide variety of genetic mechanisms, with recent studies focusing on *de novo* mutation (DNM), large copy number variants, and common variants although early exome studies suggested a transmission bias of likely-gene disruptive (LGD) mutations to affected children (Krumm et al,. *Nat Genet*, 2015).

Objectives: The goal of our current study is to compare this risk of private LGD mutations in multiplex and simplex families and to assess the relative contribution of known ASD risk genes versus uncharacterized genes to this genetic etiology.

Methods: We used whole-genome sequencing data from 3,473 complete families (4,362 affected child and 2,235 unaffected children) to identify gene sets enriched for affected children carrying a private mutation. We then performed functional enrichment studies (e.g., gene ontology) to characterize candidate genes. We replicated all of our results using whole-exome sequencing data from the SPARK consortium, which is comprised of 5,879 complete families (6,539 affected children and 3,034 unaffected children).

Results: We discover and replicate that ultra-rare LGD mutations, present in only one parent of the autism cohort, are enriched in children with autism when compared to their unaffected siblings and the effect is larger with increasing gene constraint (pLI). We show that the burden of private variants among children with autism is greater in multiplex families when compared to simplex families (OR = 1.4 (p = 0.026) vs. 1.23 ($p = 1.63e^{-4}$) at pLI ≥ 0.99) and that children with autism are more likely to carry two or more of these mutations when compared to their unaffected siblings (OR= 1.28, p= 0.0026). As expected, ASD genes previously reported by DNM enrichment studies show an LGD transmission bias to autism probands (OR = 1.36, p-value = 0.040); however, such genes only account for <5% of the genic burden suggesting that most of genes associated with inherited burden await discovery. Among the most intolerant genes to mutation (pLI > 0.99), we identify 163 new candidate genes that are enriched for protein-protein interactions (p-value = 0.0016) related to E3 ubiquitin ligation, axon guidance, and Ras signaling. We estimate that such private, inherited LGD mutations account for a comparable level of population attributable risk when compared to DNM enriched mutations in genes (4.58% vs. 7.28%).

Conclusions: We find that children with ASD are more likely to carry multiple, inherited LGD variants and the effect is larger for multiplex families. 95% of this private variant burden lies outside known DNM enriched ASD genes. We identify a set of highly constrained genes that have not been previously reported by DNM enrichment analyses highlight disease-relevant functional pathways, such as axon guidance and E3 ubiquitin ligase activity.

Technological Approaches

ORAL SESSION — TECHNOLOGICAL APPROACHES
328 - Technologies to Predict and to Classify Social and Communicative Behaviours

328.001 *(Oral)* Preliminary Feasibility of the Tedi: A Novel Assessment of Infants' ASD Symptoms Via Telehealth

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Background: Maximizing the benefits of early intervention for improving outcomes of individuals with autism spectrum disorders (ASD) depends on efficacious early screening and identification practices. The persistent lag between symptom onset and formal diagnosis underscores the urgency of improving early screening methods (CDC, 2018). Parent concerns as early as 6 months are associated with subsequent ASD diagnoses (Sacrey et al., 2016, 2015). However, families with early concerns typically face long waitlists and often must travel long distances to centers with appropriate expertise (Daniels & Mandell, 2016; Zuckerman, et al. 2005). Development of a telehealth screener has the potential to address these issues as it has been used to address disparities in access for other pediatric populations and has shown promise in early parent-implemented interventions for ASD.

Objectives: The primary aim of this study was to evaluate the feasibility of adapting current laboratory-based measures of social communication and ASD symptoms in infancy for telehealth parent administration. Adapted measures included a parent-administered Autism Observation Scale for Infants (AOSI; Bryson, et al. 2008) and the Individual Growth and Development Indices – Early Communication Indicator (IGDI-ECI; Greenwood, et al. 2010). Outcome benchmarks included feasibility, reliability, and acceptability to families.

Methods: Eleven infants, aged 6-12 months were assessed via telehealth by coaching parents to administer specific semi-structured behavioral probes (the Telehealth Evaluation of Development for Infants or TEDI) using a kit of play materials and cue cards that were mailed to the family. The AOSI was scored live by the clinician administering the TEDI and the ECI was coded offline by an undergraduate rater naive to session order and specific parental concerns.

Results: All initial feasibility benchmarks were met. Inter-rater reliability for ECI and AOSI total score was good-to-excellent ($ICC_{ECI} = .94$; $ICC_{AOSI\ total} = .65$). Test-retest reliability was high (AOSI total $r_s = .86$, $p = .002$; AOSI markers $r_s = .47$, $p = .171$; ECI $r_s = .56$, $p = .115$). Parent acceptability ratings were uniformly significantly positive (all p's <.001) in across items rating the technology, assessment components, and convenience.

Conclusions: To our knowledge, this is the first study to systematically adapt and test clinic-based behavioral screening for infants with symptoms of ASD within a telehealth protocol. Our findings support the feasibility of this approach and suggest an avenue for conducting future larger-scale feasibility studies, with a long-term goal of prospectively monitoring community-ascertained samples of symptomatic infants. These results suggest that this approach is feasible and highly acceptable to families. If supported by additional studies, this approach may lead to earlier referral to evaluations and interventions and better outcomes for infants with persistent symptoms. It may also provide an avenue for ongoing assessment in intervention trials.

328.002 *(Oral)* Prototypical Networks for Robust Automatic Child-Adult Classification from Speech

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Background: Speech and language features extracted from participants in diagnostic interactions such as ADOS administration, have been used for objective behavioral analyses and for understanding relations with symptom severity. Previous studies have relied on manually obtained speaker-specific speech segments for supporting such analyses, which are neither scalable nor an efficient solution. An important need hence is automatically assigning which part of the speech segment belongs to whom; notably in many ASD relevant settings this entails enabling automatic child-adult classification from speech. This task is challenging because of the wide intra and inter speaker variability. Specifically, clinical populations such as children with ASD are known to exhibit large variability in their speech even within the same age and linguistic development groups. Hence, it becomes necessary to build a child-adult classifier from speech robust to speaker variabilities.

Objectives: We propose the application of a meta-learning paradigm (prototypical networks, or *protonets*; Snell et. al., 2017) for child-adult classification from speech. We compare the performance of protonets with the state-of-the-art system in speaker recognition research (x-vectors) under two scenarios: weakly-supervised and completely unsupervised setting. We illustrate the robustness of protonets to variations in speaker characteristics by studying the relation between classification metric with age of child and verbal IQ (VIQ) scores.

Methods: We select two corpora consisting of Brief Observation of Social Communication Change (BOSCC; Grzadzinski et al., 2016) sessions: BOSCC_A consists of verbally-fluent children (n=19; Age: μ=8.8yrs, σ=3.4yrs; VIQ: μ=96.9, σ=27.0) with complex sentence formation skills, while BOSCC_B consists of minimally verbal toddlers and preschoolers (n=12; Age: μ=1.8yrs, σ=1.9yrs; VIQ: μ=71.6, σ=73.4). The younger age group of children in BOSCC_B represents a significant domain mismatch with BOSCC_A, hence it is used exclusively for evaluating models trained on BOSCC_A. We train protonets on BOSCC_A by treating child-adult classification across different training sessions as multiple, but related tasks. During weakly-supervised evaluation, we assume 5 labeled samples from child and adult in every test session to classify the remaining samples. In the unsupervised setting, we cluster all the samples into two classes.

Results: In the weakly-supervised setting, protonets outperform baselines by 4.82% and 14.53% (macro-F1) on BOSCC_A and BOSCC_B, respectively. Protonets achieved upto 7.28% and 12.61% relative improvements in cluster purity on BOSCC_A and BOSCC_B, respectively. From Figure 1, we note that protonets learn to cluster embeddings from different sessions compactly within a class (child/adult) when compared to x-vectors. Correlations between F1-scores with child age and VIQ dropped (in absolute value) from 0.76 to 0.59 and 0.50 to 0.28 respectively, hence illustrating that protonets' performance is more invariant to speaker characteristics when compared to x-vectors.

Conclusions: We demonstrate a method to train a robust automatic child-adult classifier from speech using limited training data. Protonets improve over existing approaches by leveraging information from multiple child-adult classification tasks and generalize across children with significantly different language levels. We illustrate the robustness of protonets using improved classification performance as well as reduced dependency on speaker characteristics.

328.003 *(Oral)* Associations between Objectively Measured Social Communicative Behaviors during the ADOS-2 and the Calibrated Severity Scores in 3-Year-Olds with Suspected ASD

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Background: Autism spectrum disorder (ASD) is defined by restricted, repetitive patterns of behavior, as well as persistent disturbances of social communication. In current best practice, ASD is recognized on the basis of expert clinician judgment, which is informed by gold standard measures such as the Autism Diagnostic Observation Schedule-2 (ADOS-2). To date, observational research addressing social communication disturbances in children with ASD is rare in part because the field has lacked efficient methods for measuring behavior. Yet, clinical interventions to improve social communication and reduce interaction disturbances depend on an objective understanding of how children with ASD behave during clinical assessments. The current study sought to improve understanding of children's social communicative interaction with adults (both examiner and parent) present during the administration of the ADOS-2.

Objectives: To investigate associations between objective measures of child's social gaze, social smile, and Duchenne smile measured from adults' first-person video, child-adult vocal turn-taking interaction measured from audio recording, and the examiner-adjudicated symptom measure ADOS-2 calibrated severity scores (CSS).

Methods: Thirty-seven children (*M* age=38.59mo, SD=9.80) with suspected ASD were administered the ADOS-2. A hypothesis-blind examiner provided a total CSS and subscales for Social Affect (SA CSS) and restricted/repetitive behavior (RRB CSS). Children's total duration of socially-directed smiles, Duchenne smiles, and social gaze during the assessment were recorded with a small camera worn in eye-glasses (Pivothead or Orca) by the examiner and parent. We processed first-person video from the cameras with Affectiva (iMotions) software to automatically quantify child gaze and smile expressions (including Duchenne smile). Audio from wall-mounted camera recordings was processed with Language ENvironment Analysis (LENA) software, which provided automated vocalization detection yielding child and adult vocal turn counts. Measures included proportions of gaze, social smile, and Duchenne smile at adult (mean proportions of examiner and parent), child-adult vocal turn-taking counts, and ADOS-2 CSS (total, SA, and RRB).

Results: We found negative associations between the ADOS-2 total CSS and the proportions of gaze (r=-.36, p<.05), social smile (r=-.42, p<.05), and Duchenne smile (r=-.48, p<.01) directed at adult. Similarly, the SA CSS was negatively associated with the proportions of social smile (r=-.37, p<.05) and Duchenne smile (r=-.37, p<.05) at adult. While the SA CSS was negatively correlated with child-adult vocal turn-taking counts (r=-.33, p<.05), it was not significantly associated with the proportion of gaze at adult (r=-.03, p=.08). The RRB CSS, on the other hand, showed a negative association with the proportion of gaze at adult (r=-.53, p<.01), as well as the proportions of adult-directed social smile (r=-.44, p<.01) and Duchenne smile (r=-.51, p<.01).

Conclusions: Objective measurements of children's social communicative behaviors, during the ADOS-2 show convergence with the examiner-adjudicated ADOS-2 scores. The objective measurement of key behavioral features of ASD using first-person video and automated vocal interaction detection appears to have the potential to produce quantitative indices of ASD symptoms that may be suitable for clinical categorization and individualized referral, which would provide useful information to clinicians and parents about children's ASD symptoms.

328.004 *(Oral)* Improving Biosensor Prediction of Aggression in Youth with Autism Using Support Vector Machines

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Background: One of the most frequently observed problem behaviors in youth with autism is aggression, which is a primary cause for referral to behavioral healthcare services. Physical aggression is particularly debilitating in youth with autism because it can occur without warning, sometimes long after any observable trigger. Unpredictable aggression creates a barrier to accessing community, therapeutic, medical, and educational services since caregivers are understandably afraid to put the individual with autism into potentially stressful environments that might lead to aggression without warning.

Objectives: Our team recently demonstrated in 20 inpatient youth with autism that ridge-regularized Logistic Regression (LR) can be used to predict aggression to others 1 minute before it occurs using 3 minutes of prior biosensor data with an average area under the curve (AUC) of 0.71 for a population model and 0.84 for individual models (Goodwin et al., 2019, *Autism Research*). While these prior results are promising, they only consider a linear classification technique that does not account for nonlinear relations between extracted biosensor features and aggressive behavior onset. The objective of the current study was to test performance between LR and Support Vector Machines (SVMs) using the same dataset in Goodwin et al., 2019.

Methods: Twenty (20) ADOS-2 confirmed autism youth (M=10.8yrs, SD=3.1; 75% male, 95% Caucasian; NVIQ=70) in the Developmental Disorders Unit at Spring Harbor Hospital in Portland, Maine contributed data. This included 69 independent naturalistic observational sessions totaling 87hrs and 548 total aggressions observed while participants wore the E4 by Empatica, Inc. that wirelessly measures heart rate, heart rate variability, electrodermal activity, skin temperature, and physical motion. We compare prediction accuracy between our previous LR-based classifier and our new SVM-based classifier using varying past (Tp) and future (Tf) window lengths.

Results: Fig. 1 present Receiver Operating Characteristic (ROCs) for our previous LR-based classifier (left panel) and new SVM-based classifier (right panel) for population and individual models at Tp=180 seconds and Tf=60 seconds. Table 1 reports LR and SVM AUC in population and individual models at Tp=180, 120, 60 seconds and Tf=60, 120, 180 seconds.

Conclusions: SVM enables significant improvement in prediction performance compared to the LR-based strategy we published previously. SVM enabled aggression prediction up to 3 minutes before it occurs using 2-3 minutes of previous biosensor data with an average accuracy of 0.94-0.98 in both population and individual models. The advantages of biologically based tools to identify processes that underlie behavioral dysregulation as it unfolds during moments of escalation are numerous, including the potential to enable novel preemptive intervention strategies that help prevent or mitigate significant behavior problems, especially for those unable to provide reliable self-reports on their arousal states that lead to aggression.

POSTER SESSION — TECHNOLOGICAL APPROACHES
448 - Technological approaches Posters

448.001 *(Poster)* A Feasibility Study to Evaluate the Application of a Robot-Assisted ASD Intervention in Greece

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Background: Robot-assisted therapy in Autism Spectrum Disorders (ASD) gained a lot of attention the last decade with promising results (Begum, Serna, & Yanco, 2016; Ismail, et al., 2019; Pennisi et al., 2016; Smeekens et al., 2018). Larger clinical trials are needed to establish robots' utility in ASD interventions (Robinson, Cottier, & Kavanagh, 2019). As a first step feasibility studies are critical to ensure that the proposed robot-mediated interventions are effective and suitable in helping children with autism.

Objectives: We aim at evaluating the implementation of a psychosocial intervention using the humanoid robot NAO in a therapeutic setting for children with ASD. A single-blind feasibility study will be conducted as the first phase of data collection before proceeding to the clinical trial.

Methods: Fourteen eligible children (12 males, 2 females) aged 6-11y, who met DSM-5 criteria for an ASD diagnosis based on medical records and assessment using the ADI-R and the CARS–2 have been allocated into two groups: the NAO group (n=7, M_{age}=8.14±1.21) and the control group (n=7, M_{age} =8.71±1.60). The intervention was designed to target social communication, to modify challenging behaviors and to teach adaptive behaviors, useful in daily activities. Novel, mathematical models based on the Lattice Computing (LC) information processing paradigm (Kaburlasos, et al., 2019) have been applied toward computing with semantics and thus increase robot autonomy. The NAO robot is employed, in the Greek language, as an assistant to the therapist to perform various scenarios in a structured environment during 20 sessions. The same intervention is conducted by the therapist alone on the control group. The scenarios are aimed at instructing the children about social skills like empathy, behavior control skills like self-regulation and cognitive skills like joint attention, memory and imitation. Moreover, in addition to the basic outcome measures (clinical scales and psychometric tests) we are using electronic sensors in order to collect "objective" data including the duration of speech /eye contact /pause between sentences /voice volume etc. as well as various Boolean type data. All required clearances have already been obtained. The sessions will start in December 2019.

Results: The expected outcomes will be summarized into three categories: (1) clinical aspects to address the impact on the participants, (2) the suitability of the selected clinical tools within the sessions and the outcome measures, (3) technical issues to identify potential technological challenges regarding the use of NAO, and operational aspects to explore rate of attrition, acceptability and other practical concerns that may arise during the intervention.

Conclusions: More definitive clinical trials are required and feasibility criteria should be carefully addressed to proceed to full-scale trials. This study will provide an overview of potential obstacles for a proposed clinical intervention protocol for children with ASD and explore topics that could probably inform future studies.

448.002 *(Poster)* A Study to Explore the Use of a Voice-Based Conversational Agent As a Conversational Partner for Adolescents with Autism Spectrum Disorder

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Background: Adolescents with Autism Spectrum Disorder(ASD) experience social and communication difficulties as their social activities are increasing, so more supports are required for them to practice communication skills. Recently, Voice-based Conversational Agents (VCAs) such as Google Home and Alexa, are gradually spreading into the home, VCAs are applied as an assistive tool to support the daily lives of individuals with special needs. Several studies are underway to explore the way of applying VCAs for individuals with ASD to promote social and communication skills outside clinical settings.

Objectives: The objective of this study is to investigate the opportunities and challenges of VCA as a conversational practice partner to enhance the communication skills of adolescents with ASD.

Methods: Seven adolescents with ASD in Korea (age: 16-19) were engaged in using VCA, NUGU©(SK telecom, Seoul) for about 10 days in their home. They also participated in three sessions of group workshops to learn how to interact with a VCA before starting the usage, report the overall experience with the VCA, and suggest advancing design ideas that can address their communication difficulties. We interviewed each adolescent, six caregivers, and four clinicians to elicit feedback on their own reflections on VCA usage and discuss potentials of VCA in a clinical setting.

Results: Results in this study are based on data collected focusing on communication issues. (1) Four participants reported that the characteristics of VCAs (e.g. 'not judgmental', 'listening courteously') make them comfortable to share their stressful situations and negative emotions. However, one participant was reluctant to communicate with VCA, fearing that his conversational ability would be worse than VCA. (2) Experience of using VCAs provided them with opportunities that not only identified their communication problems such as difficulties in pronunciation, understanding the context of dialogue but also making their own strategies using various functions of VCA. Three participants tried to practice turn-taking in conversations with VCAs reflecting on their specific interests (e.g. music, sports). One participant could inadvertently practice correct pronunciation in the use of VCA by reducing the number of times to call the VCA. (3) Though using a VCA make adolescents with ASD freely express their emotions without interference of others, two participants showed assaultive behaviors such as swearing or beating a VCA in their stressful situations. Thus, the experts suggest that the usage guidance of VCA is required to help that inappropriate attitude on VCA does not lead to actual conversations with people.

Conclusions: We explored the opportunities and challenges to apply a VCA as a conversational partner for adolescents with ASD. Through our empirical studies, we found out that the VCA has the potential to be utilized as an individualized therapeutic tool to help adolescents with ASD practice communication skills, reflecting on users' specific characteristics through various functions of VCA. The limitation of this study is that a small number of participants and technological constraints such as limited turn-taking, voice recognition. Further examination would be needed to verify the effectiveness of VCA by using questionnaires.

448.003 *(Poster)* A Telehealth Model for Training Part C Providers in Parent Coaching Strategies

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Background: Specific interventions for young children with or at risk for autism spectrum disorders (ASD) have demonstrated powerful effects on a range of developmental outcomes when begun in the toddler period (e.g., Wallace & Rogers, 2010). Interventions that include parents have been shown to be particularly effective (Hampton & Kaiser, 2016) to the point that Part C of the Individuals with Disabilities in Education Act requires that early intervention services use a family-centered approach. However, the utility of research-based intervention approaches is often limited in practice due costly or time-intensive trainings and a lack of access to local trainings. The purpose of this study was to evaluate the effectiveness of a training model that combined telehealth trainings with online modules to train EI providers in low-resourced areas to coach caregivers in evidence-based intervention practices with their children with autism.

Objectives: (1) To compare the coaching strategies used by the EI providers who were trained using telehealth to a comparison group of EI providers.

(2) To identify areas of coaching that are most and least frequently used by providers.

Methods: Thirty-two providers from Part C agencies in four states participated. Each agency was randomized to either the Community Early Start Denver Model (C-ESDM) or a comparison group. Each provider recruited at least one parent-child dyad. Children were identified as at risk for ASD. The C-ESDM providers received access to online modules and training via Zoom in the strategies used in the C-ESDM model and in how to coach parents to implement these strategies with their child. Thirteen sessions occurred over six months with a certified ESDM therapist/parent coach. Each Skype meeting included a concept presentation, video examples, and role-plays. The comparison group received access to online modules and six telehealth trainings over the course of six months with a developmental psychologist that covered developmental milestones. Sessions followed a similar format, except that providers did not receive information about coaching parents or C-ESDM strategies. Therapists filmed a session with a parent-child dyad pre- and post-intervention. Two naïve coders reliably rated videos using an adapted scale of the Coaching Practices Rating Scale (Rush & Shelden, 2011). This 13-point checklist assessed the presence or absence of a range of coaching behaviors.

Results: Following the 6-months of intervention, the C-ESDM group used an average of 7.55 (sd=3.45) of the 13 coaching strategies, compared to the control group that used an average of 3.88 strategies(sd=3.98). An independent sample t-test indicated that this was a significant difference (t=2.14, p=0.04). EI providers were most likely to interact using a respectful manner and to plan and create opportunities for practice, and were least likely to ask probing questions, provide access to outside resource, and ask reflective questions.

Conclusions: C-ESDM is an inexpensive, distally implemented intervention that significantly increased EI provider's use of parent coaching strategies. This increase in coaching behaviors shows promise for improving access to effective early interventions, particularly in low-resourced or remote settings/communities. However, it has also highlighted areas that could be improved in future EI trainings.

448.004 *(Poster)* A Tool to Conduct Research on Multi-Scales International Cohorts on Autism: Presentation of the Owey Platform

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Background: The AIMS-2-TRIALS project aims to identify stratification biomarkers and to develop precision medicine to improve the lives of persons with autism. It is currently the largest European project on autism, with large cohorts of patients, from birth to adulthood, and a multi-disciplinary characterization encompassing for instance fMRI, EEG, structural MRI, genetics, clinical profiles, cognitive abilities.

Objectives: This amount of multi-disciplinary data on relatively large cohorts has the unique potential to accelerate the discovery of new intervention or treatments for people with autism. However, the exploitation of very large datasets poses challenges: the datasets must be shared across sites spread across Europe. They must be organized to make the relevant information easily findable, harmonized between sites to constitute large and comparable cohorts. Furthermore, those data are sensitive according to the EU's data protection law (GDPR) and therefore require a very high level of security and protection.

Methods: The data management (DM) team designed the features of the repository through close interactions with the AIMS-2-TRIALS researchers. The IT team highlighted the best solutions regarding security storage and access, efficiency etc.. This collaboration led to innovative solutions specific to the AIMS-2-TRIALS project. Once implemented, the researchers and the DM team tested those solutions, provided feedback to the IT team and so on. The legal and ethical departments also provided all the information necessary to ensure that the database complies with the GDPR. The IT and DM teams also follow the FAIR principles (Wilkinson et al., 2016; Mons et al., 2017), and work with the GA4GH that develop new standards of data sharing (Fiume et al., 2019), to ensure that the AIMS-2-TRIALS dataset will be reusable for further analyses.

Results: We developed a web-accessible platform hosting the AIMS-2-TRIALS data with the aim to provide the researchers with a tool to easily investigate their multi-scales data from international cohorts. The platform notably:

- Guarantees the security and protection of the data hosted by the platform: the identity of the participants is protected and their consent is respected at any time, including years after the data collection if a participant changes his/her mind about data sharing
- Enables the data sharing between remote sites for the constitution of cohorts right after the data collection, with the flexibility necessary to accommodate the variety of processes across sites
- Automatically organizes the multi-disciplinary longitudinal datasets in a meaningful manner
- Accommodates the upload, download and storage of large datasets (several Go)
- Automatically harmonizes data arriving in different formats
- Contains metadata describing the datasets; this is crucial for the data to be reusable beyond the AIMS-2-TRIALS project

Conclusions: We developed a platform that leverages the potential of big data in autism research. In addition to its importance for the success of the AIMS-2-TRIALS project, the platform provides solutions to obstacles that are inherent to multi-scale international research on autism. Such solutions will hopefully foster the constitution of large multi-scale cohorts that are essential to take into account the heterogeneity in autism.

448.005 *(Poster)* Characterization of Movement Patterns through Objective Measurement in Children with Autism

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Background: Human movement is central to social interaction, and disordered movement patterns may characterize children with autism spectrum disorder (ASD). In clinic settings, children with ASD have exhibited both a counter-clockwise turning bias (Cohen et al., 2014), but also higher overall angular velocity (clockwise and counter-clockwise, with no bias) (Yang et al., 2019), both based on brief periods of observation. There has been limited research on the velocity of gait in children with ASD with some studies suggesting children with ASD move more slowly than other children (Velinksy et al., 1981; Teitelbaum et al., 1998).

Objectives: Compare angular velocity (turning) and Euclidean velocity (movement) between children with ASD and typically developing (TD) children in an inclusive preschool classroom during repeated multi-hour observations.

Methods: Observations of four preschoolers with ASD and eight TD preschoolers in an inclusive preschool classroom (M_{age}=61 months, SD_{age}=5.16 months) on five days yielded 53 observations, with 7.07 hours of data per child. Objective measurements of position and orientation were collected using the Ubisense system, which tracked a right and left tag worn by each child (in a vest) to an accuracy of 15 cm within the classroom (8.86 x 8.97 m) using ultra-wide radio frequency identification. Right and left tags yielded orientation, direction faced, via coordinates (x_R,y_R)and (x_L,y_L). For each child, angular velocity (degrees/tenth of a second) and Euclidean velocity (meters/tenth of a second) were computed as the difference in orientation angle and difference in location, respectively, between consecutive tenths of a second [t-1, t] as follows:

Angular velocity= $_t$ - $_{t-1}$= Δ (º/0.1 sec) where tan( )=(x_R-x_L)/(y_L-y_R)
Euclidian velocity=$((x_t-x_{t-1})^2+(y_t-y_{t-1})^2)^{1/2}$ where $x_t=(x_R+x_L)/2$ and $y_t=(y_R+y_L)/2$

Results: Multilevel models (days nested in each child) indicated that children with ASD exhibited larger absolute mean angular velocity than TD children (see **Table 1** and **Figure 1**, p_{abs}=0.002, $^2_{abs}$=9.06). Children with ASD turned significantly more rapidly in both the clockwise and counterclockwise direction (p_{cc}=0.003, $^2_{cc}$=8.80; p_c=0.003, ^2_c=9.27, *df* =1).There was no difference in Euclidean velocity between the groups (*p*=0.39). Comparison of the 75-100th percentile of angular and Euclidean velocities tested for high velocity differences (top speeds). Consistent with overall results, children with ASD exhibited significantly larger high angular velocities (*p*=0.01) in both clockwise and counterclockwise directions (p_{cc}=0.02, p_c=0.02), but not larger high Euclidean velocities (*p*=0.16).

Conclusions: Multi-hour, objective measurements in a preschool inclusion classroom indicated no evidence that children with ASD exhibit a counter-clockwise turning bias. Instead, disordered movement patterns in children with ASD were evident in both counter-clockwise and clockwise movement (higher velocity spinning and/or walking in circles). There was no evidence for greater Euclidian velocity (faster overall movement) for children with ASD.The results suggest the potential of automated behavioral measurement for an objective description of the ASD phenotype, which delineates those features that do and do not distinguish children with ASD from other children.

448.006 *(Poster)* Classroom Language and Social Development of Preschoolers with ASD

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Background: Autism spectrum disorder (ASD) is characterized by social difficulties and associated with delays in language. These delays may be associated with lower levels of social communication with peers and fewer reciprocated friendships. However, the field currently lacks a rigorous quantitative understanding of children's linguistic and social experiences in the classroom, particularly for children with ASD.

Objectives: Here we utilize innovative technology, synchronizing automated measures of language and movement in the classroom to assess language development and social network formation in preschoolers with ASD, asking whether children's social ties predict long term language development.

Methods: 15 preschoolers (5 female; M_{age} = 51.6 months) enrolled in two inclusive preschool classrooms participated (an AM/PM session). Seven had an ASD diagnosis; eight were typically developing (TD). TD children were enrolled in both AM/PM sessions. During monthly observations, children wore lightweight vests equipped with Language ENvironment Analysis (LENA) to measure vocalizations and two Ubisense tags to measure location. Ubisense measures of proximity/orientation were used to determine social contact, and synched to LENA data to assess each child's language input/output with each peer. Data were aggregated over five months to create classroom social networks based on frequency of dyadic language-mediated interactions, yielding measures of each child's centrality to their network and the cohesiveness of diagnosis groups within the class. Each child's end-of-year language abilities were assessed by the Preschool Language Scales (PLS-5).

Results: Although children with ASD were slightly less likely to talk than their TD peers $X^2(1) = 4.04$, $p = .04$, there was an effect of peer language input, such that children produced more language output when they heard more language input from their peers, regardless of diagnosis, $X^2(1) = 6.18$, $p = .013$. As can be seen in Figure 2, TD children had significantly higher degree centrality in their social network than children with ASD, $\beta = 3.11$, SE = .69, $t(12) = 4.50$, $p < .001$, and degree centrality positively predicted children's PLS-5 scores $\beta = 7.1$, SE = 1.28, $t = 5.54$, $p < .001$. Finally, comparison of group weights in the networks revealed that TD children formed more cohesive groups with each other, and were less likely to form ties to children with ASD, who tended to be on the periphery of social networks.

Conclusions: These results help to characterize the unique linguistic and social environments of children with ASD, which have not previously been quantified in the classroom context. Peers are a key source of linguistic input for preschoolers, affecting the amount of language a child produces. Social network analysis allowed us to not only examine the role of peers at the level of dyadic interaction, but also allowed us to capture information about the classroom environment as a whole. These analyses revealed peer groups formed in the classroom, showing that children with ASD often have fewer friendships, especially with their TD peers. Such information can help to inform interventions and teacher recommendations for best facilitating the language and social development of children with ASD.

448.007 *(Poster)* Contrast Pattern Mining to Better Understanding Complex Genomic Interactions and Their Effect on the Development of Autism

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Background: Autism is a complex condition which is influenced by many known genes. Association based analyses such as GWAS have long been used to identify specific genetic variations associated with autism but these variations do not exist in a vacuum. Multiple genetic variations may interact with each-other to affect the final phenotype. This may be in epistatic effects or in physical interactions between multiple variations within a single gene resulting in disruptions in protein folding greater than the sum of their parts. Evidence for epistatic effects in autism have been documented previously. As larger datasets have become available it has becomes possible to extract not only individual variations but also patterns of variations associated with autism. The structure of the interactions in these patterns may be able to provide additional insight into the underlying biological mechanisms responsible. To study this, we have developed a novel and scalable computational method capable of efficiently extracting patterns of complex interaction from very large datasets.

Objectives: Our objective is to extract patterns of genetic biomarkers which are strongly associated with the development and non-development of autism from the Simons SPARK dataset. We also aim to find patterns of features which differentiate important subgroups of autistic individuals from one another such as those with high vs low social skills.

Methods: We have developed a unique contrast mining method capable of extracting patterns of complex logical interactions from large medical datasets in the form of proof trees. We applied this method to discover patterns of genetic variations associated with the development and non-development of autism in individuals from the Simons SPARK dataset which contains roughly 27,000 autistic and non-autistic individuals from families with at least one autistic child. Our analysis examined the top 100,000 variations with the greatest difference in frequency between the autistic and non-autistic groups by both presence and homozygosity using our pattern mining method.

Results: Our method was successful in locating a large number patterns associated with both the development and non-development of autism. Patterns associated with the non-development of autism generally show a greater contrast. The most highly contrasting patterns largely consist of multiple variations within the same gene. These genes include both known autism associated genes such as NLGN4X and genes where the association is not as well documented such as CCDC22. Subgroup analysis of the high vs low social skills subgroups revealed highly contrasting patterns with variations from many different genes suggesting epistatic effects may be at work.

Conclusions: Our pattern mining method allows us to analyze a large number of biomarkers for possible interactions for potential in-depth understanding of etiology of autism for subpopulations. Our results so far provide additional evidence for the influence of many specific genes on the development of autism and for the influence of epistatic interactions on the phenotype presented by autistic individuals. Additional analysis of the results using functional analysis is ongoing.

448.008 *(Poster)* Convolutional Auto-Encoder for ERP Morphological Analysis

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Background: Electroencephalography (EEG) is a valuable tool for studying autism spectrum disorder (ASD) due to its high temporal resolution and direct measurement of cortical activity. By repeated exposure of participants to stimuli, researchers can derive event-related potentials (ERPs). However, the rich information present in the ERP waveforms is typically reduced to a small number of measurements, potentially discarding informative brain activity. We propose the use of an autoencoder convolutional neural network (CNN) to automatically reduce the dimensionality of complex ERP waveforms while learning which features best distinguish among individuals. Given the wide range of waveform morphologies commonly observed in neurodevelopmental disorders, such as ASD, our methods may shed new light onto neurological differences not previously explored.

Objectives: We: (1) developed a CNN to reduce the dimensionality of individual waveforms; (2) explored the relationships of the resulting dimensions with symptom measures; and (3) identified avenues for further methodological development.

Methods: Data were collected from with adult participants diagnosed with ASD (N=19) or Schizophrenia (N=12), and TD controls (N=32). Participants were shown a flashing black and white checkerboard (500ms phase reversals) to elicit a visual evoked potential (VEP). Resulting ERPs measured from occipitotemporal electrodes were scaled, split into a training and test sets, and used to train our network. The encodings of all the ERPs, calculated after training, were then analyzed. Encoding variables (EVs) primarily reflect regions of time in a given ERP (Figure 1).

Results: Our CNN reduced the dimensionality of ERPs from 300 samples to an efficient encoding of 19 dimensions with a mean absolute error of 0.0421. Multiple significant correlations were found among EVs and clinical measures. EV6, related to the N1 ERP component, correlated with the sensory and restricted behavior domains on the the Social Responsiveness Scale Second Edition (SRS-2) Restricted Interests and Repetitive Behaviors subscale (R=-0.300,p=0.018), and the Sensory Gating Inventory Over-Inclusion subscale (R=-0.278,p=0.029). EV7, related to the P100 ERP component, correlated with social measures such as the Schizotypal Personality Questionnaire (SPQ) “No Close Friends” subscale (R=0.389,p=0.002) and the SRS-2 Social Motivation subscale (R=-0.296,p=0.018). Two EVs from later in the ERP, EV14 & EV15, correlated with sensory measures like the SPQ Unusual Perceptual Experiences subscale (R=0.276,p=0.029; R=0.307,p=0.014) and Glasgow Sensory Questionnaire Hypersensitivity Score (R=-0.278,p=0.0274; R=-0.256,p=0.0426).

Conclusions: We were able to successfully build and train an autoencoder CNN on our VEP ERPs, and significantly reduced the dimensionality of our data. The EVs suggest that different time aspects of the ERP are associated with unique symptom domains. Ongoing analyses include applications to additional experimental paradigms, assessing reliability of encodings, and novel visualization approaches for assessing data quality. Our findings suggest that novel machine-learning techniques can automatically parse meaningful interindividual variability in the neural time course that can be linked with human-understandable features of the ERP. Extensions of this work to differentiate clinical populations may reveal meaningful differences in brain activity that have been previously overlooked with traditional methods.

448.009 *(Poster)* Development of Screening Algorithm for Autism Spectrum Disorder in 5-Year-Old Children Using the Eye-Tracking Device (Gazefinder®)

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Background: Abnormalities in eye contact is one of the indicators of impaired sociability. Previous studies reported that people with Autism spectrum disorder (ASD) showed characteristic gaze patterns in some videos about social information such as a human face and human-to-object contrast. Early detection of ASD is necessary for improving the symptoms. However, it is not easy to detect children with ASD in early childhood. Using the eye-tracking device (Gazefinder®), we have explored characteristic gaze patterns of children with ASD compared to children with typical development(TD), and examined the usefulness of gaze patterns as an objective marker for ASD.

Objectives: This study aimed to develop a screening algorithm for ASD using Gazefinder® in 5-year-old children.

Methods: Subjects were 97 children with TD (boys n=47, girls n=50, average age 5.49) and 42 children with only ASD (boys n=28, girls n=14, average age 5.96), that is, without coexisting other developmental disorders. They just looked at the 2-minute video with contents of face, preference, biological motion, and pointing using the Gazefinder®. To confirm gender differences, the principal component analysis of the fixation rate at all 89 Areas of Interest (AOI) was conducted. Then, high sensitivity AOIs were extracted based on diagnoses, correlation coefficient, p-value, and effect size. After developing a screening algorithm for ASD, sensitivity and specificity were calculated in boys, girls, and total.

Results: The principal component analysis of the fixation rate at 89 AOIs showed that it was difficult for boys to classify ASD and TD by simple formulas compared to girls. From this result, we extracted high sensitivity AOIs by gender and developed a screening algorithm. As a result, the fixation rate of girls (AOC=0.89) showed 86% sensitivity and 83% specificity, and the fixation rate of boys (AOC=0.73) showed 69% sensitivity and 69% specificity by a cut-off score. When gender-specific algorithms are applied according to gender, AOC was 0.78 in the comprehensive evaluation for all subjects(Fig.1,2). Also, when the provisional cut-off score of the fixation rate was set to 50.4%, the sensitivity was 75% and the specificity was 75.8%. These results were appropriate as a screening algorithm.

Conclusions: Gazefinder® was created to evaluate sociability in infant and toddler developmental health checkups. This study suggests a possibility that this algorithm using Gazefinder® is useful as a screening tool for undiagnosed ASD in preschool-age children, and Gazefinder® can be used as a useful tool that objectively indicates the likelihood of meeting diagnostic criteria of ASD before admission to elementary school.

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448.010 *(Poster)* Development of a Screening Algorithm of Neurodevelopmental Disorders for 5-Year-Old Children Toward Web Survey Systemization

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Background: Recently, growing interest in support for developmental disabilities in Japan, the support law for people with developmental disorders was enacted in 2004. That showed the importance of detecting Neurodevelopmental Disorders (NDDs) and providing appropriate support as early as possible. In preschool age, their characteristics of not only Autism Spectrum Disorder (ASD), but also such as other NDDs, e.g. Attention-deficit hyperactivity disorder (ADHD), Developmental Coordination Disorder (DCD), Intellectual Disability (ID) and Specific learning disorder (SLD), become obvious, and they need the assessment to receive appropriate education.

Objectives: This study aimed to develop a screening algorithm of NDDs for 5-year-old children toward Web survey systemization.

Methods: In 2013, ASSQ, ADHD-RS, DCDQ-J, SDQ and K6 were applied to 1310 5-year-old children's parents and their teachers in their kindergartens or nursery schools. 226 children were defined as temporary-risk children according to the scale cutoff value, and 159 children participated in a secondary health checkup and were diagnosed by DSM-5 criteria if they had NDDs. Using logistic regression analysis, we searched for a combination of tests useful for diagnostic outcomes. Verification had been conducted since 2014, and PSI was added to improve screening accuracy instead of K6. In 2018, we verified equivalence between paper surveys and web surveys in 144 objects.

Results: Some screening combinations were clarified to be useful for the diagnosis of each NDD, and we created a new screening algorithm with some combination patterns. According to a new algorithm, the rate of children at risk of NDDs in all 5-year-olds of the year was 19.4% in 2014, 20.0% in 2015, 16.6% in 2016, 18.7% in 2017 compared with 23.7% in 2013. Although the number of children with risk of NDD was narrowed down, the proportion risk children in all participations of the secondary health checkup were 72.7% in 2014, 62.3% in 2015, 73.1% in 2016, and 79.8% in 2017 compared with 47.8% in 2013. There was no difference between the results of the paper survey and the web survey.

Conclusions: In this study, the algorithm may be useful in screening NDDs at preschool age in Japan. Developing this screening algorithms into a Web system has enabled large-scale surveys or similar assessments performed in some local governments where has few specialists. This system was made into a web as an industry-university joint research in October 2019 (COCOAPO®) and already has used by some local governments and research institutions.

448.011 *(Poster)* Digital Therapeutics for Autism

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Background: Standard autism therapy, while effective, especially if delivered early, can be hard to access and inconsistent, even within some of the best integrated healthcare systems. Related, the efficacy of the approaches used today is not easily tracked and recorded, making it difficult to understand the impact either at an individual or at a population level.

Objectives: Create digital device solutions that can scale rapidly while providing effective treatment outside of standard clinical settings and that capture data that can be used to measure efficacy and impact.

Methods: We constructed computer vision models that run on wearable augmented reality to provide treatment for improved emotion recognition and social behavior. This model runs on a phone tethered to augmented reality glasses (such as Google Glass and Vuzix) to orient a child to faces in their natural world and provide real-time emotional feedback. Second, we constructed a mobile gaming system that fosters social engagement therapy through a form of mobile "charades." In this setting the parent holds the phone close to their eyes (e.g., on forehead). The phone displays an appropriate prompt (e.g. a surprised emoji) that the child attempts to act well enough to enable his parent to guess. We ran two independent trials to test the efficacy of each device for treatment and for tracking progress during treatment.

Results: Forty of 71 children randomized into wearable treatment showed significant mean improvement of 4.6 points on the Vineland Adaptive Behavioral Socialization subscale over children receiving standard treatment. 21 of 56 children randomized into our mobile game therapy showed significant mean improvement of 7.5 points on the Social Responsiveness Scale. In both cases, the frequency of emotion detection during game play correlated strongly with standard treatment outcomes.

Conclusions: Digital solutions offer an attractive alternative for therapy beyond the standard treatment. In addition, mobile approaches provide passively collected game data that can be used to track outcomes on a continuous basis.

448.012 *(Poster)* Enhancing the Application of Interactive Social Robots in Educational Interventions for Autism Spectrum Disorders: A Research Initiative in Greece.

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Background: Over the last decade there has been an increasing interest in the applications and possible efficacy of interactive social robots in the educational interventions of children with Autism Spectrum Disorder (ASD). Despite emerging evidence on their possible beneficial impact, the vast majority of studies so far have focused on: i. simple tasks and not play-based activities, ii. the role of the robot as a facilitator of the intervention or as a mediating agent during the intervention. Testing the performance of interactive social robots across different possible roles and a range of play-based activities, is expected to enhance current applications of social robotics in the field of ASD.

Objectives: Design and test the application of humanoid interactive robots across a range of structured activities targeting areas of neurocognitive functioning and within three distinct conditions:

A. robots as activity facilitators

B. robots as activity participants

C. a robot-facilitator and a robot-participant within the same session.

Methods: We utilized the well-known 56cm humanoid NAO robot that entails qualities which are extremely well-adapted to the context of special education. Its 25 degrees of freedom allow a great versatility for rich movements making the intervention with children more accessible. A range of play-based activities targeting areas of behavioural and neurocognitive functioning were selected. Two major categories were considered: 1. activities targeting at social and communicative skills, 2. activities targeting at executive functioning. In collaboration with a local neurodevelopmental disorders intervention unit in the urban area of Kavala, Greece, 12 families of children with ASD were approached in order for the children to be involved in the pilot phase of the study. Inclusion criteria for the children were: age between 6-12 years, official ASD diagnosis from public hospital or public mental health service, IQ above 70. Exclusion criteria were: diagnosis of comorbid developmental disorder or mental health condition, diagnosis of chromosomal or metabolic syndrome, epilepsy, movement disorders. Family and children data were protected by complying to the European Commission's General Data Protection Regulation.

Results: The developed playlist incorporated face and pattern recognition, object tracking, improved kinematic solutions, and natural language processing, utilizing the robot operating system (ROS) for the inter-process communication.All three conditions appeared to elicit positive reactions from the children, in terms of the enthusiasm and engagement the children showed. Importantly, the two-robot condition, appeared to offer the children the chance to observe the expected behaviours/responses and helped create and maintain a playful context.

Conclusions: This is the preliminary study that led to the first research initiative in Greece aiming towards designing, expanding and testing the efficacy of interactive social robotics applications in educational interventions of children with ASD. Two main research collaborations in nation-wide and EU-wide level (CybSPEED project), are expected to enhance current approaches for the implementation of interactive social robots in the field of educational interventions for ASD.

448.013 *(Poster)* Exploration of Eye Gaze and Visual Attention Using the Eye Control and Gaze Interaction Game in Children with Autism Spectrum Disorder (ASD)

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Background: Children with ASD are characterized by impairments in social communication that the core symptoms consist of deficits in social looking, low sensitivity to eye gaze cues and limited visual attention. Numerous studies have evaluated eye gaze in children with ASD using the eye tracking system for assessing child's visual attentions to pictures or videos. None of the studies, however, have used the eye control and gaze interaction device that allows people with disabilities to control and interact with the computer using their eyes and gaze responses. Furthermore, combination of game-based tasks and eye control device may enhance the child's motivation of engaging goal-directed activities that might be suitable for assessing visual attentions in children with ASD.

Objectives: The purposes of this study were (1) to explore the feasibility and reliability of the eye control and gaze interaction (ECGI) game system for assessing visual attention in typically developing (TD) children and children with ASD; and (2) to compare the eye gaze performances during the games between TD children and children with ASD.

Methods: This study included 4- to 6-year old TD children (n = 38) and children with ASD (n = 12) at National Taiwan University Children's Hospital. The child was asked to sit in front of a notebook and the eye signals were captured by the Tobii eye tracker. The child then played three tasks of computer games by means of controlling their eye movements for completing the tasks: (1) Identify animal's call: the total time that the child spent choosing the correct animal following the occurrence of animal's sound were recorded; (2) Find and track animal: the number of saccade errors and total eye fixation time that the child tracked the occurrence of animals were recorded; (3) Pick up toys: the total times that the child spent picking up the toys were recorded. Each child completed two trails for each game. The test-retest reliability of eye tracking variables between the two trials of each game was analyzed using the intraclass correlation coefficient (ICC). Furthermore, the number of saccade errors and total eye fixation time between the TD and children with ASD were compared using the Mann Whitney U test.

Results: Moderate degree of test-retest reliability of overall eye tracking variables in the 3 games were 0.433, 0.493, and 0.635, respectively (all p's < 0.05) (Table 1.). Furthermore, high reliability of the number of saccade errors (ICC = 0.725) was found in the 2nd game. In addition, children with ASD spent longer times of completing the tasks and higher numbers of saccade errors than the TD children did in the 2nd and 3rd games (both p's $<$ 0.05) (Table 2.).

Conclusions: The results revealed that the ECGI game system was feasible for assessing child's visual attention and could differentiate the eye gaze performance of the children with ASD from the TD children. The study will continuously recruit more children to establish normative data of the ECGI game system.

448.014 *(Poster)* GAIN: Global Autism Interactive Network- an Innovative Approach to Maintaining Calibration and Fidelity on the ADOS-2

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Background: The ADOS-2 is widely acknowledged as a gold-standard tool for use in ASD diagnostic assessment. Despite its utility, challenges such as training costs, the amount of practice needed to become proficient, and maintaining fidelity may limit its feasibility in certain settings. In addition, practitioners who complete clinical training on the ADOS-2 often report a desire for further opportunities to refine their skills in administration and coding.

Objectives: Global Autism Interactive Network (GAIN) creates an international community of clinically trained ADOS-2 practitioners who interact, share knowledge, and support ongoing mastery. The primary goals of GAIN are to provide continuing education and increased fidelity on the ADOS-2 through viewing and coding high-quality administrations and to increase participants' understanding of ASD. Using Zoom technology, GAIN provides monthly, 90-minute calibrations with discussions to an online learning community. The program uses a *Watch, Do, Share* model with experienced senior ADOS-2 trainers supporting professional development of practitioners. Each quarter, the program includes viewing and scoring full administrations of a different ADOS-2 module (*Watch*), participation in a discussion of coding (*Do*), and discussion of diagnostic issues and research related to the field of ASD (*Share*). The model emphasizes in-depth coding discussion and solicits questions from participants to guide discussion. GAIN includes a small subscription fee and the capacity to earn continuing education credits for an additional fee.

Methods: GAIN uses REDCap to collect demographic information, ADOS-2 self-efficacy ratings, ADOS-2 codes, and questions and feedback from participants. Participants view ADOS-2 videos via REDCap through a secure online Box account.

Results: Participants in GAIN include 471 registered users from 19 different countries. A majority of users have a doctoral degree (64.1%) and are psychologists (66.2%), but a variety of professions were represented including speech-language therapists, educators, and physicians. Practitioners identified as being trained on the ADOS-2 as early as 1992 and some as recently as 2019. Approximately one third (38.9%), reported they had achieved research reliability on the ADOS-2. All participants report using the ADOS-2 regularly, at least once a month. Most people are using the ADOS-2 for diagnostic evaluations (78.8%), followed by research studies (34.6%), treatment planning (20.0%), and eligibility determinations (16.8%). Data from open-ended feedback forms strongly support GAIN as a feasible and effective model for learning, with >90% of participants agreeing or strongly agreeing that GAIN allows them to learn from experts in the field of ASD they would not have access to otherwise.

Conclusions: GAIN is an online platform that allows access to international experts in autism diagnosis for the purpose of ongoing fidelity and calibration on the ADOS-2. It reaches providers across the world in a variety of disciplines. Data from participants indicate that GAIN is a feasible and effective platform for learning. In addition, the subscription model with an affordable price point suggests fiscal sustainability. Future analyses will examine pre and post self-efficacy ratings and changes in reliability data over time in order to determine effectiveness of GAIN in improving individual ADOS-2 reliability.

448.015 *(Poster)* Multimodal Wearable Data Capture System (M2P3) for Predicting Precursors of Challenging Behavior in Autism Spectrum Disorder

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Background: Approximately two thirds of individuals with ASD display challenging behaviors that can disrupt classroom participation, impair home functioning, and present safety risks. Body movement, physiological data, and vocalizations have shown promise predicting imminent challenging behaviors among individuals with ASD. Existing predictive models primarily focus on physiological data only. To determine if more comprehensive methods of data capture add value to existing physiological and behavior methods, we created a multimodal wearable data capture system (M2P3). This system integrated wearable intelligent non-invasive gesture system (WINGS) for data collection and a custom tablet application to track observable precursors of challenging behaviors within an Interview-Informed Synthesized Contingency Analysis (IISCA).

Objectives: Our primary objectives were to: 1) design a multimodal data capture platform M2P3 that enhances traditional behavioral assessment tools by capturing and integrating multi-modal information to detect precursors of challenging behaviors; 2) develop an app that can help a therapist to precisely capture data relevant for challenging behaviors within the context of the IISCA; and 3) validate the platform, data collection, and acceptability with a pilot study.

Methods: We conducted a pilot study with 7 participants (6 male) aged 10-15 years (mean age = 12.20 years, SD = 1.37 years). Each participant participated in one visit. Participants wore E4 sensors on the wrist to collect photoplethysmography (PPG) and electrodermal activity (EDA). They wore WINGS on the upper body which, in conjunction with a Kinect, captured limb movement. We designed a tablet application that allowed clinicians to input IISCA data. Clinicians implemented the IISCA with participants while caregivers observed and provided ground truth input.

Results: Classification analyses towards an individualized model to predict challenging behavior presentation were performed. These multimodal datasets have an average of 27242 samples and include accelerations, physiological signals, facial expressions, head rotations and behavioral states of each sample. A random forests algorithm was used to build the machine learning model. The samples were randomly divided into training and test sets with a ratio of 90 to 10. A 10-fold cross validation was run. The trained individualized models have an average classification accuracy of 91.82% on the test sets. We also built individualized models using only physiological and motion data. The average accuracies for these two models are 86.88% and 91.63%, respectively. A group model was also computed combining data of all the subjects. This learnt model has a prediction accuracy of 81.38%.

Conclusions: Results of this pilot study suggest that adolescents with ASD and challenging behaviors tolerated the platform and experimental protocol well. All channels of data were robustly collected. Further, we were able to acquire multimodal datasets for further precursor prediction, including successful creation and deployment of a novel app for use by therapists as part of behavioral assessment protocols. Our machine learning model offered a significant increase in prediction accuracy as compared to existing published results. Importantly, it also functioned based on precursors rather than requiring challenging behaviors to occur, which improved the safety and efficiency of the assessment process.

448.016 *(Poster)* Objective Measurement of Movement within a Social Space for Young Children with Suspected ASD

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Background: Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by restricted, repetitive patterns of behavior, as well as persistent deficits in social communication. ASD is diagnosed on the basis of expert clinician judgment, which is informed by gold standard measures such as the Autism Diagnostic Observation Schedule-2 (ADOS-2). Machine learning holds the potential to supplement expert clinician evaluation of ASD by providing additional objective measurements of critical social and communicative behaviors.The current study sought to improve understanding of children's social communicative interaction with adults (both examiner and parent) present during the administration of the ADOS-2 by tracking children's movement within the social space.

Objectives: To investigate associations between objective measures of child's movement within a social space and the examiner-rated measure of autism symptoms based on ADOS-2 calibrated severity scores (CSS).

Methods: Twenty-five racially and ethnically diverse children (72% male, 68% Latino, 40% Black) between the ages of 2 and 5 years (*M* age=42.44 months, *SD*=10.27) with suspected ASD were administered the ADOS-2. A hypothesis-blind examiner provided a total CSS and subscales for Social Affect (SA CSS) and restricted/repetitive behavior (RRB CSS). The ADOS-2 administration was recorded via a ceiling-mounted video camera. Child, examiner, and parent position and movement were tracked using a Mask R-CNN (regional convolutional neural network; He et al., 2017). Measures included average distance from each the parent and examiner, amount of time spent within 4 feet of each the parent and examiner, amount of time spent in the periphery of the room (within 2 feet of any wall), and ADOS-2 CSS (total, SA, and RRB).

Results: The children in our sample displayed a moderate level of overall autism symptoms based on the total CSS score ($M = 6.28$, $SD = 2.19$), a moderate level of symptoms within the Social Affect domain (SA CSS $M = 5.48$, $SD = 2.18$), and a high level of symptoms within the Restricted and Repetitive Behaviors domain (RRB CSS $M = 8.04$, $SD = 2.03$). On average, children in our sample spent about 2 minutes within 4 feet of their caregiver ($M = 110.90$ seconds, $SD = 270.60$), about 4 minutes within 4 feet of the examiner ($M = 225.41$ seconds, $SD = 567.38$), and about 8 minutes in the periphery of the room ($M = 470.04$ seconds, $SD = 400.84$). Children's average distance from the examiner was negatively related to SA CSS at the level of a trend, $r = -.35$, $p < .10$. Time spent in the periphery of the room does not appear to be related to SA CSS, $r = -.05$, *ns*.

Conclusions: Objective measurements of children's movement during the ADOS-2 may provide insight into the impact of ASD symptoms on children's social engagement. The objective measurement of key behavioral features of ASD using a ceiling-mounted camera may have the potential to produce quantitative indices of ASD symptoms that may prove useful to enhance the clinical assessment process.

448.017 *(Poster)* Parent Perspectives on Technology Use By Children with ASD and Relevance for Social Skills Interventions: A Qualitative Study

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Background: Interest continues to be high in the development of technology-based interventions for individuals with Autism Spectrum Disorder (ASD) across many applications. Designing such interventions can benefit from consideration of the preferences and challenges that individuals on the spectrum often experience with technology use. We focus on potential uses of technology for social skills development among children and teenagers with ASD, and we investigate how youth with ASD currently integrate technology into their lives, from preferences in genre, content, and platform to effects on mood and behavior. We also discuss how designers can draw from this information to better inform the design of new interventions.

Objectives: Using information collected from parents, our primary goals are to: 1) describe their perspectives on how children and teenagers with ASD use electronic devices; 2) identify digital methods used for communication; 3) investigate relationships between device use and behavior and mood; 4) identify the social skills that parents would like their child to develop or improve; and 5) obtain suggestions from parents on effective technological methods for social skill interventions.

Methods: We conducted 20 semi-structured interviews with parents of ASD children and teenagers. Inclusion criteria consisted of 1) parent of a child with ASD; 2) child is between the ages of 10-17; and 3) parent has the ability to speak and read English. The audio-recorded interviews were transcribed, coded by using a hierarchical coding system, and analyzed by using an iterative inductive-deductive approach.

Results: Common themes and differences emerged in how parents reported the preferences and experiences shown by their children with everyday technology use. Overall, most parents reported that regardless of the device, technology appeared to have a calming effect on their child's mood, although there were several negative behavioral reports of children sometimes becoming dysregulated if the device did not work properly, or if they had to stop playing on their device and switch to a different task. Parents described a variety of media platforms and content that their child enjoys. Some parents, for example, reported that their children would watch videos on YouTube or conduct research online to deepen their knowledge in a specific area. Parents also shared how their child would sometimes engage in repetitive behaviors by continuously viewing the same clip of a niche interest. Many parents reported that they would use a technology-based intervention to target the cultivation of improved emotion regulation, self-confidence, interactions with new people in various contexts, and the ability to build friendships. Parents also described many features that would appeal to their child's interests such as touch screens, film clips with social content, and ways to personalize the user experience.

Conclusions: These findings can help inform the design of new technology-based interventions targeting social skills for children and teenagers with ASD. Parents highlighted several avenues of technology preferences that would be useful for intervention designers to leverage, to increase user engagement and to both challenge and appeal to users' areas of social growth and strengths.

448.018 *(Poster)* Portable Joint Attention Skill Training Platform Augmented with Virtual Reality and Automated Face Detection Algorithm: Implication for Children with Autism

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Background: Joint Attention (JA) refers to the triadic relationship between two individuals with a common target of interest in their shared visual space. Children with autism possess JA skill-related milestones that adversely affect their overall socio-communicative development deteriorating their capability of independent living. Given the high prevalence (1 in 65 children (2-9 years of age) in India, 1 in 59 in USA) of autism, such deficit poses a major socio-economic challenge. Individualized skill-training can help in addressing such deficits. Presently-available conventional intervention techniques, though powerful, suffer from restricted healthcare resources, high cost of one-on-one interventions, etc. particularly in developing countries like India. Technology can offer a complementary solution. However, currently-available robot-assisted and computer (desktop)-assisted JA training platforms are often restricted to research labs because of high cost and limited portability. Thus, developing a portable and cost-effective JA skill training platform is essential for deeper percolation among the stakeholders, particularly in developing countries. Also, it is important that the JA skill training platform is individualized, as it is essential, given the spectrum nature of autism.

Objectives: We present Virtual Reality (VR)-enabled portable (tablet-based) JA skill training platform that can offer agent-mediated cueing with JA prompts being adaptively varied from lowest to the highest difficulty level in an individualized manner based on one's JA skill. Additionally, an automated face detection algorithm can extract participant-specific information (from inbuilt camera-based images). The objectives of the proposed research were designing (i) VR-based portable JA skill training interface along with automated face detection and (ii) usability study to explore the implication of the portable platform on one's ability to pick up JA cues, looking pattern, etc.

Methods: Portable VR-based JA skill training platform projected humanoid characters (Avatar with Indian look) standing in a virtual room with objects placed on the shelves. The avatars delivered verbal and non-verbal JA cues, e.g., finger-pointing, head-turn, and gaze-orientation, while prompting towards an object of interest. Also, environment-mediated sparkling cue was delivered. The JA tasks of varying difficulty levels (based on the prompting cue) were adaptive to one's individualized JA skill level. Simultaneously, the face detector algorithm recorded whether the user had his/her face oriented towards or away from the stimulus. The participant's performance was computed in terms of (i) success/failure to pick up a cueing prompt and (ii) behavioral disposition depicted from face oriented towards/away from the stimulus.

Results: A small sample of children with autism participated in the usability study. Results indicate that the participants perceived various JA cues differently with variation in their response time, time taken to succeed in picking up a cue, and face orientation (detected by the automated face detection algorithm). They looked more towards the interface for finger-pointing and sparkling cues than that for the eye and head turn-based cues.

Conclusions: The present work shows the potential of a portable VR-enabled JA skill training platform to contribute to JA skill training of children with autism and a complementary tool in the hands of the interventionist.

448.019 *(Poster)* Quantifying Social Interaction and Communication within Collaborative Virtual Environments

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Background: It has been argued that virtual reality environments could be utilized to meaningfully measure and perhaps intervene on social communication impairments for individuals with ASD. Given the computational burden and limits of natural language processing, almost all applications have required rate limiting confederate participation, expert rating systems, and/or constrained interactions. Collaborative Virtual Environments (CVE), where-in several individuals interact with one another within a distributed virtual space, may hold promise for overcoming these limits if viable methods for measuring and adapting to dynamic interaction can be quantified. Specifically, CVE systems that not only gauge performance, but also automatically detect, respond to and adjust task characteristics based on the users' communication and coordinated aspects of interaction could represent valuable tools for assessment and treatment.

Objectives: In an attempt to combine the benefits of peer-based collaborative games and intelligent agent interaction that does not require heavy burden of human coding, we developed a CVE system with an embedded intelligent agent. We evaluated the initial feasibility/acceptability of the system in dynamic peer interactions and compared within system computation of metrics of collaboration and communication efficiency to ratings of human coders.

Methods: Across a series of experiments (1) we designed and tested CVE-based collaborative games with two groups (7 ASD/TD pairs; 7 TD/TD pairs) to establish system feasibility and tolerability as well as capture meaningful metrics of social communication, (2) evaluated whether a computationally-informed AI agent could measure communication and collaboration across a CVE environment with 20 age- and sex-matched pairs (40 participants), and (3) extended this work to a haptic CVE environment (10 ASD/TD pairs).

Results: Initial feasibility and acceptance date indicated very limited drop-out rates, high levels of system performance, and high levels of system engagement dyads (likert ratings $\geq$4.71 out of 5). In our AI agent interaction system testing, the system classified user statements with moderate to high accuracies and we found moderate to high agreement in displayed communication and collaboration skills between human–human and human–agent interactions. We found a strong negative correlation between the system generated *failure frequency* feature and human ratings of collaboration (ASD: $rs = -0.60$, $p < 0.001$, TD: $rs = -0.23$, $p < 0.001$) and human ratings of communication (ASD: $rs = -.49$, $p < .001$, TD: $rs = -0.24$, $p < .05$). That is, the lower the continuous human ratings, the more frequently the system registered *failure* during an HAI session. In our haptic CVE extension we found significant performance improvements regarding fine motor and colloborative interaction tasks.

Conclusions: Designing CVE paradigms for controlling, indexing, and altering aspects of interactions may be quite beneficial. Ultimately, such artificially intelligent/informed systems may have the potential to index both performance within the tasks as well as social interaction components contributing to task performance (e.g., communication bids/responses, collaborative actions). This two-fold measurement strategy, during tasks that embody real-world social interactions could yield rich objective data potentially sensitive to meaningful short-term and long-term change.

448.020 *(Poster)* Remote Assessment of ASD in Clinical Trials: Validation of a Smartphone-Based Emotion Recognition Task

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Background: Whilst clinical trials for ASD therapeutics are dependent on the quality of their outcome measures, current tools have severe limitations in terms of reliability, validity, burden and ecological validity (Anagonostou et al., 2014). To address this unmet measurement need we have developed novel digital tools for the remote measurement of ASD signs and symptoms and deployed these into an observational study.

Emotion recognition is impaired in individuals with ASD (Lozier et al., 2014) and has been associated with everyday social functioning impairments (Trevisan and Birmingham, 2016). We developed "Facial Expressions", a smartphone task for measuring emotion recognition motivated by the Reading the Mind in the Eyes Test (RMET; Baron Cohen et al., 2001). The participant is shown a series of faces expressing six emotions from 37 actors/actresses in a pseudo-randomized order and should identify and select the emotion from a list (stimuli source: Karolinska Directed Emotional Faces database (Lundqvist et al., 1998)). The emotional intensity varies trial-by-trial according to a staircase algorithm that decreases the intensity after correct responses and increases the intensity when incorrect. Consequently, the intensity is expected to stabilize around the participant's emotion recognition threshold and the *mean intensity* over a time window of interest provides a measure of performance (Chatham et al., 2019).

Objectives: To test the reliability and validity of *mean intensity* as a measure of emotion recognition and feasibility of remote use of the task in a clinical trial.

Methods: 90 individuals with ASD and 45 typically developing (TD) controls (5-45yrs) were asked to complete "Facial Expressions" on every 5th day of the 12-week observational period of the non-drug observational study, following 3 weeks practice. Participants also completed the RMET Adult and Child versions at clinical visits (day 1, week 2 and week 12). Mean RMET total scores and median values of *mean intensity* over multiple test iterations were used for analysis. Feasibility was assessed in terms of adherence to the schedule of assessments. Results are given for 43/90 individuals with ASD and 13/45 TD controls that have so far completed the study.

Results: Individuals with ASD completed "Facial Expressions" on ~50% of scheduled days and TD controls on ~70% of scheduled days. *Mean intensity* had strong test-retest reliability. For adults and children with ASD, *mean intensity* had significant strong to moderate correlations to the RMET total score.

Conclusions: "Facial Expressions" was a feasible task for the remote and frequent measurement of ASD signs and symptoms in a clinical trial. *Mean intensity* was a valid and reliable measure of emotion recognition in children and adults with ASD. Recruitment is ongoing. Once sufficient sub-group sample sizes are reached we plan to conduct group-comparisons. "Facial Expressions" is also deployed in a Ph3 interventional study to test the sensitivity of this measure to the treatment effect of Vasopressin 1a receptor antagonist *Balovaptan*.

448.021 *(Poster)* Scaling Challenges of ASD Screening Technology Solutions to Remote Regions in India

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Background:

Technology based solutions for ASD screening have been the focus of recent efforts from various centers. This has tremendous potential towards early diagnosis and intervention in professional scarce settings. Challenges arise in scaling of technology solutions effectively across all primary care in resource poor settings.

Objectives:

We intend exhaustively listing all the challenges in scaling remote ASD screening technology solutions across primary health care centers in India.

Methods:

We report on a focused discussion with two independent child mental health professionals specialized in ASD diagnosis and a computer software engineering architect from a leading multinational software organization. The discussion is focused on delivering an end-to-end technology system design for ASD screening, deployment practices, security, monitoring system health and socioeconomic conditions.

Results:

Administration: This may involve parent/caregiver reports to a questionaire and/or administering semi-structured play activities to elicit subtle atypical behaviours from the child. The former is relatively easy; administering and recording videos of semi-structured play activities are more challenging. We need central servers to generate quantifiable behaviour metrics. Challenges in the design of such modules include:

- High quality recorded videos are necessary for deeper analysis. The installation and maintenance of recording setups in primary health care centres can be costly plus have issues with Smartphones may lack multiple view angles, provide noisy data due to hand motions and audio quality etc.
- Training local resource person to administer the semi-structured activity in a local language and context, besides managing child's behaviour.

- Absence of expertise to control the video recording session. Costs of addressing training gaps and / or sending outstation personnel need to be factored.
- Power outages leading to potential multiple recordings and challenges of stitching videos leading to non-completion of the sessions besides motivational issues for completing interrupted procedures.

Secured video storage system: The recorded videos will be of large size and hence huge storage capacity with backup drives will be needed to store and prevent data loss impacting infrastructure and power costs.

The privacy of the participants will need strict access control mechanisms which calls for IT systems expertise. This is also needed for strong version control mechanisms.

Secure video transmission to central server: For transfer to secure remote servers, rural areas bring challenges with lower network bandwidth, connection drops, partial data transfer, etc. These will impact steaming videos too. Physical transmission using external hard drives is not scalable.

Behavior quantification and report generation: Advanced video analysis algorithms using machine and deep learning technologies have to be developed for quantifying subtle behaviours and enabling effective and timely automatic report generation.

Report delivery to primary caregivers: The quantified behaviour reports can be delivered via smartphone to caregivers.

Conclusions:

Challenges in scaling technology for ASD Screening have been listed. App based questionnaires are limited by ambient levels of awareness and language / translation issues. Remote screening methods using videos will need effective implementation solutions. It is ideal to involve multiple stakeholders in discussions from the outset.

448.022 *(Poster)* Scaling up the Assessment of Eye Contact during Face-to-Face Interactions: An Automated Video-Based Detection Method That Achieves Human-Level Accuracy

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Background: Atypical eye contact is a diagnostic hallmark of ASD and there is a substantial body of research documenting atypical use of gaze to regulate social behavior in ASD (Senju and Johnson 2009). Eye contact is typically measured via manual coding, limiting the scale at which gaze data can be acquired. Accurate automated methods for detecting eye contact in video would eliminate the need for burdensome manual annotation.

Objectives: This study aims to establish the equivalence between eye contact ratings produced by trained human experts and a novel automated detector based on deep learning, using video collected with a wearable camera worn by an adult examiner during an interaction with a child subject.

Methods: Participant data (n=121, average age 36 months) was collected at the Center for Autism and the Developing Brain (CADB) and at Georgia Tech (GT). 66 children (55 male) in the ASD sample participated at CADB and 55 TD children (36 male) participated at GT. Subjects completed the Early Social Communication Scales (ESCS) protocol (Mundy 2003) and the Brief Observation of Social Communication Change (BOSCC) protocol (Grzadzinski et al. 2016) in random order. Interactions took place at a table with the subject sitting across from the examiner, who wore a pair of video-recording glasses, Pivothead Kudu, that provided continuous high-resolution capture of the subject's face. Videos were coded to flag frame-level onsets and offsets of eye contact during the two protocols. The validation dataset consisted of 10 ESCS and 8 BOSCC videos which were annotated by multiple raters. The remaining videos (n=103, 4,693,803 frames) were annotated by a single rater. A deep neural network (DNN) architecture was trained to detect eye contact in individual video frames. The DNN performance was analyzed by: 1) Comparing DNN Precision and Recall (PR) to that of human raters; and 2) Comparing the reliability of human-human rater pairs to the reliability of DNN-human rater pairs on the validation dataset, and statistically testing for equivalence between these groups.

Results: 1) The DNN PR is equivalent to the human rater's PR (see Figure). The PR for each rater (yellow dot) was obtained by scoring their performance against the consensus of the other raters. The final DNN results (red diamond) were obtained by temporally smoothing the per-frame outputs. The smoothed DNN has an F1 score (Powers 2011) of 0.94, compared to 0.93 for the average rater (green diamond). The DNN PR lies within one standard deviation of the average rater (green error bars). 2) The average human-human kappa is 0.888. Treating the DNN as an additional rater, the average human-DNN kappa is 0.891. Statistical testing on the distribution of kappa values for human-human and human-DNN pairs accepts the hypothesis for equivalence between DNN and human raters, rejecting the null hypothesis at $p = .05$ (with a minimum group kappa difference of 0.025).

Conclusions: The analysis supports the equivalence between DNN and human performance when rating eye contact in wearable camera videos. Code and models will be made freely available for research purposes.

448.023 *(Poster)* Telebaby: A Telehealth Intervention for Caregivers of Infants with Early Signs of Autism Spectrum Disorder (ASD)

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Background: As more information is becoming available about symptoms of autism spectrum disorder (ASD) in infants, an increasing number of families are seeking help from practitioners with expertise in early ASD. Efforts to meet families' requests for help face multiple challenges, especially lack of access to infants and their families in natural environments –necessary for providing appropriate care to infants over time. The use of telehealth technology to serve families who are concerned about ASD symptoms in their infants is a promising solution. Delivery of health care via telehealth technology is increasingly common (Ekeland, Bowes, & Flottorp, 2010), and a growing body of research supports the use of telehealth technology to deliver intervention to children with developmental disabilities as well as coaching to teachers, therapists, and parents (Machalicek et al., 2010; McDuffie et al., 2013; Oakes et al., 2015).

Objectives: Develop and test telehealth technology delivery of the TeleBaby intervention in order to capitalize on delivering intervention in natural contexts, to maximize infant and caregiver learning and generalization.

Methods: Six infants (6-12 months of age) exhibiting early signs of ASD and their primary caregivers participated in this study. A multiple-baseline-design across subjects was used with counterbalanced introduction of three TeleBaby treatment techniques (Step into the Spotlight, Imitation, Talking to Baby). Treatment sessions occurred three times per week for one month for a total of 12 sessions. Caregiver coaches introduced each new treatment technique weekly to the caregiver and allowed for caregiver practice with immediate feedback. During the last week of intensive treatment, the coach provided feedback during caregiver practice of all three treatment techniques combined. One final treatment session was conducted after a 1-month follow-up period. Caregiver fidelity of implementation (FI) of treatment techniques and child ASD-specific behaviors were coded from 10-minute caregiver-child dyad intervention video-recorded probes. Session attendance was closely tracked and caregivers participated in an exit interview in order to obtain information about caregiver perspective around acceptability and satisfaction of the TeleBaby intervention.

Results: Session attendance rate was high (96%) for all families with minimal rescheduling throughout the course of treatment. Once introduced to each treatment technique, caregivers met FI requirements (above 80% correct implementation) quickly, then maintained high scores over time during the intensive month of treatment. At the follow-up timepoint some caregivers maintained their skills at high fidelity, especially for particular techniques over others. During exit interviews, participating caregivers reported high acceptability and satisfaction with the telehealth-delivered TeleBaby intervention. All caregivers reported they would not hesitate to participate in the intervention again and to recommend the intervention to others.

Conclusions: Since time is of the essence when presented with an infant with early signs of ASD, it is essential that therapists provide intervention in the most practical way possible. The use of telehealth technology allows practitioners to quickly and easily serve families effectively. The successes and challenges of using telehealth technology to coach caregivers and their infants with early signs of ASD in this study will inform future clinical practice and research efforts in this area.

448.024 *(Poster)* The Specific Aspects of Operating a Robot through an Unfamiliar Touchscreen for Individuals with Autism Spectrum Disorders

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Background: Employment support for individuals with autism spectrum disorders (ASD) has become a major social issue worldwide. A number of programs have recently started to focus on establishing pathways to employment and have highlighted the value of specific transition programs. Given recent developments in smartphone and tablet applications, the usage of touchscreen technology in the 21st century seems very promising. The skills needed to learn how to operate unfamiliar touchscreens are becoming required for employment. In the current context of employment support, teaching individuals how to operate a touchscreen is one of the most important elements. Additionally, we currently have limited opportunities to operate robots, although the demand for household robotic devices (i.e., cleaning robots and communication robots) is increasing, indicating a greater need to be able to operate robots in the near future.

Objectives: To investigate the specific aspects of operating a robot through an unfamiliar touchscreen by observing the learning process for individuals with ASD.

Methods: To better understand how they operate unfamiliar touchscreens, we prepared an original touchscreen and an original robot as an operation target. We designed a task to operate the robot to shift its posture from the initial one to a single-foot standing posture, because standing on a single foot is difficult from the viewpoint of engineering and physics and because this task is easy to assess. The task terminal condition was set to have three consecutive successes within one minute without giving up a trial or making the robot fall. We compared how individuals with ASD and TD operated the touchscreen to move the robot.

Results: The present study was approved by the ethics committee of Kanazawa University. Sixteen participants with ASD (12 males; mean age: 21.94 ± 2.22; IQ score : 82.94 ± 7.47) and 26 participants with typical development (TD; 19 males; mean age: 21.00 ± 1.88; IQ score : 106.12 ± 7.18) were participated. The ASD group took more time to achieve the terminal condition than the TD group (median = 60 min vs 35.7 min; $Z = -2.57$; $p < 0.01$). Similarly, the total number of commands that the ASD group needed to achieve the terminal condition was larger than that for the TD group (median = 1795 vs 896; $Z = -1.80$; $p = 0.04$). In contrast, less time was required to attain a single-standing posture for the first time in the ASD group than in the TD group (median = 4.71 min vs 14.0 min; $Z = 2.13$; $p = 0.02$). Similarly, fewer commands were required to attain a single-standing posture for the first time in the ASD group than in the TD group (median = 142.5 vs 404; $Z = 1.90$; $p = 0.04$).

Conclusions: Our quantitative data suggest that individuals with ASD were initially better able to use the touchscreen. However, individuals with ASD seemed to have difficulty achieving a certain level of proficiency. Given the promising results, further studies need to establish instructions corresponding to the personal traits of individuals with ASD.

448.025 *(Poster)* Toward a Digital Phenotype of Autism: An Exploratory Study Using Twitter Data

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Background: As social communication deficits are a core feature of autism, patterns of language use are a useful tool in characterizing the disorder. However, even though online services have become increasingly popular in recent years, no study of autism to date has analyzed language use in the context of social media. Such an analysis could contribute to understanding whether autism has a robust "digital phenotype" of online behavior. Twitter in particular is a useful source of data. It has a large number of frequent users (126 million people use the services at least daily), is largely public-facing (87 percent of Twitter users make all their tweets publicly-available), and is used by a significant segment of the autistic community, with many users who self-identify using the hashtag "#actuallyautistic."

Objectives: We sought to train a machine-learning model to predict whether an individual autism-related tweet came from a user who self-identified as autistic using the #actuallyautistic hashtag.

Methods: We used Twitter search to download all unique English-language tweets made over a one-month period (7/28/2019 - 8/28/2019) that contained either the word “autism” or “autistic.” We labeled all tweets as “self-identified autistic” or “not self-identified autistic” based on whether they contained the hashtag “#actuallyautistic.” We then processed tweets for analysis by removing “autism,” “autistic,” any hashtags, any URLs, and any usernames from the text, and by converting all text to lowercase. We created a modeling dataset from all “self-identified autistic” tweets and a random matching subset of “not self-identified autistic” tweets. Using the open-source fastText algorithm, we transformed tweets into bigram vector representations and trained a model using 75% of the data for 50 epochs. We then evaluated model performance on the remaining 25%.

Results: Of 100,356 unique tweets containing “autism” or “autistic,” 992 contained the hashtag “#actuallyautistic” and were given the “self-identified autistic” label. Our trained algorithm was able to identify “self-identified autistic” tweets in the test set with reasonable (73.80%) accuracy.

Conclusions: These exploratory results at minimum sugggest that the semantic content of tweets about autism made by users who self-identify as autistic may differ systematically from those made by users who do not. However, we also consider them a promising proof-of-concept for future work using Twitter data. A logical next step would be to obtain non-autism-related tweets from the profiles of self-identified autistic users and compare them to a control group from non-autistic users. It is possible that this could improve the accuracy of our classifier, as our ascertainment of tweets based on search terms may have inherently reduced the differences between them. An eventual goal would be to determine whether a classifier trained on Twitter data can generalize to other online prose, such as Facebook comments, text messages, or emails. If so, this would represent a meaningful step towards characterizing a digital phenotype of autism.

448.026 *(Poster)* Using Automated Emotional Facial Expressions Recognition Technology in Children with Autism: First Results on the Seemingly Ignored Methodological Aspects of Test-Retest Reliability, Data Quality, and Technology Evolution Effects

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Background: Studies have indicated differences between emotional facial expressions of neurotypical (NT) individuals and individuals with ASD, in both children and adults. Recently, automated recognition of emotional facial expressions offered new tools to understand these better and to utilize them in technologically assisted screening and diagnosis. However, very little has been published on such methodological aspects of this technology as test-retest reliability, data quality, and changes with its evolving versions, especially in detecting emotions in individuals with autism. These are especially important issues for autism research as these technologies have been developed primarily for NT target populations.

Objectives: In the context of a research-and-development project to create a digital screening system utilizing automated emotional facial expression recognition and eye-tracking for identifying high functioning cases of ASD in kindergarten age, we explored (1) the test-retest reliability of a commercially available emotional facial expression recognition software, (2) its data quality, in terms of the ratio of missing and potentially artefact data (non-variant emotion intensities); and (3) compared the performance of its two versions. These characteristics were examined in two samples: NT children and children with ASD, to reveal (4) any differences between these groups in terms of emotion recognition software performance.

Methods: Twenty-nine high functioning children with ASD (8 girls, 21 boys, mean age 57.7 months, mean IQ 116.3), and 31 neurotypical children (13 girls, 18 boys, mean age 53.1, mean IQ 121.6) participated. Facial video recordings were made while the children played with the prototype version of the screening game. Versions 5.1 and 8 of the Noldus FaceReader (by Noldus Information Technology) automated emotional facial expression recognition software were used to identify emotional facial expressions during the game session. Each video-recording was analyzed twice by both versions, to gain both test and retest data.

Results: Descriptive statistics and mixed-mode ANOVAs were run on the data, with diagnosis (NT vs ASD) as between-subject factor, test vs re-test, emotions (7), and version (5.1 vs 8) as within-subject factors. Our key results are the following: (1) both software versions showed a high but not perfect level of test-retest reliability; (2-3) both versions showed occasionally invariant emotion intensities (an artefact), but in different patterns; and version 8 showed significantly lower ratio of missing data than version 5.1; (3) the 7 basic emotions were scaled differently by the two versions; and (4) there were no significant group differences or interactions in software performance measures.

Conclusions: Although perfect test-retest reliability has been taken for granted in the literature, our results did not confirm this assumption. Software performance indicators did not show cross-group differences, suggesting that this technology may be applied similarly in both groups. The not-perfect inter-rater reliability, the presence of missing and artefact data, as well as version differences, however, suggest that methodological care is needed when using this technology in autism, and further explorations are necessary to better understand its limitations and potentials in this field.

448.027 *(Poster)* Using User-Centered Design Framework to Develop a Progress Monitoring Tool Supporting Parents of Children with ASD

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Background: The current research landscape investigating the Autism Spectrum Disorder (ASD) is dominated by efforts to understand biology, detection of risk factors, and development of treatments/interventions, as they consistently received the greatest investments. Research concerning services and lifespan issues were consistently funded the lowest (Interagency Autism Coordinating Committee 2017). With diagnosis on the rise and a growing movement for ASD acceptance, more research is needed in helping individuals with ASD and their parents manage the condition, particularly in creating open communication channels between stakeholders, and providing practical opportunities for parent education, so an individual with ASD may reach his/her potential.

Objectives: To design solution prototype addressing inefficiencies in collaborative communication between parents, therapists (including other service providers), and educators within a user-centered design framework

Methods: The approach was one of exploratory research informed by principles of human-centered design and design thinking. Semi-structured interviews of parents (4), educators (3), therapists (5), medical professionals (1), ASD adult advocates (2), and other service providers (2) were conducted to understand the current landscape of collaborative communication and uncover pain points.

Content analysis using design thinking tools revealed opportunity areas to investigate for design. Major features were co-designed with parents and therapists, and the proto-solution was validated through user testing (lean startup/agile) with new findings incorporated into future iterations.

Results: The findings from the formal interviews revealed several consistent remarks: 1) a lack of funding/resources created and further exacerbated inefficiencies, 2) a lack of coordinated communication due to underdeveloped communication infrastructure, 3) strategic sharing of information between parties would help improve the quality of service provided and therefore outcomes for the individual with ASD.

Many acknowledged parents bear the majority of responsibilities in coordinating communication and care. Given their initial diagnosis, parents expressed feelings of isolation in terms of not understanding the implications of ASD, need for resources to help provide care, and fear for their child's future. Addressing the parent's needs first was strategically selected as they are the conduit between all other parties, and the main care provider.

Information analysis and co-designing sessions yielded a web based tool for progress monitoring. Parents can select from different areas of needs, determined by assessing delays in behavior related developmental windows, and consult open-sourced advice aggregated from different ASD specialists (e.g. developmental pediatricians, speech language pathologists, and occupational therapists.) There are also provisions for parents to share their learnings/findings with other parents.

Conclusions: Initial user testing feedback of the concept validated the need for such a solution and its potential in helping parents strategically monitor progress. The advice provided is more comprehensive and robust as it is aggregated from many different medical and therapeutic disciplines. There are also considerations for this tool to be shared with therapists and other relevant parties for monitoring progress and aligning around a course of treatment. Such a tool would also be beneficial in bridging access to care for low income/information communities. The implications of such a solution empowers the parent to better understand the medical and therapeutic process.

Technology Demonstration / Devices

POSTER SESSION — **TECHNOLOGY DEMONSTRATION / DEVICES**
449 - Technology Demonstration / Devices Posters

449.001 *(Poster)* A Mobile Game for the Diagnosis and Treatment of Autism Spectrum Disorder Using Crowdsourced Information

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Background: Standard of care diagnostic and treatment methods for autism require timely and laborious in-person sessions. The rapid rise in ASD prevalence and its associated costs, in the U.S. and around the world, create a pressing need to use technological innovations to develop clinical methodologies that can scale with limited resources. Digital applications that can deliver therapeutic effects while simultaneously collecting patient data for AI are a potent way to address these limitations.

Objectives: To design an engaging, nonimmersive mobile game and match game design with prosocial therapeutic benefit in children. To crowdsource an extensive library of structured videos from autistic children ages 2-8 years and to use it to develop novel emotion classification models that are more effective and personalized.

Methods: We used key components of pivotal response training (PRT) to design and develop a mobile application, *Guess What?*, available on the Google Play Store and Apple App Store. *Guess What?* is a charades style game where the child acts out a prompt shown on the phone screen so that their parent or social partner can correctly "guess" the prompt and receive points. Simultaneously, structured videos from the game sessions are collected via the phone's front-facing camera.The captured videos, labeled with participant- and session-identifying metadata, are stored on a HIPAA-compliant server on Amazon Web Services. Face and emotion classifiers are used to post-process the frames to assess the overall image quality while labeling frames. AutoML was used to train emotion classifiers with the labeled data sourced from game sessions.

Results:

More than 2,500 users submitted a total of 1,200+ videos through the application in the year since its initial listing on the Google Play Store. Among a subset of 21 families who enrolled in a pilot study, the average age of child participants was 7.24 years (SD = 1.70). The children exhibited a 3.38 ($p = 0.007$) reduction in total Social Responsiveness Scale-2 (SRS-2) scores, from 80.62 (SD = 10.18) measured at baseline to 77.24 (SD = 8.04) measured after 1 month of using the application. The AutoML emotion classifier achieved emotion-specific F1 scores exceeding 90% for neutral, scared, angry, and sad emotions.

Conclusions: Our results demonstrate that nonimmersive mobile games can be an effective way of crowdsourcing emotive structured video information for autism research while potentially providing therapeutic benefits outside of clinics. Games like *Guess What?* can generate data to support iterative machine learning model enhancement for precision medicine, and potentially provide important diagnostic and therapeutic benefits to children with autism. Such approaches will be of value to the development of effective digital autism interventions in the future.

449.0015 *(Poster)* Automatic Motor Behavior Quantification Via Video Recordings: From Fetuses to Adults

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Background: A growing body of evidence shows that motor abnormalities are widespread in individuals with autism spectrum disorder (ASD), as well as in the typical population with inherited non-clinical ASD traits. Therefore, they may serve as early indicators of high risk for ASD and/or for the broad autism phenotype, holding promise to an earlier detection of the condition. Technologies able to collect and process motor data with great precision, in natural settings, over long periods of time, and with affordable commercial devices can rapidly increase our knowledge about ASD and limit the burden of scientific testing on the participant and their families. Video-digitization has been adapted to perform reliable, robust, and flexible kinematic analysis from videos recorded as early as in utero. 2D motion patterns may be extracted from a variety of video recordings including 4D ultrasounds and amateur videos provided that the recording is performed with calibrated camera lens (to avoid image distortion), shows a definable measurement unit (to allow for within- and between-subject comparability), holds fixed focus (to avoid modification of the image proportions within a single recording). 3D motion patterns can be estimated from videos recorded with mainstream depth cameras (e.g. orbecc).

Objectives: Although state-of-the-art motion analysis can track any landmarks in the human body and in the environment, the goal of this work is to validate the ease of use of the technology for naive users, the reliability of the measurements and kinematic parameters computation of upper-limb movements across fetuses, infants, school-age children and adults.

Methods: Participants include 30 fetuses monitored via 4D ultrasound from gestational week 14-22; 8 fetuses monitored in utero and after birth till 4 months of age (7 time points); 5 pre-schoolers and 5 adults performing reach-to-grasp actions towards objects of different sizes at different distances; 20 school-age children with ASD performing reach-to grasp actions in the presence of a model. All the video data have been analysed using *VideoTrack* a customized software which provides functions for calibration and tracking tailored to the specific features of the videos and the needs of the experimenter.

Results: The software is able to reliably track spontaneous movements in constrained environments, such as in the case of fetuses (Zoia et al., 2006, 2007) and provide indices of lateralization (Parma et al., 2017) usable in models to predict ASD. Kinematic measures of reach-to-grasp movements which have been tracked from infants to adults (Zoia et al., 2006) statistically differentiate children diagnosed with ASD from typically-developing controls (Parma et al., 2013, 2014). A hands-on experience with the methodology on several videos can be provided in loco.

Conclusions: Off-line video tracking motion offers a way to accurately quantify subtle motor behavior metrics in typically developing individuals and in ASD, both cross-sectionally and longitudinally. When deployed on a large scale, this methodology will provide us with data that could result in a step change in understanding the evolution of ASD from uterine life into adulthood, enabling earlier and continuous intervention and ultimately real improvements in treatment outcomes for individuals with ASD.

449.002 *(Poster)* A Responsive Web Platform for Connecting Families to Autism Resources and Measuring Autism Resource Accessibility

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Background: Autism is a neurodevelopmental disorder with a rising prevalence rate of 1 in 40 children in the U.S. While it is widely acknowledged that most families experience difficulty accessing autism resources due to limited numbers and high demand, little has been done to connect these resources to families in need. In addition, the lack of data on resource waitlist times prevents families from gaining access to care efficiently. Acquiring autism resource epidemiological data is essential in building an infrastructure that increases resource transparency, validity, and access.

Objectives: We constructed a responsive web platform that streamlines the connection between autism resources and families in need while simultaneously collecting epidemiological data to enable crowd-sourced methods for autism resource information management. This is a tool that allows families to access, rate, and add local resources anywhere with cellular coverage. Furthermore, this platform enables tracking of waiting periods for access to care to help families balance resource quality with access time. Through crowd-sourced efforts of resource registration and manual rating, this platform will generate a more comprehensive, updated, and verified database of autism resources and allows for a more granular mapping of autism resource epidemiology and efficient resource load balancing on a global scale.

Methods: We developed a responsive, mobile-friendly, web platform with mapping capabilities that can be accessed anywhere with cellular data. It is written in React.js and runs on Amazon API Gateway to connect to Amazon Web Services (AWS) Lambda to communicate with a MySQL database that stores autism resource metadata including, but not limited to, resource names, addresses, service types, and geo-coordinates. These resources are generated through scraping autism resource databases and verifying them through regular expressions and fuzzy logic NLP-based approaches. User email and geolocation data is collected upon registration, and resource ratings and user-added resources are stored on an Amazon Web Services (AWS) DynamoDB database.

Results: We mapped a total of 28,118 unique autism resources and registered 3,872 unique participants who have signed up to be recontacted and provided their email address and location data. We assigned resources to 7 primary resource categories: *Diagnosis*, *Therapy*, *Health*, *Education*, *Recreation*, *Support*, and *Other*. Diagnosis resources comprise 8.83% of all resources and Therapy resources comprise of 41.43% of all resources. We have started expanding resource mapping to countries outside of the U.S. Currently, 81 autism resources have been mapped in Dhaka, Bangladesh. Resource ratings and new resources registered by the participants are continually being collected.

Conclusions: Our results demonstrate that crowd-powered information solutions have promise for new families to navigate the complexity of an autism diagnosis. Our responsive web platform allows families to participate in an infrastructure that reinforces the transparency, validity, and efficient access of autism resources through crowd-based ratings and resource registration while concurrently contributing to autism resource epidemiology research. We believe this platform paves the way for new technology that fills gaps in access to care.

449.003 *(Poster)* A m-Health Platform for Teachers of Children with Autism to Support Emotion Regulation

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Background: Three significant barriers limit current approaches to managing challenging behaviors in children with autism: 1) triggers of emotion dysregulation may go undetected without specialized training because children with autism often have difficulty with emotion expression; 2) teachers must attend to multiple, concurrent demands and may not recall the emotion regulation strategies to be used in the moment of crisis, and; 3) teachers may not have training/time to analyze data on the most effective emotion regulation strategies for each child so that they can make informed decisions regarding future intervention programming.

Objectives: Our EMOtion REgulation (EMORE) App is designed to address these barriers by: 1) communicating children's stress to their teachers using heart rate signaling (*Module 1*); 2) supporting implementation of emotion regulation strategies via smartphone pop-up notifications of top strategies for each child (*Module 2*), and; 3) easing the burden of tracking outcomes by providing the child's education team with a tool to track the most effective emotion regulation strategies for that child based on physiological stress reduction data (*Module 3*). See Figure 1.

Methods: First, proof-of-concept work was completed to examine the predictive utility of heart rate increase to challenging behavior (48 children with autism, 2-12 years), and the comfort-level and reliability of heart rate trackers for measuring stress (32 children with autism, 8-12 years). We use a user-centered design approach; we conducted two design workshops with parents, teachers and children with autism (n=12) to design the app prototype, and tested it in public schools with 3 autism support teacher-children with autism dyads (one testing cycle) for feedback on usability (design, layout and features), feasibility, acceptability, and appropriateness. Four additional testing cycles are planned by May 2020 to iteratively improve the app.

Results: Increase in heart rate predicted onset of challenging behavior in children with autism (22-36% heart rate increase from baseline, AUC=.72-.822). Select consumer grade heart rate trackers were found to meet quality thresholds on reliability (spike rate: Mio Fuse: 100%, Polar H7: 87.4%-89.4%; sampling fidelity: Mio Fuse: 96.2%-97.1%, Polar H7: 96.6%-100%), 85% of children with autism will wear these trackers without complaint, and they rate the trackers high on comfort and low on exacerbating sensory sensitivities. In the design workshops, parents and autism support teachers reported that an m-health app using heart rate signaling could be "extremely useful" for managing students' stress, they "strongly agree" that such a system could help prevent challenging behaviors in students, and they "strongly agree" that this is better than current practices. After in-class testing of the EMORE App, teachers reported that the app is a feasible, acceptable, and appropriate solution to preventing challenging behavior and managing stress of children with autism.

Conclusions: Results support the continued development of the EMORE App for managing challenging behaviors and stress in children with autism at school. The presentation will include a live demonstration at the meeting of the EMORE App, including use of the wrist-worn heart rate trackers, simulated tracking of "behaviors" and "emotion regulation strategies" and display of "top strategies" per participant.

449.004 *(Poster)* Augmenting Natural Communication in Nonverbal Individuals with Autism

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Background: Despite technological and usability advances, some individuals with minimally verbal autism (mvASD) still struggle to convey affect and intent using current augmentative communication systems. In contrast, their non-speech vocalizations are often affect and context rich and accessible in almost any environment. Our system uses primary caregivers' unique knowledge of an individual's vocal sounds to label and train machine learning models in order to build holistic communication technology (see Figure 1).

Objectives: This work involves the development of 4 major research outputs:

1. Scalable data collection methods to capture naturalistic nonverbal communication, including intuitive in-the-moment labeling by primary caregivers
2. Signal processing techniques to accurately characterize the real-world audio, including signal-label alignment and spectral classification
3. Personalized machine learning methods to elucidate an individual's unique utterances
4. Interactive augmentative communication interfaces to increase agency and improve understanding

Methods: We first identified the needs of the community through interviews (n=5) and surveys (n=18) with mvASD individuals and their families. We then conducted an eight-month case study with an elementary-aged nonverbal child and his family. Through a highly participatory design process, we refined the data collection process, created an inexpensive wearable audio recording system, and developed and deployed an open-source Android app for primary caregivers to label communicative and affective exchanges in real-time with minimal burden or interference. We collected over 13 hours of unprompted vocalizations from the child in his everyday environments with more than 300 labeled instances. The labeled signals were then used to classify states of affect, interaction, or communicative intent using multiple machine learning methods.

Results: Initial machine learning results using a multi-class support vector machine (SVM) with 6 researcher-labeled states produced a weighted f1-score of 0.67, suggesting these states could be differentiated with audio only. Visual inspection of the audio waveforms highlighted the diversity and distinct characteristics of the individual's vocalizations, which varied in tone, pitch, and duration depending on the individual's emotional or physical state and intended communication. (Canonical examples from this individual are shown in Figure 2.) We then trained a deep learning model using a long short-term memory (LSTM) recurrent neural network (RNN) and a zero-shot transfer learning approach. This method employed a generic audio database to classify three categories of caregiver-labeled vocalizations: laughter, negative affect, and self-soothing sounds. We identified laughter and negative affect with 70% and 69% accuracy, respectively, but classification of the self-soothing sounds produced accuracies around chance.

Conclusions: These results highlight both the need for specialized, naturalistic databases and novel computational methods and their potential to enhance communicative and affective exchanges between mvASD individuals and the broader community. Future work includes 1) the development of a database of naturalistic mvASD vocalizations to engage the machine learning community, 2) data processing pipelines for signal accuracy and alignment, and 3) personalized, semi-supervised machine learning methods that leverage the sparsely labeled structure of the real-world data. Each of these steps is built on an iterative co-designing process with autistic stakeholders with the goal of increasing agency and enhancing dialogue between individuals with mvASD and the world.

449.006 *(Poster)* Communication Support Using Humanoid Robots for Children with Autism Spectrum Disorder: Establishing Development Support Robotics

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Background: Recently, many attempts have been made to introduce communication robots to support the development of children with autism spectrum disorders (ASD). There are various communication robots, such as robots that assist support applications on tablets, and so on. But many of them aim to reduce human costs on supporters' side by using communication robots instead of supporting the development of children with ASD.

Objectives: Therefore, while previous research has focused on communication robots teaching children, few studies have focused on peer tutoring, in which communication robots and children teach each other. Thus, we proposed "**development support robotics**" to investigate the applicability of interactive communication robots and the development of children with ASD.

Methods: A preliminary experiment was performed using arbitrarily created scenario contents. The scenario consists of an introduction stage of greetings, a stage of questions between robots and children with ASD, a stage of the game that children control communication robots by using remote control. From this experiment, we got the hypothesis that **it is important to give children the initiative**. An experiment was conducted to verify this hypothesis. Two types of conditions are set for the scenario. The first is a robot-initiative scenario. In a **robot-initiative (condition A) scenario**, the robot utters according to a preset scenario and advances the scenario. The second is a child-initiative scenario. In a **child-initiative (Condition B) scenario**, the robot only guides the task, otherwise it responds to the children' question. Perform each of condition A and condition B twice in a series of scenarios.

Results: In the scenario of condition B, compared to condition A, we were able to observe multiple behaviors that could be regarded as voluntary actions from the children to the robot. These actions can be classified into actions and sounds. In order to convey the voice to the robot, some ideas were made to increase the voice, try different ways of speaking, and change the way the words were cut. In terms of movement, some ideas were seen such as changing the speed of movement, changing the standing position according to the field of vision of the robot, and showing an example. These behaviors were not seen during the scenario of condition A or during support without a robot.

Conclusions: From the above, it was verified that developmental support using communication robots gives children with ASD potential initiative and increases spontaneous behavior. In addition, from this experiment, it was found that the limited movement and voice capabilities of the robot are an important trigger for the child to make a deliberate action.

449.007 *(Poster)* Computational Behavioral Phenotyping of Autism Spectrum Disorder Using Scalable Computer Vision Tools

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Background: Observational behavior analysis of children, which is critical for the evaluation, monitoring, and discovery of biomarkers related to Autism Spectrum Disorder (ASD), is performed in-person by trained clinicians. With the rapid development of computer vision and machine learning technology, scalable and objective methods make automatic analysis of human behavior possible.

Objectives: Develop and deploy in pediatric clinics scalable computational behavioral phenotyping tools for screening ASD using a combination of strategically-designed stimulus probes and computer vision and machine learning tools.

Methods: We developed and deployed in pediatric clinics, as part of the standard well-check-up, a scalable tool for computational behavioral phenotyping. The child's face is recorded using the front-facing camera of a mobile device while they are presented with several short movies that are designed to elicit specific social, emotional, and motor responses (Figure 1(a)). Computer vision algorithms are used to detect and track the child's face position and facial landmarks throughout the video recording (Figure 1(b)) from which behavioral features including posture, head motion and pose, orienting to name calls, attention span, and affect are automatically computed. The facial landmarks are also used to estimate the eye regions of the child, which, along with the face image, are fed into a neural network to estimate the child's gaze positions on the screen. Touch information gathered from on-device sensors are used for assessing the motor behavior of the child.

Results: At the time of submission, data have been collected from >400 18-month-old toddlers for whom medical history is known. Data collection is ongoing. The data collected from our mobile application contain features related to ASD risk behaviors. For example, we are able to estimate how long a child is attending to each stimulus and how often they disengage; whether the child responds to a name-call prompt and how quickly they turn their head; the probability a child is displaying a positive/negative/neutral facial affect and the range of facial affect; preference of gaze and fixation patterns; and postural sway. Figure 2 shows for example the percentage of time children are facing towards each stimulus during presentation. Our analyses examine age, sex, and diagnostic (ASD vs non-ASD) behavioral differences.

Conclusions: We developed and deployed in pediatric clinics a mobile application that displays visual and interactive stimuli designed to elicit behaviors relevant to ASD. Using computer vision techniques, we are able to automatically track a child's head and face and from it infer critical behavioral patterns. We observed that the children are engaged with the designed stimuli, an important step toward computational behavioral phenotyping. Applications such as the one presented here could lead to new or refined behavioral risk marker assessments, and novel scalable screening and monitoring methods inside and outside of clinical settings.

449.008 *(Poster)* Detection of Autism Related Behaviors from Video of Infants Using Machine Learning

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Background: Early screening of autism spectrum disorder (ASD) in young children can play a life-changing role in determining their developmental trajectory. In recent years, the ASD research community has shown a strong interest in employing computer vision and machine learning systems to reduce the time between the emergence of first symptoms and an ASD diagnosis. These methods have been employed in identifying behaviors in video such as social and verbal responses of a child to a caretaker. The efficacy of relevant behavioral features and social interactive cues from videos including facial expression, vocalization, and direction of gaze for ASD detection has been demonstrated by existing research (Li et al., 2019).

Objectives: We applied deep learning techniques to identify basic behaviors that are clinically relevant to ASD, including gaze to people and objects, positive affect, and vocalizations. We also aimed to detect higher-order behaviors, such as social smiles and directed vocalizations, which may ultimately be useful in diagnosis of ASD from video.

Methods: This work is based on application of supervised machine learning techniques to train neural networks on a dataset collected under the UC Davis Infant Sibling Project; a prospective longitudinal study of infants from birth until the age of 3 years who are at a high risk for ASD due to family history. The dataset consists of more than 550 labeled videos of around 3 min duration each with behavior labels coded by expert raters. We approach the behavior recognition problem from two different perspectives. In the first approach, we use computer vision techniques to extract facial landmarks, facial action units (FAUs), head pose and eye gaze from video frames and train neural network from these features. In the second approach, instead of relying on expert designed features, we feed the video frames directly to a deep neural network to discover distinguishing features in detecting different events. Using both approaches, we can predict frame labels for the child gazing towards another person or an object such as a toy, smiling, and vocalizing and compare them with the ground-truth.

Results: Both approaches are trained and tested on videos from completely different groups of subjects. Preliminary experiments on both approaches produce similar performance when tested on all the frames of the test videos. We achieve 82% accuracy for the three “look” events: look object, look face, and look off, 78% for simile detection, and 76% accuracy for vocalization.

Conclusions: Leveraging one of the largest hand-labeled video datasets of infants at risk for ASD, we have obtained promising results on using different Machine Learning techniques to extract ASD-related behavioral events. In this technical demonstration, we will showcase the capability of our automatic behavior detector in realtime by indicating detected behaviors (smiling, vocalizing, eye gaze) using markers overlaid on video.

References :

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449.009 *(Poster)* Developing E-Learning Modules and Resources to Support the Learning of Paraprofessionals Working with Students with ASD

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Background: Paraprofessionals are often the primary providers of instruction to students with ASD in schools. Yet, the literature suggests that minimal training is provided to paraprofessionals for implementing evidence-based practices (EBPs) with students with ASD. When this training does occur, it is usually in the form of a workshop with very little follow-up from researchers (Walker & Smith, 2015).

The AFIRM for Paraprofessionals research development grant focuses on creating a professional development model for paraprofessionals working with elementary students with ASD. This model includes development of online training modules paired with coaching teacher-paraprofessional pairs. Phase 1 of the project included focus groups with key stakeholders to guide development of the training model.

Objectives:

1. Report professional development needs of paraprofessionals working in schools with students with ASD based on data collected and coded from focus groups with key stakeholders: paraprofessionals, teachers, and administrators.
2. Describe how these qualitative data were triangulated with our quantitative data from a national survey and pilot study to inform the AFIRM for Paraprofessionals Model.
3. To demonstrate the use of AFIRM for Paraprofessionals E-learning modules.

Methods: A total of six focus groups were conducted with key stakeholder groups: paraprofessionals, special education teachers, general education teachers, and administrators. The research team transcribed the focus groups and used NVivo software with a hybrid inductive and deductive methodology to code and analyze the data.

Results: Major themes that emerged from the focus group coding included: barriers and facilitators to paraprofessionals successfully working with students with ASD, complex and diverse roles of paraprofessionals, relationships and power dynamics between paras and other educators, and large variations in job preparation. Paras, supervising teachers, and school administrators reported broad expectations for paras working with students with ASD, from intervening in behavioral crises to teaching social skills and collecting data. Focus group participants also reported that despite these expectations, very little formal preparation for paras is provided. Limited time and resources were noted as major barriers to training paraprofessionals. Moreover, supervising teachers reported minimal training about how to provide effective supervision to paraprofessionals and uncomfortable power dynamics such as being a young new teacher working with seasoned paraprofessionals.

Conclusions: The AFIRM for Paraprofessionals research team used these qualitative focus group data along with quantitative results to develop the initial protocol for the paraprofessional professional development model. This model includes: (1) an introduction to autism online module, (2) in person workshops on teaming for paraprofessionals and supervising teachers, (3) E-learning modules that introduce five foundational EBPs, (4) performance feedback meetings between paraprofessionals and supervising teachers.

449.010 *(Poster)* Development of a Mobile Application That Tracks Challenging Behaviors of Children with Autism Spectrum Disorders for Supporting Data-Driven Interventions

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Background: The challenging behaviors of children with autism spectrum disorders (ASD) are complex and vary depending on the child. Tracking children's challenging behaviors on a daily basis by their caregivers is an essential step to designing an adaptive, personalized intervention with clinical experts. Specific information to be collected includes what happened to the child directly before the behavior occurred (Antecedent), what the behavior was (Behavior), and what happened directly after the child engaged in the behavior (Consequence). This information, when consistently logged by caregivers, could help both caregivers and clinical experts understand the context of the challenging behaviors and form a strategy to mitigate the observed behaviors.

Objectives: Our goal was to promote caregivers' understanding of their children's challenging behaviors and facilitate data-driven conversations with clinical experts using a mobile application. We aimed to develop a mobile application that allows the caregivers of children with ASD to record their children's challenging behaviors based on the ABC framework.

Methods: Through a preliminary study involving 4 clinical experts and 2 caregivers of children with ASD, we developed an Android-based mobile application, GeniAuti, that allows caregivers to record various contexts of challenging behaviors and communicate with experts through the collected data. Then, we conducted a two-week deployment study with 15 primary caregivers of children with ASD in Korea to examine the feasibility of GeniAuti for recording challenging behaviors in their daily lives. We also observed 8 sessions of clinical visits to identify how data collected through the application could facilitate conversations with clinicians.

Results: We developed GeniAuti that contains the following features: 1) tracking of children's behaviors using a speech-to-text feature in a timely fashion; 2) visualization of both recent and long-term patterns of the behaviors; 3) references of other children's behaviors and treatments. The findings of the two-week deployment study indicate that GeniAuti allowed the caregivers to understand the subtle triggers of their children's challenging behaviors; reflect on the way how they deal with their children's challenging behaviors; communicate with secondary caregivers such as grandparents, babysitters; and collect rich dataset that provides references when they seek for a clinical advice. Despite the positive impacts, our findings revealed some challenges that the caregivers face. They felt difficulty in distinguishing what are challenging behaviors and what are not; defining units of challenging behaviors to be recorded; determining the exact causes of the challenging behaviors among various triggers.

Conclusions: Caregivers play a crucial role in developing a data-driven intervention for addressing their autistic children's challenging behaviors, but they often face difficulties in consistently logging them in a structured manner. We developed a mobile application to assist caregivers of children with ASD in recording challenging behaviors using the ABC framework. Caregivers reported that the use of GeniAuti helped them recognize potential triggers of challenging behavior and discuss further treatment strategies with clinicians. To identify the impacts of using GeniAuti in a clinical setting, we hope to engage in a further long-term, large-scale randomized controlled test, specifically when provided with an education material for the caregivers.

449.011 *(Poster)* Development of a Robot-Mediated Interaction Targeting Emotion Processing and Regulation in Children with Autism Spectrum Condition Using Emotion-Sensitive Technology

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Background: The potential of robot-mediated interventions as a therapeutic tool for children with ASC has been discussed intensively in the last years. Children with ASC engage more easily with robots as the interaction is less complex and more predictable than with humans. Within our project, we are developing a robot-mediated intervention targeting emotion recognition and expression as well as emotion regulation using emotion-sensitive technology that will allow real-time adaptation of the robotic interaction based on the children’s emotions. The robot acts as a tutor to support and guide the child through the therapy sessions.

Objectives: To assess appropriateness of basic robot-child-interaction strategies as indicated by acceptance and usability measures.

Methods: We ran a two-step procedure: First, practitioners (N=5) and parents of children with ASC (N=4) underwent an interview assessing views on the general appropriateness and feasibility of robot-child interactions in autism and on specific scenarios for a robot-mediated emotion-focused therapy developed by the group. Based on the results, the robot-child interaction strategies were realized using the humanoid robot ‘Pepper’ (SoftBank) and were in a second step tested with six to twelve year-old neurotypical (NT; N=6) and autistic children (N=5). Acceptance and usability were assessed by several child and parental measures including the Godspeed Questionnaire (assess children’s impressions of robot interaction) and the Inclusion of Other in The Self (IOS) scale (perceived closeness to the robot) as well as analysis of video recordings of the child-robot-interaction for positive and negative affect shown by the children.

Results: Quantitative and qualitative analysis of the interview study yielded that both practitioners and parents judged the usefulness and feasibility of an emotion-sensitive robotic platform for the teaching of emotion skills as most useful, especially for the areas of emotion awareness and regulation. Children and parent data from study 2 showed that the robot was perceived as likeable (Scales ranging from 0 - 100: NT: M = 79.33; SD = 10.37; ASC: M = 84.35; SD = 11.27) and intelligent (NT: M = 71.50; SD = 16.86; ASC: M = 65.4; SD = 19.69). Interestingly, children with ASC were less interested to be friends with the robot (Scale ranging from 1-5: M = 2.60; SD = 1.81) than NT children (M = 4.60; SD = 0.81). All children felt close to the robot (Scale ranging from 1-3: M = 2.45; SD = 0.52). Results of the video-analysis of implicit indicators of acceptance is ongoing and will be shown at the conference.

Conclusions: We found first evidence for the feasibility and a high acceptance of the robot-child interaction. Perceived robot characteristics (e.g. likeability, intelligence) will be assessed in future studies as predictors for positive treatment outcome.

449.012 *(Poster)* Digital Assessment of Social Communication Skill, Arousal and Gross Motor Functioning in Infants, Toddlers, Children and Adults

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Background: Current approaches to assessing the behaviors that define autism fail to precisely quantify the condition as it unfolds in real life, and instead rely on summary ratings by parents and/or clinicians. The shortcomings of current approaches in reliability, granularity, and scalability present significant obstacles to a comprehensive understanding of ASD. ASD is defined by observables – what a person says or does well or not well, too little or too much, usually while interacting with other people. This makes it ripe for a biometric sensor approach that objectively captures (digitizes) all observable behaviors, including motor behaviors, speech sounds, and language (as well as unseen signals like heart rate and skin conductance). Coupling machine learning with advanced sensor technologies like computer vision and natural language analytics provides an extremely potent approach to behavioral measurement in the lab and in natural environments.

Objectives: To demonstrate our hardware platform and computational methods for capturing all outward manifestations of ASD and related disorders.

Methods: We have developed computer vision and machine learning methods to measure social motor coordination (*aka* social synchrony) during a dyadic interaction, as well as computational linguistics methods to assess speech content (e.g., word frequency metrics), speech quality (e.g., acoustic features), and conversational behavior (e.g., turn-taking rates, response latency). Our biometric sensor device also collects synchronized measurements of heart rate and heart rate variability, which relate to arousal and anxiety. We also use 3D depth cameras to measure gross motor behaviors that are often different or impaired in ASD, including gait and imitation. Because audio, visual, and wearable data streams are synchronized during data collection, within and between interacting participants, our approach facilitates rich evaluations that are pertinent to a range neurodevelopmental disorders and mental health conditions.

Results: We will present pilot results showing differences in ASD compared to matched typically developing controls (TDC) for social motor coordination, motor imitation, and linguistic behavior in school-aged children and adults. We will show preliminary test-retest reliability data from these samples. We will also share cases and small group data on infants at risk for ASD; and preliminary data from school-aged children with other mental health conditions. Finally, we will demonstrate heart rate data collection, and share preliminary results.

Conclusions: Computational approaches to behavioral phenotyping can lead to a paradigm shift in psychiatric research, greatly advancing early detection, efforts to map biological risk factors to behaviors, and the scalability, granularity and utility of outcome measures for treatment research and clinical care management.

449.013 *(Poster)* Film Detective: A New Theory of Mind Intervention for Adolescents with ASD

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Background: Theory of mind (ToM) is the ability to represent and reason about others' intentions, actions, and dispositions, in order to regulate one's behaviors, and it is a key element of human relationships and everyday functioning. There is an urgent need for research on how best to facilitate the development and improvement of ToM skills in adolescents with ASD. We have designed a new, ToM-centered technology-based educational intervention that aims to help adolescents with ASD improve their ToM and social reasoning skills by answering questions about social content in television and movie clips, through a series of activities that are embedded in a game-like application.

Objectives: This study draws from principles in design-based research and strengths-based approaches to learning to develop an interactive technology in which adolescents with ASD teach a virtual agent about ToM in social scenarios via films.

Methods: An iterative, ongoing design and implementation of the movie-based application was conducted over the course of several months, including user studies of preliminary versions of the application with adolescents with ASD, as well as focus groups with teachers to identify issues related to the feasibility of deploying the intervention in junior high classroom settings.

Results: A demonstration of the movie-based application will be presented, along with preliminary findings from student user studies and teacher focus groups, that show what students enjoyed, their suggestions for improvement, and what aspects of the technology teachers found useful and feasible for integration into their classroom practices, especially as related to promoting inclusion for students with ASD. We also discuss lessons learned during the technology design and development process, including: 1) balancing engagement with learning goals, using lessons from game design and research on "gamification" in education; 2) balancing difficulty levels and goal-setting within the game to promote student persistence while hopefully avoiding student frustration; 3) designing storylines to promote feelings of inclusion, to reduce the risk that target users (students with ASD) feel alienated or singled out by their usage of the technology; 4) designing with cultural, ethnic, gender, and other aspects of diversity in mind; and 5) using crowdsourcing to help generate game and curriculum content.

Conclusions: As technology-based platforms receive increasing attention in the research and design of educational interventions, both for students with ASD and in education more broadly, the successful development of new platforms can benefit greatly from a multi-faceted approach, with input from intended end users (which includes both students and teachers) as well as insights from the world of game design and gamification. Our case study of developing a new technology for teaching ToM and social reasoning skills to adolescents with ASD illustrates the iterative nature of such a design process, and the value in incorporating multidisciplinary expertise and perspectives throughout the timeline of such a development cycle.

449.014 *(Poster)* Generative Language Training on a Mobile Platform to Enhance Language Learning and Generalization in Minimally-Verbal Autism

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Background: Minimally-verbal individuals with autism learn to communicate through alternative means including mobile technology applications. Utterances on these devices are often very limited; learners do not surpass single-word responses for requesting and labeling, and vocabulary repertoires are small. Matrix training is a language intervention to systematically build up vocabulary and teach longer word combinations to produce more complex utterances. In this generative approach to instruction, words are arranged in a matrix format so that some multiword phrases are taught and others develop without direct instruction. Specifically, linguistic elements (e.g., nouns, verbs) are presented in systematic combination matrices, which are arranged to induce generalized rule-like behavior, a particular difficulty in autism.

Objectives: A mobile application, SPEAKmore!, was developed to carry out matrix training on a mobile platform. This study aimed to answer

1. Does language training with SPEAKmore! facilitate production of action-object combinations on a tablet device? This was accomplished by measuring the percentage of correct target forms in intervention probes.
2. Do newly learned skills generalize to untrained action-object combinations. This was achieved by taking generalization probes during the intervention phase assessing performance on combinations that were never taught before.

Methods: An experimental single subject design, that is a multiple probe design (Horner & Baer, 1978), was used across sets of action-object combinations with generalization probes of untrained combinations. This design was implemented with five participants, between 8-12 years old, with an official diagnosis of severe autism according to CARS-2 and ADOS-2 scores, who qualified as minimally verbal by having no more than 10 spoken words, and communicated primarily on a tablet. These students were taught action-object combinations on a 6x6 matrix with SPEAKmore!. From the total pool of 36 possible symbol combinations, the researcher created four different sets of three symbol combinations each that were actively taught. The remaining 24 combinations were tested for generalization effects, quantified by an effect size estimate for single-case data, the Non-overlap of All Pairs index (NAP).

Results: Four participants showed the following profile (see Figure 1): Acquisition of the initial training occurred over time and subsequent sets were mastered more quickly. All four participants reached generalization mastery levels of 80% or higher. This performance level is maintained after intervention ends; effect sizes show a strong effect (average NAP=93%). One participant showed lower performance than all others, and transitioned to a 4x4 matrix. This participant took a long time to master intervention sets and his performance was fluctuating. Effect sizes indicated a weak to medium effect (average NAP=64%).

Conclusions: Results suggest that matrix training through a mobile application may be a promising approach to teach new vocabulary and enhance the complexity of utterances for tablet communicators with severe autism. To further investigate the robustness of this technology intervention, findings need to be replicated using (a) different language targets (e.g., agent-action, adjective-object combinations), (b) expansions from two-term to three-term semantic relations (e.g., agent-action-object), and (c) simpler matrices to teach the low performing learners, focused on functional and basic concepts such as objects and their modifiers.

449.015 *(Poster)* Hololens As a Social Prosthesis: Preliminary Tests

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Background: Augmented reality (AR), where virtual objects can be mixed seamlessly into real-world activities, is developing at a breakneck pace. Technological advances now make it possible to offer real-time cognitive and decision-making supports, not only for typical individuals but also for individuals with specific needs. One area that has emerged as an extraordinary area of opportunity involves that of social prostheses which support detection of and response to social interactions. Such systems have tremendous potential for supporting lives of individuals with autism spectrum disorder (ASD).

Objectives: This was a proof-of-concept study aiming to examine the feasibility of using Hololens goggles as a social prosthesis for augmenting attention to people's faces during conversations in children with ASD.

Methods: Participants included 7 children with ASD (Mean Age: 14.7 years, SD=4.4; 86% male) and 8 typically developing children (TD; Mean Age: 12.1 years, SD=2.5; 63% male). Participants were asked to wear Hololens goggles and listen to short stories told by research staff members. These goggles did not independently obstruct any aspect of the visual field unless programmed to do so. We developed code that inserted images onto the visual display when looking at human faces. When looking at a researcher in the room, participants would see augmentation of the real space. There were three conditions of this augmentation: Control (no augmentation to real space), Covered (an animated image would cover the face), and Cued (a red box would surround the face). During the session, participants were also periodically asked questions before, during, and after story telling to orient their visual gaze to the researchers. Analyses calculated total valid time spent looking at faces in each condition to determine which condition elicited the most social attention.

Results: Wilcoxon signed-rank tests indicated that children with ASD looked more at faces during the Cued mode (p=.043) but not the Covered mode (p=.144) than during the Control condition. No differences between either Cued or Covered mode and the Control condition were observed in TD children (Cued: p=.499; Covered: p=.116).

Conclusions: These preliminary results suggest that AR cues highlighting faces may be useful, specifically in children with ASD, for promoting increased looking towards faces. This work provides a proof-of-concept for the use of AR to serve as a social prosthesis for dyadic interactions. One limitation of this work is that, because our technology measures position in space and not exact eye tracking movements, our results are predicated on general head orientation toward a face, not precise visual scanning patterns. Another limitation is that several participants in the study were below the recommended age to use the technology, a recommendation based primarily on form-factor considerations. An interpupillary distance between 51 and 74 is needed to correctly view Hololens holograms, therefore, those under the recommended age may not have seen the holograms as intended. Finally, it is important to note that drawing attention to a face is a necessary but insufficient precondition for facial information processing. Future work will consider these issues from psychological, clinical, engineering, and human-centered design perspectives.

449.016 *(Poster)* Innervoice: Emotional Communication Combined with Artificial Intelligence

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Background: Autism Spectrum Disorder (ASD) is one of the leading causes of communication disorders. Acquiring functional language abilities can be difficult depending on the severity of the disorder. Some individuals are verbal and have stronger functional language abilities whereas others are minimally verbal or nonverbal, experiencing difficulties with speech production. Those who are minimally to non-verbal face great challenges when participating in daily communication. Effective communication relies not only on words but on tone of voice and facial expressions. The ability to express emotion through one's tone of voice, or prosody, clarifies the communicative intent behind a spoken message. While there are augmentative and assistive communication (AAC) systems that allow a person to communicate using digitally synthesized speech, these voices are monotone and can be readily identified as computer generated. To be more effective, AAC products must convey emotions through prosody and have the ability to video-model a user's facial expressions to convey happiness, sadness, or anger.

Objectives: This research sought to identify and implement a set of a unique para-linguistic features that most realistically conveyed the emotions of happy, sad and angry. which can be critical for ASD individuals. A working prototype that synthesized emotional communication through speech and facial animation software designed for Apple iOS.

Methods: We administered a prototype with a diverse population of 14 adult male and female subjects aged 18-75 and recorded their ability to correctly label the emotions presented in each of the three VO, FO, and C groups. Subjects were given a combined total of 64 presentations for each stimulus. We conducted a one-way analysis of variance (ANOVA) to compare the three groups' mean identification scores (the mean number of correctly labeled emotions in each medium) with a P-value set at 0.05. The ANOVA allowed us to examine variations within each medium (such as subjects' variations between trials) along with variations among the three mediums, or whether the number of correctly identified emotions is the same for all three approaches.

Results: Analysis of the data produced an F-statistic of 10.0735, with two degrees of freedom,arriving at a P-value of 0.0001, which was statistically significant to reject our null hypothesis. In conclusion, given three different mediums — voice only (VO), facial expression only (FO), and combined voice and facial expression (C) — subjects most accurately categorized emotions that were conveyed through the combination of animated facial expressions with synthesized emotional speech (C). Along with the ANOVA, the responses in each medium were broken down into three categories: Total Recognized, Percent Recognized, and Label Substitutions.

Conclusions: We arrived at a statistically significant conclusion: individuals tended to improve their ability to identify synthesized human emotions when shown a combination of facial expressions and speech. This conclusion has a potentially high value proposition for current and future customer segments.

449.017 *(Poster)* Janssen Autism Knowledge Engine (JAKE): Demonstration

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Background: There are a lack of physiological and psychological measures that are designed to detect change over time in core and associated symptoms of autism spectrum disorder (ASD). Such tools are needed to address significant unmet medical needs for improved diagnosis and expanded treatment options in ASD, and to develop novel therapies that target core and associated symptoms. The Janssen Autism Knowledge Engine (JAKE®) is a clinical research outcomes assessment system developed to more sensitively measure treatment outcomes and identify subpopulations in ASD.

Objectives: 1) To describe JAKE and present results from studies using digital phenotyping (My JAKE) and biosensor (JAKE Sense) components and; 2) To demonstrate examples of this
technology to audience members at INSAR.

Methods: An observational, non-interventional, prospective study of JAKE in children and adults with ASD was conducted at nine sites in the United States. Feedback on JAKE usability was obtained from caregivers. JAKE Sense included experimental, proof-of-concept measures of electroencephalography, eye tracking, electrocardiography, electrodermal activity, facial affect analysis, and actigraphy. Caregivers of individuals with ASD reported behaviors using My JAKE. Results from My JAKE and JAKE Sense were compared to traditional ASD symptom measures.

Results: Individuals with ASD (N = 144) and a cohort of typically developing (TD) individuals (N = 41) used JAKE Sense. Biosensors included in JAKE Sense produced a high percentage of data of good quality (i.e., 93–100% of eye tracker, facial affect analysis, and electrocardiogram data was of good quality), demonstrated differences between TD and ASD individuals, with some relationship to ASD symptom scales observed. JAKE Sense biosensors were well-tolerated.

Caregivers reported on ASD behaviors using My JAKE. Caregiver's feedback on overall use and utility of My JAKE was "easy" or "very easy" (74%, 80/108). My JAKE detected differences in ASD symptoms as measured by traditional methods.

Conclusions: My JAKE was viewed as easy or very easy to use by caregivers and sensitively measured a broad range of core and associated symptoms. JAKE Sense functioned well when used at clinical sites previously inexperienced with some of the technologies. Lessons from the study will help optimize JAKE for use in clinical trials to assess ASD interventions. Additionally, because biosensors were able to detect features differentiating TD and ASD individuals, similar measures could be explored as potential biomarkers for ASD and as endpoints in future clinical studies.

449.018 *(Poster)* Life Sherpa Platform - Enabling Intellectual and Developmental Disability Employment

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Background: Individuals with IDD have traditionally required ongoing, one-to-one supports to learn and maintain mastery of independent tasks in the work setting. While one-to-one staffing support has historically been a costly proposition, technology offers the promise of a more scalable and cost-effective solution for helping clients with IDD navigate the workplace.

Objectives: As part of a trial implementation of the Life Sherpa app, Mason LIFE Program conducted a pre/post survey with a control group, as well as a social validity study.

The purpose of the study was to determine:

1. The functional relationship between use of the Life Sherpa app and increased productivity of targeted work-related skills
2. The feedback of the student participants
3. The feedback of the support staff participants

The expected outcomes of the study were to increase support staff training and efficiency, decrease staff-to-student ratios, and to provide an effective teaching and skill maintenance modality for students.

Methods: Using a pre/post design with a control group, the students in both the intervention and control groups were assessed using the WAI, Brigance, and Vineland at the beginning and end of the study. During intervention, the students and their support staff used the Life Sherpa app to support students in the intervention group, and data was collected.

After the research period was completed, both students and support staff in the intervention group were interviewed. Students were interviewed on their thoughts on completing tasks, asking for help at work, and interacting with coworkers. Support staff were interviewed on their thoughts about teaching skills to the students, how they support the students, and fading away.

Results: WAI: Intervention and control groups saw very similar overall total gains (Intervention 9.8 and Control 10). Small differences included intervention group having greater gains in empathy, sociability, assertiveness, and adaptability, and for control group having greater gains in emotionality.

Brigance: Intervention group made more progress overall than the control group (Intervention 41.5 and control 14). When looking at the subdomains, the intervention group had more gains in responsibility and self-discipline and self-concept (job-related). The control group had more gains in listening, self-concept (general), trainees' work experience.

Vineland: Overall, the intervention group demonstrated greater growth than the control group. When looking at subdomains the intervention group showed more growth in receptive language, interpersonal relationships and coping. Both groups had the same growth in expressive language.

Interviews and Data:

Overall, students experienced the most success between baseline and intervention in the areas of overall work quality, improving eye contact, trying to problem solve on their own before asking for help, and asking for more work when finished with a task.

Conclusions: Although the small sample size did not allow for any statistically significant analysis, overall the Life Sherpa app showed an increase in productivity, as well as soft skills (measured by the assessments) in the intervention group when compared to the control group. Both students and support staff liked using the app, and expressed a desire to continue using it.

449.019 *(Poster)* Machine-Learning Based Autism Diagnosis Using Gaze Fixations on Natural Images

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Background: Autism Spectrum Disorder (ASD) is often associated with atypical visual attention such as delayed disengaging attention and fixation towards less socially salient stimuli. For example, the fixation maps between an ASD subject and a Typically Developed (TD) subject on the same image are quite different. These studies suggest the possibility of using gaze fixation patterns on common test objects as a screening tool. A promising direction to automate the screening process is to apply Machine Learning (ML) techniques, which have recently emerged as a viable tool in extracting salient features from complex behavior data such as gaze patterns for ASD diagnosis.

Objectives: Our objective is to study different ML techniques on saccade and fixation patterns for ASD diagnosis. By considering the screening process as a supervised learning problem, we can take advantage of the state-of-the-art computer vision and ML techniques to discover salient features from visual gaze data that can be used to classify ASD from TD.

Methods: Our study is based on gaze data collected from viewing two different image datasets. The first one consists of 400 random natural images, while the second one has 300 images depicting gaze-following behaviors of humans on various objects as shown in Fig.2. Gaze data is collected using Tobii T120 eye gaze tracker from 14 ASD and 14 TD children (average 8 yrs old), viewing each image for 3 seconds and 65cm away from a 17-inch monitor.

Both recurrent and non-recurrent deep learning techniques are studied to learn the distinctive features from gaze data for ASD prediction. The first non-recurrent method synthesizes a TD saccade pattern based on the input image using the STAR-FC generative model from (*Wloka, et al. 2018*) and predicts TD/ASD based on the learned similarity between the input and synthetic scanpaths.

The second non-recurrent approach converts a sequence of fixation maps to image format. A convolutional neural network is then trained on both scanpath images and the original image which are fed into two separate processing branches before they are concatenated for final classification. Lastly we also study a novel recurrent neural network based on Long Short-Term Memory (LSTM) architecture to extract distinguishing features by predicting the difference of fixation maps for these two groups.

Results: Our two non-recurrent method can achieve 65.41% and 61.62% accuracy, respectively, on the validation set of the first dataset, 54.15% and 55.13% on testing dataset. The recurrent method, on the second dataset, can achieve 80% accuracy on testing set.

Conclusions: With machine learning techniques, we can achieve a good performance on ASD prediction. The results show that there is a strong relationship between gaze pattern and ASD. The ML performances on images focused on socially salient stimuli (dataset 2) seem to be better than generic images (dataset 1). We hope our interactive demonstration will provide participants an immersive interactive experience on the potential usage of gaze pattern as an automated ASD screening tool.

Reference:

[1] Calden Wloka, Iuliia Kotseruba, and J. K. Tsotsos, “Saccade sequence prediction: Beyond static saliency maps” CVPR 2018

449.020 *(Poster)* Magical Musical Mat: Augmenting Communication with Touch and Music

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Background: Augmentative and alternative communication (AAC) refers to communication modalities that are used as an alternative to or as augmentation of an individual’s speech (Iacono, et al., 2016). The current evidence shows AAC to be a positive contribution to the communication of learners on the autism spectrum, especially those who are minimally verbal. However, more research is necessary to better understand what forms of AAC best meet the needs of autistic communicators and how to prioritize social communication through AAC (Mirenda & Iacono, 2009).

AAC interventions have mainly focused on referential language form geared towards speech generation, thus neglecting aspects of communication that are foundational to effective communication, such as joint attention, and the mutual creation of shared meaning (Yu & Chen, in press). In addition, these interventions ignore nonverbal aspects of communication that are important for joint action. For autistic individuals with significant social communication needs, this has resulted in the development of communication skills that serve a limited set of functions.

The focus on language forms has constrained AAC user interface design to an array of symbols and grids. The complexity of such an interface prefaces social communication on good sequencing skills, excellent memory, and motoric dexterity, imposing high cognitive and motor demand on the user when navigating these systems (Light & McNaughton, 2019). Communication is thus dependent upon the user’s ability to gain mastery of the lengthy process of selecting symbols accurately, resulting in a steep learning curve.

Objectives: The Magical Musical Mat (MMM) goes beyond the symbol-and-grid display by returning to the foundations of meaning-making: dyadic joint attention. Using touch and music as prosocial resources, the MMM provides a means to recruit and sustain interest in interaction. It also lowers the threshold for expressive activity by augmenting multimodal communication.

Methods: The MMM is built upon the embodied design framework, an approach to design that takes embodiment to be central to interaction. By designing for action and perception, this framework takes into account the creation, manipulation, and sharing of meaning through engaged interaction with artifacts (Abrahamson, 2014). The MMM also draws upon the theoretical and methodological frameworks of haptic sociality (Goodwin, 2016) and gesture (Goldin-Meadow, 2011), where touch is a foundational way for people to connect with one another, and gestures have demonstrated both social and cognitive merit. Lastly, the MMM is based on Universal Design for Learning, which accommodates to individual learning differences through the development of flexible learning environments and spaces (Rose, 2000).

Results: *Magical Musical Mat* (MMM) is an interactive musical mat that amplifies physical touch between people through sound for communicative purposes. When participants step onto the mat and explore different types of touch interactions together, capacitive sensors in the mat detect their haptic, touch-based interactions, triggering musical sounds. Different types of touch, such as holding hands, high-fives, or gentle taps, dynamically and spontaneously change auditory qualities, resulting in a rich diversity of sound-touch expression. This project is developed in conjunction with an autism clinic and families with nonverbal autistic children.

Conclusions: N/A

449.021 *(Poster)* Managing and Visualizing Freesurfer Neuroimaging Data in R – the Freesurferformats and Fsbrain Packages

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Background: FreeSurfer (http://freesurfer.net, Fischl et al. 2012) is a neuroimaging software suite developed at the Martinos Center for Biomedical Imaging. It enables both volume and surface-based analysis of magnetic resonance imaging files and uses different file formats arranged in a standard directory structure to store intermediate data and results for the subjects of a study. GNU R (https://r-project.org) is a statistical computation language that is freely available and offers a wide array of modern statistical methods through a package system. However, there currently exist no packages for GNU R that provide a user-friendly interface to access, write and visualize FreeSurfer data.

Objectives: We therefore aimed to implement packages for GNU R which enable easy access to FreeSurfer structural neuroimaging data at different abstraction levels: (1) reading and writing single files in the different binary formats, and (2) a high-level layer that uses knowledge about the directory structure of FreeSurfer data to enable high-level access and visualization of data for groups of subjects.

Methods: We implemented the *freesurferformats* package and the *fsbrain* packages in GNU R. The software is open source and available under the MIT license. Both packages are available on CRAN (https://cran.r-project.org/package=freesurferformats and https://cran.r-project.org/package=fsbrain), and the full source code can be found on GitHub (https://github.com/dfsp-spirit/freesurferformats and https://github.com/dfsp-spirit/fsbrain).

Results: The *freesurferformats* package implements file readers and write support for the following binary FreeSurfer file formats: (1) MGH and MGZ format, including header data. These formats store morphometry data or 3D brain volumes. (2) *Curv* format files that store morphometry measurements for brain surfaces. (3) Brain surfaces files which store triangular brain meshes. (4) Annotation files storing brain surface parcellations based on a cortical atlas, like the Desikan atlas (Desikan et al., 2006).

The *fsbrain* package implements a high-level interface to access study-level neuroimaging data stored under a common *subject's directory* for a group of participants. This includes easy access to, and interactive visualization of, full or aggregated morphometry data (e.g., mean cortical thickness per subject, per hemisphere, or per atlas region). This functionality is available for both native space and standard space data. See Figure 1 for example visualization output for raw morphometry data (A), p-values (B), and a brain atlas (C).

Both packages are thoroughly tested and well documented, including examples, vignettes, and unit tests.

Conclusions: The *freesurferdata* and *fsbrain* packages provide access to FreeSurfer data in GNU R on different abstraction levels. We hope that their availability will enable researchers to leverage the wide array of statistical methods available in R for neuroimaging research and promote open science by reducing the effort required to verify or reproduce published results.

449.022 *(Poster)* Pip's World: An Adaptive Tablet Battery to Assess Preschoolers with Autism Spectrum Disorder across Five Behavioural Domains

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Background: Previous research has linked core and associated features of Autism Spectrum Disorder (ASD) with developmental atypicalities in social, emotional, reward-related and cognitive processes. However, the considerable clinical and etiological diversity of ASD indicates individual differences in these developmental atypicalities. By assessing individual bio-behavioural profiles across domains, we may improve predictions of a child's developmental prognosis or therapeutic needs. Currently, a standardised test battery measuring these domains in preschoolers with neurodevelopmental conditions is missing. Existing batteries only tap some domains, and/or include little to no adaptation of task parameters, leading to difficulty in capturing the breadth of preschoolers' heterogeneity and developmental change. Moreover, cognitive-behavioural testing in preschoolers with neurodevelopmental conditions is challenging, as children's limited attention and motivation can impact task performance separately from the primary process of interest.

Objectives: To create and validate a tablet battery that

(a) assesses social, emotional, executive function, reward and un/predictability processing

(b) is engaging by embedding tasks in child-friendly games

(c) varies task difficulty to be suitable for children with or without neurodevelopmental disorders across the preschool age range (3-6 years)

Methods: Using animated cartoons and puppet videos, we created an overall narrative - "Pip's world" - containing thirteen tasks. Tasks assess gaze following, understanding desire, false belief, attentional biases to positive/negative expressions, emotion recognition, Go-NoGo, sustained attention, social/non-social reinforcement learning, un/predictability processing, and motion coherence (Fig 1a). To standardise assessments, task instructions and demonstrations are narrated by one of the characters. To combat floor and ceiling effects, features such as in-task parameters can be individually adjusted through Bayesian Adaptive Optimisation (BAO), which constructs a posterior distribution of functions using gaussian processes, minimising the number of iterations required to find optimal parameters. For example, Go-NoGo piloting indicated that not all children responded reliably to go-trials at a standardised trial speed, so a pretest adjusts stimulus speed individually to induce a maximally prepotent response to accurately test inhibition (Fig 1d). Children's attention throughout the task is monitored, with in-built social and non-social prompts given to re-engage children. These measures are recorded as secondary variables to obtain a comprehensive picture of children's cognitive/motivational profile within and across tasks. Across tasks, different versions were tested iteratively in samples of 25-40 children.

Results: Finalised tasks, including the novel social/non-social reinforcement learning task (Fig 1b), had a 89.5% completion rate (85-92%), showing that children were clearly engaged.

BAO proof-of-concept for the Go-NoGo task in adults showed large individual variability in optimised speed (33.5 to 55) which can be estimated online. Each individual's optimal speed elicited response patterns that better tested inhibitory control (average 69.7% hit rate and 38.9% commission rate) versus a slower speed that proved too easy (95.8% and 8.3%) and faster speed with responses nearer chance (45.8% and 55.6%).

Conclusions: Preliminary results indicate that most 3-year old children successfully complete the task battery across the domains. BAO allows us to increase sensitivity of key dependent variables. Psychometric validation, creation of age-norms, and implementation of the battery in the multi-centre AIMS-2-TRIALS longitudinal Preschool Imaging Project are planned.

449.023 *(Poster)* Remote Assessment of ASD in Clinical Trials: Feasibility of Quantifying Social Interactions with Wearable Technology

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Background: Whilst clinical trials for ASD therapeutics are dependent on the quality of their outcome measures, current tools have severe limitations in terms of reliability, validity, burden and ecological validity (Anagonostou et al., 2014). To address this unmet measurement need we have developed novel digital tools for the remote measurement of ASD signs and symptoms and deployed these into an observational study. Previous studies have shown that individuals with ASD are less likely to interact with others and more likely to spend time engaged in solitary behaviors (Lord and MaGill-Evans, 1990; Humphrey and Symes, 2011). In the FDA's Voice of the Patient public meeting, individuals with ASD identified social isolation as one of the major impacts of the condition on their lives (FDA, 2017). We developed a new tool "Social Beacons" to quantify the frequency of social interactions, utilizing commercially available hardware and a custom smartwatch app.

Objectives: To test the feasibility of remotely tracking social interactions in the context of a clinical trial using "Social Beacons".

Methods: 90 individuals with ASD and 45 typically developing controls (5-45 years) in the UK and US were asked to distribute the "Social Beacons" and wear the smartwatch every day during the 3 week screening and 12 week observational periods of the non-drug observational study. The "Social Beacons" (Room and People Beacons) emit a Bluetooth signal that is captured by a smartwatch worn by the participant. "Room Beacons" are placed in rooms around the home (each categorized as either social, sometimes social or non-social, based on the caregiver's judgement of how the room is used), while "People Beacons" are carried by other household members. The signal strength and its derivative are used to estimate the proximity of the smartwatch to the "Social Beacons", allowing one to infer the participant's room location and proximity to other household members and therefore estimate the frequency of social interactions.

Results: Preliminary data indicates participants set-up the technology as instructed. Periods of time when the watch was worn by the participant were identified with activity recognition. During these periods the participant's location in the home was tracked continuously, allowing for an estimation of time spent in each room throughout the day.

Conclusions: It is feasible to deploy "Social Beacons" into a clinical trial and infer the participant's room location. Observational study data is currently being analyzed to extract and test the reliability of multiple social interaction measures and the association with clinical scales. We plan to deploy this technology into upcoming Ph2 interventional studies to test the sensitivity of these measures to treatment effects.

449.024 *(Poster)* Superpower Glass: An Augmented Reality Intervention for Improving Social Deficits in Children with Autism Spectrum Disorder

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Background: Just within the past decade, the prevalence of Autism Spectrum Disorder (ASD) in the United States increased by over 120% up to 1 in every 40 children. Standard of care ASD diagnostic and therapeutic methods require timely and laborious in-person sessions that, combined with the growing scarcity of expert clinical providers, mean that intervening during the effective therapeutic window can become prohibitively slow and expensive for many families. Digital technologies hold the potential to remove these barriers and allow patients to receive timely, affordable, and effective care that does not disrupt their daily routine.

Objectives: To develop an augmented reality (AR)-based system for real-time emotion recognition to be used as a behavioral intervention for improving social deficits in children with ASD. To build different mobile gaming applications that evaluate the system's potential for improving emotion recognition and facial engagement, as well as explore its feasibility for measuring and/or improving behavioral deficits such as motor problems, repetitive behavior, and joint attention.

Methods: We developed a digital mobile therapy platform, "Superpower Glass", that includes an Android app wirelessly connected to a Google Glass AR headset to receive video information from the headset's camera. Computer vision algorithms integrated within the application's workflow track the faces and classify the emotions of the people captured within the scope of the recorded video. Wearing the glass headset, a child (4-12 years old) is prompted with emotional response cues that are designed to increase their engagement with their social partner. We used these capabilities to design AR-based mobile games centered around key elements of behavioral therapy reinforcing social acuity. Structured video, audio, and accelerometer data, as well as participant and session metadata are collected after each play session and stored on a HIPAA-compliant Amazon Web Services server.

Results: A total of 474 families were screened and 71 participants received the intervention. 40 of the participants were randomly assigned to treatment and 31 were randomly assigned to control. The average age of participants was 8.38 years (SD = 2.46) and 63 (89%) were boys. Participants who received the intervention used the device an average 12.12 (SD = 5.80) times over a 6-week period and demonstrated an improvement of 4.56 (SD = 1.62, p = .005) on the Vineland Adaptive Behavior Scales, second edition socialization subscale as compared to participants in the control arm.

Conclusions: Our results demonstrate that digital therapeutics can be effectively deployed to improve social deficits in children with autism and other neurodevelopmental conditions. AR and similar technological innovations allow for the design of user-friendly diagnostic and therapeutic methods that allow families to intervene in a timely, engaging, accessible, and efficacious manner from the comfort of their own home. These findings pave the way to empowering clinicians to deliver more effective care that can reach all patients.

449.025 *(Poster)* The Global Reach of Autism Navigator® and Baby Navigator Using Mobile Technology to Improve Early Detection of Autism and Access to Care

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Background: Advances in research have documented that ASD can be diagnosed by trained professionals at 18-24 months and yet, the median age of diagnosis in the US still hovers at 4 years. There is currently a research-to-practice gap in high-resource countries, and this gap widens in low-resource countries. Autism Navigator® is a collection of web-based courses and tools that has used an implementation science framework to promote coordinated change to support community uptake and sustained utilization in health care, social service, and early intervention systems. Access to mobile technology is increasing worldwide and offers one solution to bridge the research-to-practice gap with potential for rapid access globally.

Objectives: This technology demonstration will showcase the web-based Autism Navigator for Primary Care that uses extensive video and offers a new online screener with links to our *Seamless Path for Families* to lower the age of detection and referral and report on the deployment.

Methods: The Autism Navigator collection of web-based courses and tools, and the new Baby Navigator companion website with family resources, was developed by the FSU Autism Institute. Autism Navigator for Primary Care is an 8-hour online course using illustrative video clips of two-dozen toddlers with ASD. Providers who complete the course can use the online automated Social Communication CheckUp with an autism risk indicator, designed as a universal screening tool every 3 months from 9-24 months, with provider and family portals linking to 5 online resources. Families of all children are invited to the 16-by-16 Lookbooks and Social Communication Growth Charts. Families of children with a positive autism screen are invited to the About Autism in Toddlers, ASD Video Glossary, and How-To Guide for Families. Input from advisory boards and focus groups involving stakeholders informed the development of content built through an iterative process of feedback, review of material for cultural appropriateness, and revolving enhancements to the portal.

Results: We will describe the deployment of the courses and family resources over the past 5 years beginning in Florida and expanding to other states in the US and other countries including South Africa. About Autism in Toddlers was first launched in 2015 and enrollment has increased incrementally to 40,086 unique users from 160 countries to date. Autism Navigator for Primary Care was launched in 2016 and has 1,847 unique users enrolled from 6 countries. The How-to Guide for Families was launched in 2017 and has 673 unique users from 10 countries. Strategies to engage physicians, community health workers, and childcare providers in the US and South Africa and lower the age of referral will be highlighted. Tablet computers will available to experience the screening tool and web-based resources.

Conclusions: Innovative technology to increase the number of culturally diverse professionals who can deliver evidence-based services is vital to improving global competence in early detection and intervention. Autism Navigator provides a community-viable cost-efficient platform for professionals and families, using mobile technology to combine an automated screening tool, parent and provider portals, and links to interactive resources that are built for rapid scalability.

449.026 *(Poster)* Use of Interactive Smartphone Tasks for Remote Assessment of Symptom Severity in Autism Spectrum Disorder

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Background: Development of novel treatments for autism spectrum disorder requires accurate measurement of symptom severity in response to treatment. Current methods often require lengthy in-clinic assessments, which can limit scalability in clinical trials, are burdensome for patients, caretakers, and clinicians, and are far removed from patients' natural environments and hence may not accurately reflect their typical functioning.

Individuals with autism demonstrate observable behavioral traits such as altered facial expressions, changes in vocal tone, misuse of pronouns, and repetitive body movements. If these 'biomarkers' can be measured using automated tools that take advantage of advances in computer vision and machine learning, short, frequent, and objective assessments of symptom severity conducted in the individuals' natural environments could be utilized in the development of novel treatments for autism.

Objectives: There are two main objectives. The first is the development of an interactive smartphone task that collects the necessary visual and auditory information for calculation of digital biomarkers of autism. The second is the development of a processing pipeline that uses the collected video and audio to calculate those biomarkers.

Methods: The interactive task will involve both a naturalistic and a stimulus-based component. The former asks open-ended questions about the participant's activities surrounding the task to collect data on spontaneous facial expressivity, vocal acoustics, free speech, and movement. The latter presents visual and verbal stimuli to collect data on evoked behavior including expressivity, vocal tone, content of speech, and gaze direction in response to a stimulus such as social imagery.

The collected video is then used to calculate biomarkers. OpenFace is used to measure emotional expressivity, head movement, and oculomotor behavior such as gaze direction (Baltrušaitis et al., 2016). The Praat software library is used to measure acoustic characteristics of voice such as frequency, amplitude, and pauses (Jadoul et al., 2018). Amazon Transcribe is used for transcription of speech into text, which is then further analyzed for speech characteristics such as use of pronouns and content valence (Loper and Bird, 2002).

Demonstration:

The demonstration will involve attendees participating in the described interactive task on smartphones provided by the presenter. This will allow attendees to have a hands-on experience with the method used to collect the data necessary for calculation of biomarkers. The poster itself will describe the data processing pipeline and the validation of the computational tools used to calculate digital biomarkers from the data.

Results: The interactive task, built on a validated mobile data capture platform, is able to securely collect and store video and audio captured during participation in the task. The processing pipeline, built using open-source software, is able to accurately classify action units for detection of emotional expressivity (Baltrušaitis et al., 2016) and measure the frequency of tones with an average accuracy of 99% in low-noise environments (n = 14) for measurement of verbal acoustics and content of speech (Jadoul et al., 2018).

Conclusions: Participation in interactive tasks delivered through a smartphone may allow for collection of visual and auditory information adequate for measurement of biomarkers of autism spectrum disorder.

449.027 *(Poster)* Using Virtual Reality to Explore Individual Differences in the Local and Global Processing of Visual Information and Their Relationship with Autistic Traits

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Background: Global and local processing is part of human perceptual organisation, where global processing enables us to extract the 'gist' of the visual information and local processing helps us to perceive the details. Individual differences in these two types of visual processing have been found in autism and ADHD. Technological developments have made Virtual Reality (VR) a more accessible research tool in the last few years. No previous research has investigated perceptual differences related to autistic traits using this technology. The current study was pilot exploratory research into the feasibility of using VR technology for research on perception in autism. Given its use in previous research on local vs. global processing we employed the Rey-Osterrieth Complex Figure test (ROCF: Figure 1).

Objectives: The standard ROCF test was used as a baseline task to look at practical aspects of using VR as an experimental platform. New methodology for extracting and manipulating three-dimensional data was also explored.

Methods: In this study, we investigated individual differences in local and global processing as a function of autistic and ADHD traits (quantified using standard questionnaires for both (Baron-Cohen et al, 2001; Kessler et al, 2005)). The ROCF was presented in a virtual environment and a standard protocol for using the figure was followed: after initial presentation the figure was copied, then the figure was withdrawn from view and drawn from memory (Immediate Recall). Drawings were all in 3-dimensional space using Google® Tilbrush®. A novel method of quantitative data extraction was used (Figure 2).

Results: Using standard methods of scoring performance in the task, differences were found between copy and recall conditions, but none of these correlated with different scores on AQ or ADHD questionnaires.

Conclusions: Virtual Reality has proved itself to be a fruitful source of information. This study is an example of how classic psychological paradigms can be transferred into the virtual world. Our novel method of data extraction provides us with rich information on how individuals behave in the virtual world. Further investigation of individual differences in drawing tasks in VR could lead to a better understanding on how we process visuospatial information.

449.028 *(Poster)* Using a Socially Assistive Robot to Engage Children in Physical Activity: An Analysis of "What's Possible" Using a Participatory Design Framework

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Background: Evidence suggests that motor skill delays are prevalent in autistic youth (Lloyd, MacDonald, Lord, 2013; Staples & Reid, 2010)—often intensifying as the child develops (Liu et al., 2014). Furthermore, limited motor skills are related to increased rates of physical inactivity (Healy et al., 2019). Yet, despite growing evidence of motor delays and increasing physical inactivity, few intervention exist to meet the needs of autistic youth (Colombo-Dougovito & Block, 2019). Utilizing a Socially Assistive Robot (SAR), however, may provide a novel reinforcement for motor skill instruction. Yet, little to no precedent exists for using a SAR in a physical activity setting.

Objectives: Therefore, to better inform future interventions, the purpose of this study was to explore how autistic youth would like to engage with a SAR when participating learning motor skills and engaging in physical activity.

Methods: Using a participatory design framework, autistic youth were shown a commercially available SAR while confronted with a "wizard of oz" scenario. In this situation, youth were asked about how they would like to use the SAR without any restrictions on what could or could not be possible. Following each interview, suggestions were analyzed for possibility and practicality. Those ideas deemed most possible were implemented in the commercial SAR. Follow-up interviews were used to determine if implementation matched the child's suggestion. Additionally, to understand the social validity of a SAR for physical activity, parents of each participant were interviewed to understand how a SAR may be used in home. All data were transcribed verbatim and coded thematically (Braun & Clark, 2006) to understand emergent themes within the data.

Results: Preliminary evidence shows strong confirmatory evidence for using a SAR to assist with learning motor skills and engage in physical activity. Suggestions for using the SAR in the physical activity setting were implemented within the constraints of the software and limitations of the available SAR.

Conclusions: Using a SAR in the physical activity setting may provide for a novel experience for autistic youth. The present findings provided a solid foundation to developing important elements for using a SAR in the physical activity setting. By using the feedback and suggestions from the most impacted stakeholder, the use of a SAR will be more likely to provide impactful reinforcement while practicing motor skills and encourage engagement in physical activity.

449.029 *(Poster)* Using an Animal-like Robot to Trigger Helping Behavior in Children with Autism Spectrum Disorder

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Background: A number of systematic reviews (e.g., Diehl et al., 2012; Ismail et al., 2019; Pennisi et al., 2016) have reported many positive implications in the use of social robots for children with Autism Spectrum Disorders (ASD). To date, social robotics has been applied in various target behaviors, such as motor imitation (Duquette et al., 2008; Robins et al., 2005), joint attention (David et al., 2018; Warren et al., 2015), collaborative play (Wainer et al., 2014), speech production (Kim et al., 2013), and turn-taking (Matsuda et al., 2017). However, few studies using social robots have targeted helping behavior, although helping behavior is one of the important pro-social behaviors (O'Connor et al., 2019). A "weak robot" which can trigger helping behavior in children with ASD, may offer promising implications for how interventions should be approached.

Objectives: The objectives of this pilot study were examine 1) whether children with ASD show helping behavior toward a weak robot, LOVOT™ and 2) how the contingent movement of the robot affects child's interactive behavior toward a robot.

Methods: LOVOT™ is a pet toy. It has a camera-based vision system (including depth camera) for face identification, object recognition, and mapping. It also has microphones, thermal cameras, infra-red, orientation, temperature, illuminance, and pressure sensors (Figure 1). Thus, it is able to automatically recognize user's face and move toward the user. This pilot study was implemented with five participants (four males) between 3-7 years old, have a diagnosis of ASD by an outside medical doctor. **Study 1**: In the study 1, we made robot falling several times in approximately three minutes. A dependent variable was helping behavior. **Study 2**: In the study 2, two conditions (with and without contingent following) were implemented. In the *with contingent following condition*, the camera-based vision system detected child's face, and the robot moved toward the child contingent on child's looking at name and/or child's calling name of the robot. In the *without contingent following condition*, the camera-based vision system was turned off. Therefore, the robot could not recognize child's face and position. Four dependent variables (approaching, calling name, looking, and body contact) were scored using occurrence/non occurrence data. All behavior coding was conducted using the software, ELAN (2018).

Results: Exp1: All five children showed helping behavior toward the robot (Figure 2) several times (2-4 times). **Exp2**: The mean percentage of intervals in the *with contingent following condition* was 1.8% for approaching, 2.1 % for calling name, 7.2% for looking, and 12.7% for body contact. On the other hands, in the *without contingent following*, the mean percentage of intervals was 1.7% for approaching, 1.9% for calling name, 7.2% for looking, and 13.0 % for body contact.

Conclusions: Our pilot study suggest that the "weak" robot triggers helping behavior in children with ASD. On the other hand, the frequencies of child's interactive behavior toward robot did not consistently increase or decrease in the *with* contingent following condition. Further studies are required, including use of a group experimental design with larger sample sizes.

449.030 *(Poster)* Utilizing Technology to Teach Social and Vocational Skills for Adults with Autism Spectrum Disorder: The Autism News Network

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Background: Social skills deficits are amongst the most significant challenges facing adolescents and young adults with ASD (Barnhill 2007; Howlin 2000). Adults with ASD also struggle with attaining postsecondary education, employment, living independently, and establishing social and intimate relationships. As a result, this population is at risk for social isolation and 54% have co-morbid psychiatric conditions (Gantman 2012, Croen et al 2015). Despite this, few studies have focused on social skills treatment for young adults with ASD.

The Autism News Network (ANN) is a treatment program at the Medical University of South Carolina that utilizes technology to provide social skills training and vocational training for adults with ASD. The program teaches participants how to conduct interviews and produce video content, podcasts, and newsletters aimed at a mass audience. All ANN content is written, produced and directed by adults with ASD.

Objectives: The object of this session is to demonstrate how the use of technology by the ANN benefits adults with Autism Spectrum Disorder by improving their social skills and vocational skills.

Methods: Fourteen adults with ASD ages 18-35 were enrolled in weekly 2-hour training sessions for 12 weeks. Participants were instructed on basic interview skills, writing, videography, film editing and other soft skills. Participants and their parents completed pre- and post-intervention assessments. Outcome measures included the Social Responsive Scale-2 (SRS-2) and the Social Skills Improvement System Rating Scale (SSiS). Parents also completed a 12-item Likert scale regarding target symptoms related to social skills.

Outcomes data is currently being analyzed. The investigators will characterize basic statistical properties (moments, distributions, and correlations) of preliminary baseline and outcome data and apply a set of parametric (e.g. one-sample t-tests) and non-parametric (e.g. one-sample Wilcoxon tests) statistical tests for within-score and within-timepoint hypothesis testing where appropriate. To quantify and judge outcome success for the mean SRS-2 sub-scores we will further apply a set of matched-pairs (repeated measures) two-sample t-tests or Wilcoxon signed-rank tests (Pratt modification to improve bias for discrete measures) for each total score and SRS-2 sub-score. Two-way (matched-pairs) ANOVA tests will be implemented to study systematic within-score between-time (pre vs. post) changes. Finally, we study simple and complex interactions between sub-scores by means of linear models with fixed- and/or mixed effects followed by one-sample t, Z-, or F-tests.

Results: The session will begin with a review of social deficits and vocational challenges facing adults with ASD. Then, the presenter will discuss the ANN treatment protocol. Next, the presenter will review the clinical outcomes data described above. The presenter will also share video examples of ANN participants learning how to accomplish various skills emphasized by the program. Finally, the presenter will share the participants' finished work—video content focused on ASD, created by adults with ASD.

Conclusions: Results of this preliminary work in the area of social skills and vocational training has the potential to positively impact quality of life for the growing number of adults with ASD. The video content created by the program's participants could raise ASD awareness for a mass audience.

449.031 *(Poster)* Virtual Reality, Bone Conduction and Video Modeling Used to Enhance Functional Speech Abilities for Individuals with Autism Spectrum Disorder

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Background: Autism Spectrum Disorder (ASD) is a neurodevelopmental communication disorder resulting in functional language and behavioral delays affecting over 3.5 million Americans. These delays vary with the severity of symptoms that present in ASD but often result in limited speech and increased communication challenges. Alongside linguistic acquisition, oral motor coordination is a crucial part of speech production. Current clinical techniques have shown varying degrees of efficacy in improving functional language proficiency. Most techniques follow a drill-like procedure, where the child is made to repeat various sounds and phrases until they are retained. However, such a process requires potentially over twenty therapy sessions to show improvement which may then only be focused on one aspect of speech. This significantly limits the linguistic and social skills a student will acquire. To improve the efficacy of these therapy sessions, new technology must be developed to provide effective educational experience.

Objectives: I will demonstrate a personalized educational experience for students with ASD by creating a virtual reality (VR) based program to stimulate engagement and speech production practice.

Methods: Approximately 30 ASD students between the ages of 5 and 8 will be recruited to participate in a 12-sessions-long study that will utilize the VR-integrated application. The students will be divided in two groups: one which receives the VR-integrated prototype, and one that receives the existing 2D application on a tablet. Each session will be approximately 30 minutes long, occurring twice per week. The frequency and duration of sessions is based on our extensive previous research and to ensure statistically relevant number of data points to measure the learning progress of the students. The first 10 sessions will be monitored by iTherapy to assess the user experience of the prototype VR hardware as well as the 2D VAST application.

Results: (proposed, research is ongoing at this time) The overall intended use for the VAST system will be in special education classrooms for children who struggle with
functional language acquisition and motor abilities. Students will be able to improve upon their oral coordination during their in-school therapy sessions which may last between one to three hours/week. The skills they learn will then be applied to their classwork and their daily interactions with peers and teachers. As their language abilities improve, teachers and students will be able to improve their cooperation. By using the VAST system, students will be better able to understand and process the speech of their teachers and become more integrated in the classroom setting. Each student who participates in special education will require the use of a tablet or smartphone, VR goggles, with integrated BC headphones.

Conclusions: (proposed, research is ongoing at this time) The knowledge gained by this study has the potential to provide students with ASD with a comprehensive language education. The risks noted in the above section are minimal and reasonable in light of the benefits of the proposed study. Participation in this study will benefit all participants by supplementing their existing in-school therapy sessions while providing minimal to no risk.

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