Pre-Conference Workshops I and II
Monday, September 27
9:00 a.m. - 1:00 p.m.

1. DEVELOPING A TOOLKIT FOR STUDYING THE INTERACTION BETWEEN EXECUTIVE FUNCTION (EF) AND LEARNING DISABILITIES

Tzipi Horowitz-Kraus*[1], Jessica Church-Lang*[2], Paul Cirino[3], Laurie Cutting[4], Eric Wilkey[4], Marcia Barnes[4], Keri Rosch[5], Brett Miller[6], Andrew Rossi[7]

[1]*Technion and Kennedy Krieger Institute,* [2]*The University of Texas, Austin,* [3]*University of Houston,* [4]*Vanderbilt University,* [5]*Kennedy Krieger Institute,* [6]*NICHD,* [7]*NIH*

Overall Abstract: Executive functions is an umbrella term describing several basic and higher-level Cognitive abilities related to learning and monitoring supporting academic skills such as reading and math abilities. These abilities are related to several brain networks that interact with other, more basic attention networks that gradually develop with age. Interestingly, several learning disabilities, such as dyslexia, dyscalculia and attention deficit hyperactive disorder (ADHD) suffer from different degrees of executive function difficulties. In this workshop, we will cover the definition, cognitive testing and neurobiological correlates of executive functions and explain how executive functions interact with reading (at the word and contextual level as well as in reading comprehension) and math skills. We will then outline the interaction of several learning disabilities with executive functions behaviorally and neurobiologically and interventions focusing on executive functions to improve academic skills. Finally, we will discuss the field's possible future directions and funding mechanisms that can support the work in this area.

2. BEYOND SES: NOVEL RESOURCES FOR PLACING ADOLESCENT BRAIN AND COGNITIVE DEVELOPMENT (ABCD) INVESTIGATIONS IN THE CONTEXT OF INEQUITIES IN SCHOOL QUALITY, LEARNING OPPORTUNITIES, ACADEMIC ACHIEVEMENT OUTCOMES, AND NEIGHBORHOOD CHARACTERISTICS

Bruce Mccandliss*[1], Marybel Gonzalez[2], Ethan Roy[1], Wes Thompson[3], Elizabeth Hoffman[4], Elizabeth Albro[5], Oliver Sawi[1], Terry Jernigan[3]

[1]*Stanford University,* [2]*The Ohio State University,* [3]*University of California San Diego,* [4]*National Institutes of Health/National Institutes for Drug Addiction,* [5]*Institute of Educational Sciences, United States Department of Education*

Overall Abstract: ABCD data originally lacked many contextual factors related to educational opportunities and inequities associated with schools, despite mounting evidence that such factors are key drivers of lifelong physical and mental health, and at times can play a role in overcoming social inequalities.
Goals: Provide a conceptual and practical overview about a new set of available ABCD resources related to contextual factors encompassing educational opportunities. This includes nationwide school level educational inequity data from the Stanford Educational Data Archive (SEDA)

including over 50M assessments nation-wide, longitudinal direct assessment of math fluency via the Stanford Mental Arithmetic Reaction Time Evaluations (SMARTE) and dense longitudinal sampling of school closure experiences during COVID19. Speakers will reveal emerging discoveries of how these factors interact with white matter tract and brain connectivity studies, and recommend best practices for using and responsibly reporting on these measures in analyses of brain development.

This workshop is designed to be relevant to attendees conducting Developmental Cognitive Neuroscience research in years that are influenced by education, especially those investigating the ABCD database.

This workshop will provide a systematic introduction on how to use novel linked datasets available in the ABCD data including school level educational opportunities for growth provided (SEDA), novel measures of number and mathematical cognition linked to academic achievement (SMARTE), and longitudinal surveys capturing student attitudes during COVID related school closures, among others.

Our speaker series will present a series of novel results that demonstrate how school environment and home environment variables show distinct patterns of association with brain development, including new findings from two-year white matter tract development and individual differences in resting state connectivity analyses of Poly Neural Risk Factors (PNRF) and fronto-parietal networks linked to domain specific developments in mathematics. We will also review COVID-19 school closure survey data revealing the influence of parental involvement with home-learning outcomes during school closures.

We will also present recent work on codifying best practices for integrating contextual factors into analyses of the ABCD data in an ethically responsible and culturally sensitive way. This portion will introduce data dictionaries for the linked datasets and provide a deeper understanding of the contextual factors captured by each variable and guidelines for best analytic practices.

Open workshop discussions will focus on future directions for these linked datasets research in ABCD, including future collaborations with schools to develop a more nuanced view of school-level variables, generating cross-walks with state-level data to examine the developmental impact of policy decisions, and constructing plans to collect measures of life-outcomes after the completion of the ABCD study. We will also discuss how to identify pathways by which educational opportunities at the individual level stem from broader structural factors at the community and societal level, as well as identify pathways by which meaningful investment and policy change can create better educational experiences, and in turn better health outcomes, for youths across diverse environments. Attendees will be encouraged to share research goals and workshop how these resources may enhance their efforts.

Pre-Conference Workshop III
Monday, September 27
1:15 p.m. - 5:00 p.m.

3. A NEW USER'S GUIDE TO THE HEALTHY BRAIN CHILD DEVELOPMENT (HBCD) STUDY

Wesley Thompson*[1], Christina Chambers[2], Terry Jernigan[2], Damien Fair[3]

[1]*Laureate Institute for Brain Research,* [2]*University of California, San Diego,* [3]*University of Minnesota*

Overall Abstract: The HEALthy Brain Child Development (HBCD) Study is currently recruiting 7,500 pregnant women at 25 sites around the United States. Infants will be followed for at least 10 years, with four in-person visits in the first 30 months of life and annually thereafter, including MRI, EEG, biosamples, genetics, environmental measures, language and cognition, mental health, and behavior. Longitudinal structural and functional brain imaging are also being collected to assess the growth and neurodevelopment and how these relate to behavior, language development, mental health, and cognition. Given the size and complexity of the HBCD Study, a symposium is necessary provide enough depth to enable researchers to fully grasp and analyze the data once it becomes publicly available to all researchers in January 2025.

The HBCD Study is the largest longitudinal study of Infant brain development and child health in the United States. The consortium will collect data beginning before birth, neonatally, and through childhood, including anthropometrics (growth measures); medical and family history; biospecimens (samples such as urine and blood);and social, emotional, and cognitive function. Infants will be followed for at least 10 years. Study aims include the characterization of variation in neurodevelopmental trajectories from infancy in the US population and the genetic and environmental factors that impact these, including the prenatal environment. (Further information on the study can be found at hbcdstudy.org.) The HBCD Study will contain neurodevelopmental data on a sample of unprecedented size and scope, with participants mirroring the complex and varied sociodemographic diversity of the US. With the public release of the full baseline dataset in January 2025, this symposium will be the first of its kind in any venue to introduce the study, its aims, design, and measures to neurodevelopmental scientists who will be able to access and utilize its data to address their own research questions. Given the size, complexity and scope of this landmark study and unprecedented resource, this symposium is timely and crucial to promote understanding of the HBCD Study aims, design, and measures to the neuroimaging field.

Understand the overarching HBCD Study aims, recruitment strategy, measurement domains, and jittered longitudinal design for data collection,2. Distinguish the different ways of accessing and utilizing the neuroimaging, demographic, cognitive, biosamples, and health data. Analyze study data in ways that maximizes internal and external validity, estimation of individual trajectories of brain, behavioral and cognitive development, and characterize the advantages and limitations of the HBCD dataset when designing, executing and publishing HBCD research.

Trainee Workshop: Career Perspectives Panel
Monday, September 27
5:30 p.m. - 6:20 p.m.

4. CAREER PERSPECTIVES PANEL
Michelle Shipkova, *University of North Carolina at Chapel Hill*
Elvisha Dhamala, *Feinstein Institutes for Medical Research*
Laura Thomas, *NIH/NIMH*
Gagan Wig, *The University of Texas at Dallas*

Trainee Workshop: Grant Writing Panel
Monday, September 27
6:30 p.m. - 7:20 p.m.

5. GRANT WRITING PANEL
Jin Wang, *University of California, Los Angeles*
Ashley Smith, *National Institute of Mental Health*
Jamie Hanson, *University of Pittsburgh*
Sarah Tashjian, *University of Melbourne*

Symposia & Special Sessions

Jacobs Foundation - Science of Learning
Saturday, September 28
9:30 a.m. - 10:45 a.m.

1. NATURE AND NURTURE CONTRIBUTIONS TO VARIATION IN LEARNING: INSIGHTS FROM DEVELOPMENTAL COGNITIVE NEUROSCIENCE
Tzipi Horowitz-Kraus
Technion and Kennedy Krieger Institute

Overall Symposium Description and Outline: The Science of Learning symposium supported by the Jacobs Foundation will provide an overview of the structural and functional correlates of early life events and their relations to long-term learning. These include socioeconomic status and stress on one hand and home math environments and early life education on the other. The symposium will cover studies on various ages, from the pre-birth (fetus) to adolescence.

1.1 SOCIOECONOMIC DISADVANTAGE, STRESS, AND THE DEVELOPING BRAIN

Emily Merz*[1]

[1]*Colorado State University*

Individual Abstract: Socioeconomic disadvantage during childhood increases risk for mental health difficulties across the lifespan. At the neural level, socioeconomic disadvantage has been repeatedly associated with altered structure and function of neural circuitry responsible for cognitive and emotional control. Chronic stress is a key proximal factor potentially partially underlying these associations. This talk will present our work contributing to this literature. The talk will cover how socioeconomic disadvantage may increase exposure to chronic stress during childhood and adolescence. I will then present results showing associations between chronic stress and the structure and function of neural circuits underlying emotional and cognitive control. Together, findings imply that socioeconomic differences in frontoparietal and corticolimbic function may pose challenges for coping with stress during adolescence, influencing mental health. Our recent studies examining these associations in socioeconomically diverse child and adolescent samples will be highlighted. I will end with the larger goal of our teamwork which is advocating for effective strategies supporting children and families experiencing economic hardship.

1.2 HOW EARLY LIFE EDUCATION IMPACTS LONG-TERM BRAIN STRUCTURE

Nicholas Judd*[1], Rogier Kievit[1]

[1]*Donders Institute for Mind, Brain and Behaviour*

Individual Abstract: Mandatory education is a major early life cognitive invention, related to a wide variety of beneficial health, behavioral, and societal outcomes. However, whether education causes long-term structural changes in the brain remains unclear. A pressing challenge is that individuals self-select into continued education, thereby introducing a wide variety of environmental and genetic confounders. Fortunately, natural experiments allow us to isolate the causal impact of increased education from individual (and societal) characteristics. Here, we exploit a policy change in the UK (the 1972 ROSLA act) that increased the amount of mandatory schooling from 15 to 16 years of age to study the impact of education on long-term structural brain outcomes in a large (n~30.000, UK Biobank) sample. Using regression discontinuity, a causal inference method, we find no effect from an additional year of education on any structural neuroimaging outcomes. This null result is robust across modalities, regions, and analysis strategies. An additional year of education is a substantial early life cognitive intervention, yet we find no evidence for sustained experience-dependent plasticity. Our results provide a challenge for the importance and sustained nature of neural impacts from early life learning interventions. Our preregistered findings are one of the first implementations of regression discontinuity on neural data; opening the door for causal inference in population-based neuroimaging.

1.3 POPULATION NEUROSCIENCE OF THE GROWING BRAIN

Tomas Paus*[1]

[1]*University of Montreal*

Individual Abstract: In my lecture, I will focus on developmental processes underlying the growth of the human cerebral cortex. I will begin by introducing the concept of population neuroscience as a cross-disciplinary endeavour aimed at identifying factors shaping the human from conception onwards. I will then touch briefly on our previous work on pregnancy and brain growth, followed by our genetic studies that used data obtained in large datasets to reveal molecular architecture underlying the tangential growth of cerebral cortex. Next, I will discuss our findings obtained with "virtual ontogeny" that support a neurodevelopmental model of vulnerability to mental illness whereby prenatal risk factors acting through cell-specific processes lead to deviations from typical brain development during pregnancy. I will conclude with the most recent work from my laboratory on the relationship between fetal growth and the tangential expansion of the human cerebral cortex in times of food scarcity and abundance.

1.4 INTERACTIVE RELATIONS BETWEEN CHILDREN'S HOME MATH ENVIRONMENT AND THE NEURAL BASIS OF NUMERICAL PROCESSING

O. Ece Demir-Lira*[1], Elena Busick[2], Megan Schumer[3], Paige Nelson[1], Gülnaz Yükselen[4], Sinem Burcu Erdogan[4]

[1]*University of Iowa,* [2]*Grinnell College,* [3]*Washington University in St. Louis,* [4]*Acıbadem Mehmet Ali Aydınlar University*

Individual Abstract: Early numerical skills are foundational for children's future math achievement, with significant disparities evident even before formal schooling begins. This underscores the potential role of early numerical experiences in the home environment. Although there is growing literature on the neurocognitive basis of numerical processing and its implications for behavioral performance, less is known about the sources of variability in brain activation patterns, particularly before school entry. To address this gap, our study examines how the neurocognitive underpinnings of numerical processing relate to children's home math environment, controlling for broader environmental factors like socioeconomic status. Using functional near-infrared spectroscopy, we explore the neurocognitive basis of symbolic and nonsymbolic numerical processing before Kindergarten entry. The home math environment is assessed through questionnaires on home numerical activities, parental math anxiety, and lab observations of parental talk. Our findings suggest that variability in the neurocognitive basis of symbolic number processing, but not nonsymbolic processing, is related to specific features of the home environment. Children with different experiences recruit distinct brain systems to perform at similar levels. To our knowledge, this study is the first to pinpoint the interactive relations between the neurocognitive basis of numerical processing and preschoolers' home math environment.

Dissertation Award Talk
Saturday, September 28
11:00 a.m. - 11:20 a.m.

2. HETEROGENEITY IN THE NEURAL MECHANISMS OF ADVERSITY: IMPLICATIONS FOR DEVELOPMENTAL RISK AND RESILIENCE

Felicia Hardi
Yale University

Talk Description: Although the adverse effects of stressful experiences are well established, the wide heterogeneity in outcomes suggests that more research is needed to understand individual differences in risk and resilience to adversity. Specifically, why and how do certain experiences lead to mental health problems in some individuals but not others? What neural mechanisms could explain the long-term effects of adverse experiences? In this talk, I will provide a broad overview of my dissertation, which aimed to investigate these questions by examining the associations between exposures to adversity and brain networks, with implications for mental health, in a longitudinal, population-based birth cohort sample.

Young Investigator Award Talk
Saturday, September 28
11:20 a.m. - 11:50 a.m.

3. DEFICIT, DIFFERENCE, OR DIVERSITY? MY JOURNEY INVESTIGATING CHILDREN'S LANGUAGE, EXPERIENCE, AND DEVELOPMENT

Rachel Romeo
University of Maryland

Talk Description: In their first years of life, children develop a remarkable foundation of linguistic and communicative skills, yet individual children vary widely in their developmental trajectories. What factors contribute to these differences, and what are the biological mechanisms linking experience to development? And how can we apply that understanding to improve education, clinical practice, and social policy? In this talk, I will recount my journey (so far!) trying to answer these questions, including my discoveries of the causes and consequences of disparities in language and brain development; my theoretical, moral, and personal journey with these issues; and my vision for the future of this discipline.

Symposium
Saturday, September 28
1:15 p.m. - 2:30 p.m.

4. DECODING ADOLESCENCE: DISENTANGLING AGE AND PUBERTAL EFFECTS ON THE DEVELOPING BRAIN

Nandita Vijayakumar*[1]
[1]*Deakin University*

Overall Symposium Description and Outline: From the origins of developmental cognitive neuroscience, the field has conceptualized adolescence as beginning with puberty. We have recognized that examining pubertal effects on the developing brain is critical to understanding the many social, emotional and cognitive changes that characterize adolescence. And although a growing literature investigates brain development as individuals progress through puberty, our understanding of pubertal mechanisms remains limited as it is difficult to dissociate its effects from age. Therefore, this symposium presents a series of talks that aim to tease apart the effects of age and puberty using different scientific approaches. The first presentation examines this question in a longitudinal cohort of adolescent females, highlighting differential patterns of white matter development driven by different markers of puberty (physical changes, hormone levels) that are independent to age. The second presentation considers varied definitions of pubertal timing that disentangle the effects of age and puberty, and how the operationalization of timing influences our inferences of pubertal effects on functional brain development and future mental health. However, as age and puberty are inextricably linked in humans, the final presentation uses animal models to directly dissociate pubertal status from chronological age in Siberian hamsters. Following these presentations, we will allocate 30 minutes to a moderated discussion that stimulates debate on our prevailing definitions of adolescence, including: Should age be our default metric of maturation? Can we truly dissociate age and pubertal effects in humans? How should we conceptualize rising hormone levels that follow reproductive maturity? We will also discuss the strengths and limitations of animal models to advance our knowledge, and avenues for future interdisciplinary research directions.

4.1 TRACKING WHITE MATTER DEVELOPMENT BY AGE AND PUBERTY: FINDINGS FROM A 5-WAVE LONGITUDINAL STUDY OF ADOLESCENT GIRLS

Christopher Machle*[1], Marjolein Barendse[2], Samantha Chavez[1], Robert Chavez[1], Elizabeth Shirtcliff[1], Jennifer Pfeifer[1]

[1]*University of Oregon,* [2]*University of California, Davis*

Individual Abstract: The rapid development of white matter (WM) is a key neurobiological process that characterizes adolescence and is fundamentally shaped by the coordinated release of hormones during puberty. The strongest evidence for this relationship comes from studies that remove pubertal hormones from rodents during adolescence, resulting in permanent changes to WM organization. However, it remains unclear how pubertal hormones influence WM connectivity in humans, as few longitudinal studies have directly measured hormones and WM development together. To address this gap, the present study densely sampled hormones of 161 adolescent girls across five timepoints (ages 10-19) to examine whether changes in basal hormone levels are associated with changes in WM microstructure. In separate models, we also investigate the effect of age and pubertal stage on WM development. In line with previous work, we found positive associations between age and WM microstructure in numerous tracts. However, we also observed multiple negative associations between age and WM microstructure, a relationship that has yet to be reported. Results for pubertal stage indicated significant associations in multiple tracts and replicated findings from previous longitudinal studies in humans and work with non-human animals, particularly for the corpus callosum genu. Collectively, these results suggest that the trajectory of WM development is tract specific, and depends on the maturational marker that is used.

4.2 UNDERSTANDING THE EFFECTS OF PUBERTY ON THE DEVELOPING BRAIN: WHY OUR OPERATIONALIZATION OF PUBERTAL TIMING MATTERS

Nandita Vijayakumar*[1], Tim Silk[1], Sarah Whittle[2]

[1]*Deakin University,* [2]*University of Melbourne*

Individual Abstract: Individual differences in the timing of puberty influences risk for mental health problems during adolescence, through hypothesized pathways via the developing brain. To better understand these pathways, it is critical we consider how differences in the measurement and operationalization of pubertal timing influence our results and conclusions. Using the Adolescent Brain and Cognitive Development Study, we found pathways between earlier pubertal timing and greater depressive symptoms via resting-state corticolimbic connectivity in 9- to 14-year-olds, with the strongest effects involving connections between limbic regions (amygdala, hippocampus) and the cingulo-opercular network. Next, specification curve analysis examined how the relationship between timing and corticolimbic connectivity differs across operationalizations of timing, including comparing gonadal vs adrenal development, definitions of "pubertal stage for a given age" vs "age at reaching a given pubertal stage", and self vs parent report. Stronger effect sizes were evident for parent- vs child-report, as well as for gonadal vs adrenal aspects of development. Further, consistency of findings across definitions of timing was found to vary across waves, and by sex. This presentation will discuss the potential mechanistic implications of using different operationalizations of pubertal timing, and how this influences our inferences of the effects of timing on corticolimbic connectivity.

4.3 USING ANIMAL MODELS TO DISSOCIATE PUBERTY FROM AGE IN ADOLESCENT RESEARCH

Matthew Paul*[1]

[1]*The University at Buffalo - SUNY*

Individual Abstract: Alongside puberty, adolescents undergo remarkable social, emotional, and cognitive development. A fundamental question is whether these changes are triggered by the increase in pubertal hormones (puberty-dependent) or by non-pubertal, age-related processes (puberty-independent). Studying these mechanisms is difficult because in most species, puberty is tightly coupled to age, rendering the two difficult to disentangle. In this presentation, I introduce an approach that takes advantage of seasonal adaptations of Siberian hamsters to dissociate pubertal status from chronological age. Siberian hamsters reared in a short, winter-like photoperiod delay puberty by 5 months compared to those reared in a long, summer-like photoperiod. In the wild, this photoperiodic delay of puberty ensures that attainment of reproductive competence is synchronized with the spring breeding season. In the lab, we have used it as a tool to disentangle puberty-dependent and puberty-independent influences on adolescent social (social play), affective (anxiety-like/exploratory behaviors), and neural (prefrontal cortex dopamine and lateral septum vasopressin) development. Findings from these studies indicate that puberty-dependent and puberty-independent factors regulate different components of adolescent-typical behaviors and demonstrate how adolescent development requires the coordinated interaction between the two.

5. HOW UNPREDICTABLE AND STRESSFUL ENVIRONMENTS IMPACT BRAIN DEVELOPMENT

Jamie Hanson
University of Pittsburgh

Overall Symposium Description and Outline: While early adversity can clearly impact development, the specific mechanisms by which early life experiences shape long-term trajectories of the brain and mental health are complex. An emerging area of research suggests that unpredictability and volatility in early environments may be a particularly influential aspect of early life experience. Unpredictability may modify neurodevelopmental programming in ways that impact cognitive, social, and emotional outcomes. This symposium brings together leading researchers utilizing diverse methodological approaches across rodent models and human cohort studies to investigate how unpredictability at varying timescales, from moment-to-moment parental signals to instability across years, influences developmental trajectories from infancy through adolescence. Presentations will explore how unpredictability in the form of inconsistent parental sensory signals impacts cognitive and emotional circuit formation in rodents. Computational modeling will illustrate how dynamics of these momentary parental interactions shape brain development. Additional work will probe how household instability is associated with changes in human neuroimaging network properties. Research will also detail the influence of unpredictability in maternal mood and behaviors on effortful control and self-regulation in children. By leveraging multi-method assessments, these presentations provide novel insights into potential biological mechanisms linking unpredictable early environments to cognitive and mental health outcomes. The discussant will attempt to integrate findings across studies, noting implications for advancing basic scientific knowledge as well as informing prevention efforts and public policy. Focusing on unpredictability could provide important new insights into how early life experiences program the brain in ways not fully captured by existing research on adversity.

5.1 DYNAMIC PATTERNS OF PARENTAL SIGNALS SHAPE BRAIN CIRCUIT MATURATION: ENDURING EFFECTS OF UNPREDICTABLE PARENTAL AND ENVIRONMENTAL SIGNALS IN CHILDREN, AND MECHANISTIC INSIGHTS FROM EXPERIMENTAL ANIMALS

Matt Birnie[1], Laura Glynn[2], Elysia Davis[3], Hal Stern[1], Tallie Z Baram*[1]

[1]*University of California, Irvine,* [2]*Chapmann University,* [3]*Denver University*

Individual Abstract: The maturation of brain networks involves an interplay of genes and environment, the latter crucial during sensitive developmental periods. The role of dynamic patterns of sensory signals is well established for optimal sculpting of visual, auditory and motor circuits, yet the nature of signals influencing normal or aberrant maturation of emotional and cognitive circuits is unresolved. Key sensory signals during infancy and early-childhood originate in parents; yet the dynamic properties of parental signals for optimal or disrupted circuit maturation are unknown. In addition to their valence, parental care behaviors sequences may be predictable or unpredictable. Here we leverage animal studies and prospective studies in human cohorts to

examine the role of patterns of maternal behaviors, and specifically fragmented and unpredictable patterns, in the normal maturation of brain circuits and cognitive and emotional outcomes. We use computational approaches to quantify the dynamics of parental signals, and devise questionnaires to facilitate scaling-up of these studies. We demonstrate in animals that unpredictable maternal signals disrupt the function of specific brain circuits and, in children, contribute significantly to poorer executive function even in the context of other early-life adversities. In summary, across humans and rodents, the dynamics of parental signals, including their predictability, is an important factor in optimal cognitive and emotional brain development.

5.2 HOUSEHOLD INSTABILITY IN CHILDHOOD AND ITS LONG-TERM LINKS TO BRAIN DEVELOPMENT AND MENTAL HEALTH

Felicia Hardi*[1]

[1]*Yale University*

Individual Abstract: Childhood adversity is highly prevalent and accounts for close to 30% of mental disorders. Early adversity can have health consequences and increase susceptibility to psychopathology later in life through modulation of critical neural systems. The present study examined the longitudinal associations between early household instability (residential moves, changes in household composition, and caregiver transitions in the first 5 years), structural network (age 15), and internalizing symptoms (ages 15, 21) in a sample (N=237; 52% female, 75% Black) recruited from a population-based study. Metrics of structural connectivity network organization estimated using diffusion magnetic resonance imaging (dMRI) data were computed to represent structural network integration and segregation. Results showed that greater childhood instability was related to increased structural network efficiency in adolescence, and this association remained after accounting for other types of adversity. Moreover, instability predicted increased depressive symptoms in young adulthood via increased global efficiency during adolescence. Exploratory analyses found that structural connections of the left frontolateral and temporal nodes were most strongly related to instability. These results suggest that instability related to structural network efficiency may impose a trade-off cost to increase the risk for later depression, and highlight the ways in which early instability may constrain neural development.

5.3 THE EARLY-LIFE STRESS OF PATERNAL DEPRIVATION, IN A BIPARENTAL RODENT, CONTRIBUTES TO SEX-SPECIFIC SOCIAL BEHAVIOR DEFICITS AND NEUROIMMUNE SUPPRESSION

Erica Glasper*[1], S.L. Walker[1], L. Wangler[1], J. Godbout[1]

[1]*Ohio State University*

Individual Abstract: Background: Nearly one-quarter of US children are reared in a home lacking appropriate parental care. This can increase the likelihood of social behavior problems and serious health outcomes. In the absence of paternal care (i.e., paternal deprivation) in the biparental California mouse (Peromyscus californicus), vigilance-avoidance behavior (i.e., social anxiety-like) was observed in males and females. This behavior was associated with reduced pro-inflammatory cytokines in brain regions involved in socio-cognitive and stress-related behaviors in males, but not females. The extent to which neuroinflammatory processes underlie paternal

deprivation-related alterations in sociability is unknown. We hypothesized that paternal deprivation induces lasting sex-specific impairments in immune function and social anxiety-like behaviors. Methods: Using a three-chamber apparatus, control-reared and paternally-deprived adult male and female California mice performed a social preference test to assess preference for a novel mouse versus a novel object. Inflammatory gene expression was determined in brains to identify pathways and processes involved in neuroinflammation. Peripheral immune cells phenotypes were determined via flow cytometry. Results: An interaction between sex and rearing emerged, such that in the presence of a novel-same sex conspecific, paternally-deprived females exhibited vigilance avoidance, while paternally-deprived males increased social interactions instead of avoiding them. Neuroimmune-related canonical pathways were significantly inhibited in paternally-deprived females, compared to control-reared females – paternal deprivation did not inhibit any neuroimmune-related canonical pathways in males. Circulating T-cells were reduced in paternally-deprived female, but not male, adult offspring. Conclusion: Paternal deprivation may induce greater social impairments in females that are accompanied by neuroimmune suppression.

5.4 THE EFFECTS OF UNPREDICTABILITY OF MATERNAL SENSORY SIGNALS ON CHILD'S COGNITIVE SELF-REGULATION: INSIGHTS FROM THE FINNBRAIN BIRTH COHORT STUDY

Fiia Takio*[1], Saara Nolvi[1], Pilvi Peura[2], Akie Yada[2], Eeva Holmberg[1], Pauliina Juntunen[1], Anniina Karonen[1], Eeva Eskola[1], Elisabeth Nordenswan[1], Kirby Deater-Deckard[3], Eeva-Leena Kataja[1], Hasse Karlsson[1], Linnea Kalsson[1], Riikka Korja[1]

[1]*University of Turku, Finland,* [2]*University of Jyväskylä, Finland,* [3]*University of Massachusetts Amherst*

Individual Abstract: Objective: Unpredictable maternal sensory signals in early life are considered a potential risk factor for poorer self-regulation (SR) in children. In the FinnBrain Birth Cohort Study, we investigated their associations with child's effortful control during early childhood(1 and 2). Further, we explored the longitudinal changes and associations between the predictability of maternal sensory signals and child executive functioning (EF) from infancy to preschool years(3).

Methods: In total, 126 mother-child dyads were included in Study1, 133 in Study2, and 541 in Study3. The predictability of maternal sensory signals was measured at 8 months, 2.5 years, and 5 years using entropy rate derived from a mother-child play episode. Child's SR was assessed with the IBQ at 12 months, the ECBQ at 24 months, and the CBQ at 5 years. EFs were measured at 8 months, 2.5 years, and 5 years with psychological measurements.

Results: The unpredictability of maternal sensory signals at 8 months was associated with lower child regulation and orientation at 12 months, and lower effortful control at 24 months. Higher unpredictability in infancy was associated with poorer effortful control at age 5. The unpredictability of maternal sensory signals decreased from 8 months to 5 years, and less unpredictability was associated with a higher likelihood of belonging to the highest performing EF profile. The findings highlight the importance of maternal caregiving unpredictability in early cognitive self-regulation.

DCN Public Policy Roundtable
Saturday, September 28
2:45 p.m. - 4:00 p.m.

6. THRIVING IN EARLY DEVELOPMENT: IMPROVING RESEARCH TO ESSENTIAL INFORMATION AND ACCESS TO RESOURCES

Sarah Short[1], Arianna Gard[2]
[1]*University of Wisconsin-Madison,* [2]*University of Maryland, College Park*

Overall Symposium Description and Outline: The symposium "Thriving in Early Development: Improving Research to Essential Information and Access to Resources" addresses the multifaceted aspects of early childhood development, focusing on the intersection of research, policy, and practical resources. This event aims to enhance understanding of how early caregiving environments and systemic factors impact child development and to explore strategies for improving outcomes.

6.1 INVESTIGATING THE ROLE OF MATERNAL STRESS PHYSIOLOGY ON INFANT NEUROCOGNITIVE DEVELOPMENT

Natalie Brito*[1]

[1]*New York University*

Individual Abstract: Research consistently demonstrates that the first two years of life are sensitive periods during which warm, predictable, and responsive caregiving are important to children's social, emotional, and cognitive development. Caregivers impact the developing infant's ability to flexibly adapt to the demands of the environment, and the caregiver's own stress physiology is a critical factor influencing caregiving behavior and subsequent child development. This talk will examine how maternal perinatal experiences may contribute to early differences in infant neurocognitive outcomes, examining both proximal interactions and more distal social policies like paid maternal leave. Understanding the wider effects of the ecological context on development can potentially help to disentangle the many pathways through which early caregiving impacts infant brain and behavior.

6.2 A CHILDREN'S RIGHT TO HEALTHY BRAIN DEVELOPMENT IN CALIFORNIA

Emily Murphy*[1]

[1]*UC Law San Francisco*

Individual Abstract: This talk will present an ongoing interdisciplinary project to construct and advance a state-level legal right to healthy brain development. The presentation will discuss interdisciplinary collaboration methods, the risks and challenges as well as the benefits associated with a legal rights framework, and navigating the relationship between policy, law, politics, and community values.

6.3 GROUNDING FEDERAL EARLY CHILDHOOD POLICY IN THE PRINCIPLES OF HUMAN DEVELOPMENT

Hailey Gibbs*[1]

[1]*Center for American Progress*

Individual Abstract: Behind every policy decision, legislative proposal brought to the floor, or vote cast, there is an armada of staffers, advocates, and researchers striving to connect those choices to the best, most reliable evidence for the desired outcome. In the area of early childhood policy, this evidence is often scant, patch-worked, or largely inferential, because the outcomes of interest may not come to fruition for decades. While several landmark studies demonstrate the long-term positive impact of high-quality, affordable early childhood education, much of this research remains fragmented, is now out-of-date, or struggles to address key policy questions when those data are most needed. Moreover, longitudinal data demonstrating the impact of recently-developed or implemented policies and programs is needed to help make the case for future investments and systemic improvements to the sector. The Center for American Progress' Early Childhood Policy team contributes to this body of research informing policy recommendations that affect families with young children – including a suite of resources on how the social determinants of health manifest during early stages of development, and a large-scale mapping project illustrating the density of child care deserts across the country. But the partnership and advocacy of the scientific research community is crucial to addressing gaps in the literature on child and family wellbeing and advancing the efforts of state and national policy partners.

Local Symposium
Sunday, September 29
9:00 a.m. - 10:15 a.m.

7. 'FROM NEURONS TO NEIGHBORHOOD': TWENTY-FIVE YEARS LATER

Chandan Vaidya
Georgetown University

Overall Symposium Description and Outline: On the eve of the 25th anniversary of the National Academies of Sciences' commissioned volume "Neurons to Neighborhoods: The science of early childhood development", this symposium will celebrate its transformative insights for an integrative research agenda for developmental cognitive neuroscience. The speakers will highlight advances in understanding factors promoting risk and resilience for early brain development with data from animal models and humans. The symposium will end with a discussion of the major advances in our understanding of the interactive factors shaping the development of brain and behavior and challenges that remain in all children attaining positive developmental outcomes.

7.1 STUDYING RISK AND RESILIENCE TO ECOLOGICAL ADVERSITY: A STRENGTHS-BASED DEVELOPMENTAL NEUROSCIENCE APPROACH

Arianna Gard*[1]

[1]*University of Maryland, College Park*

Individual Abstract: Twenty-five years ago, "Neurons to Neighborhoods" led to a cadre of studies investigating the role of childhood adversity in sculpting children's cognitive, behavioral, and neurobiological development. Our understanding of the mechanisms of risk improved greatly and informed interventions, policy decisions, and the field of developmental neuroscience itself. In this talk, I will turn our attention to strengths-based developmental neuroscience by reviewing qualitative, behavioral, and neuroimaging evidence from my lab and other leaders in the field. I will also argue for a shift in how we conduct this research - an approach that integrates education, science communication, and advocacy into all aspects of the scientific process.

7.2 NEUROBIOLOGICAL MECHANISMS OF EARLY LIFE STRESS AND INTERVENTIONS: LESSONS FROM PRECLINICAL MODELS

Autumn Ivy*[1]

[1]*Kennedy Krieger Institute*

Individual Abstract: Twenty-five years after the publication of “From Neurons to Neighborhoods,” the integration of basic neuroscience science discoveries with real world applications has improved, but still presents a challenge for the field. Specifically, the link between chronic stress exposure during neurodevelopmental periods and negative emotional and mental health outcomes is highly recognized, yet strategies to offset the consequences of early stress remain non-specific and inequitably accessed. How may we move closer to bridging the gap between wet bench neuroscience discovery and bedside intervention across communities? Naturalistic, mammalian models of early life experiences are employed in preclinical research to bring discoveries closer to human relevance. In this talk, data from preclinical research employing an early life adversity model of erratic, fragmented maternal care will be presented, as well as cross-species strategies for investigating accessible interventions to mitigate the negative consequences of early life stress exposure.

7.3 INCORPORATING MEASURES OF THE ENVIRONMENT IN STUDIES OF EARLY BRAIN DEVELOPMENT

Heather Volk*[1]

[1]*Johns Hopkins Bloomberg School of Public Health*

Individual Abstract: The environment can be defined by the social, physical, and chemical characteristics which surround an individual in a population. Increasingly, population-based studies of neurodevelopmental disorders, traits, and cognitive development have shown the impact of prenatal and early life environmental exposures. Methods and techniques to characterize the environment span self-report, record extraction, geographic assignments, and have increasingly expanded to include biomarkers and wearable technologies. In this talk methods for integrating the social, physical, and chemical environment will be discussed and applied to findings on early

brain structure and volume, in the context of pre and peri-natal exposures with implications for later childhood developmental conditions.

Linda Spear Award Talk
Sunday, September 29
11:15 a.m. - 11:45 a.m.

8. TRANSLATIONAL SYSTEMS AND TRANSPARENT SCIENCE: A JOURNEY IN DEVELOPMENTAL SOCIAL NEUROSCIENCE
Jennifer Pfeifer
University of Oregon

Talk Description: As an emerging field, developmental social neuroscience initially focused on questions like when and how the "social brain" matured, or if differences in "social brain" responses could inform us about a child's social abilities. More contemporary approaches to developmental social neuroscience expand this framework by considering brain development from a transactional perspective – as both a cause and consequence of complex interactions over time across dynamic systems. I will illustrate this transactional perspective primarily through our prospective longitudinal study which connects pubertal, neural, and social changes during adolescence to each other, as well as to risk for internalizing problems. Throughout, I will also reflect on the importance of transparent, reproducible, and inclusive scientific practices based on my experiences in advocating for and implementing them.

Huttenlocher Award Talk
Sunday, September 29
1:15 p.m. - 2:25 p.m.

9. A CAREER IN NEUROPLASTICITY AND NEUROPLASTICITY IN A CAREER
Bradley Schlaggar
Kennedy Krieger Institute

Talk Description: Dr. Schlaggar will share his career journey as a neurobiologist, academic physician-scientist, and nonprofit executive, describing how deep interests, plans, life events, and serendipity have interacted along the way.

Diversity Symposium
Sunday, September 29
2:45 p.m. - 4:00 p.m.

10. DIS/ABILITY, ACCESSIBILITY, AND INCLUSION: SHIFTING THE FOCUS FROM INDIVIDUALS TO SYSTEMS

Monica Ellwood-Lowe
University of Pennsylvania

Overall Symposium Description and Outline: This session promotes a shift from viewing disability and accessibility through the lens of individual limitations to addressing systemic factors that influence inclusivity. Speakers will examine how obstacles can be leveraged for personal growth and success, challenge the exclusion of disabled individuals and racial/ethnic minorities in cognitive neuroscience research, and provide an inside look at disability within the Flux community. Highlighting a range of topics across personal, academic, and societal levels, the session will point to opportunities for enhancing inclusion. Ultimately, this session aims to raise awareness about the diversity of dis/ability and arm Flux members with practical knowledge for growing toward accessibility and inclusivity, within and beyond the Flux society.

10.1 LEVERAGING OBSTACLES - AWAKENING OPPORTUNITIES

Scott Hatley*[1]

[1]*INCIGHT*

Individual Abstract: Obstacles are powerful, and we can harness their energy in our lives rather than be shaped and defined by them. What if we could leverage our obstacles to awaken opportunities and unlock greater potential in our lives? Scott Hatley shares his journey leveraging Duchenne Muscular Dystrophy to reach his dreams while shattering the myths and perceptions around disability.

10.2 SYSTEMATIC EXCLUSION: DIS/ABILITIES AND RACIAL AND ETHNIC MINORITIES IN COGNITIVE NEUROSCIENCE

Inge-Marie Eigsti*[1]

[1]*University of Connecticut*

Individual Abstract: Studies of brain structure and function in individuals with neurodevelopmental conditions systematically exclude participants from racial and ethnic minority groups. Few studies even report these sociodemographic factors, further limiting our ability to know about the degree of generalizability of findings. Drawing on a broader literature from Dis/ability studies and Critical Race Theory (DisCrit), I will discuss some of the factors that exacerbate exclusion of some individuals from research, and discuss some remedies that will strengthen our science by including more of the population.

10.3 AN INSIDE LOOK AT DIS/ABILITY AND OPPORTUNITIES FOR PROGRESS WITHIN FLUX

Monica Ellwood-Lowe*[1]

[1]*University of Pennsylvania*

Individual Abstract: Conversations about disability can sometimes feel abstract or removed. In this talk I will bring the issue closer to home, sharing results from a survey about disability and accessibility within Flux, and my own personal experiences navigating our field with an invisible disability. I will discuss the broad range of disabilities our members have, how these show up in their lives and work, and ways the Flux community can continue to grow toward accessibility and inclusivity.

Symposia
Sunday, September 29
4:15 p.m. - 5:30 p.m.

11. CROSS-SPECIES APPROACHES TO UNDERSTANDING ADOLESCENT LEARNING

Catherine Insel*[1], Juliet Davidow[2], Laura DeNardo[3], Linda Wilbrecht[4]

[1]*Columbia University,* [2]*Northeastern University,* [3]*University of California, Los Angeles,* [4]*University of California, Berkeley*

Overall Symposium Description and Outline: As adolescents navigate their growing independence, they must learn how to approach good outcomes, avoid bad outcomes, and achieve their goals. When do adolescents thrive at learning, and when do they experience limits or challenges? How do developmental changes in brain structure and function create windows of opportunity for learning and goal-directed behavior? This symposium will present cross-species approaches to understanding how adolescent learning matures in tandem with ongoing brain development. First, Juliet Davidow will present human data showcasing how adolescents exhibit key advantages in reinforcement learning, which are paralleled by developmental differences in subcortical function. She will discuss behavioral and fMRI evidence that reveals the cognitive and computational mechanisms that scaffold adolescent learning. Second, Laura DeNardo will discuss how protracted development of medial prefrontal circuitry modulates threat learning in mice. She will highlight how multiple developmental switches in frontolimbic circuit connectivity influence distinct learning behaviors that emerge at different ages. Third, Catherine Insel will present work showcasing how cortical development supports the ability to generalize learning across distinct rewarding experiences. She will present behavioral and neuroimaging data demonstrating that learning and generalization mature during adolescence in tandem with selective neural coding of reward value. Fourth, Linda Wilbrecht will present work in mouse models that examines how neocortical development supports the maturation of rule learning. She will describe anatomical and functional changes in mouse frontal cortices that reveal how changes in inhibitory input and structural plasticity support the ability to learn and encode task rules. Finally, Catherine Insel will moderate a discussion on how the field can better integrate human and animal work to enhance our understanding of adolescent learning.

11.1 NEUROCOGNITIVE ADAPTIVITY IN ADOLESCENT GOAL-DIRECTED LEARNING.

Juliet Davidow*[1]

[1]*Northeastern University*

Individual Abstract: Adolescence is a crucial stage for understanding motivated behaviors including learning in the service of goal identification and attainment. Adolescent neurocognitive development of multiple subcortical systems constrains strengths and challenges in learning, revealed by associations between actions, Reinforcement Learning Model outputs, and fMRI. We examine motivated learning behavior in three independent samples (N = 72, N = 94, and N = 174) finding that adolescent learning can exceed performance of younger children and adults (age range across samples 8 to 30 years old). Better learning is supported in part by age-related differences in cognitive processes that contribute to learning, suggested by Reinforcement Learning Model parameter estimates, and by age-related differences in the coordinated recruitment of multiple neural systems for learning (N = 47). Taken together, these findings highlight the potential adaptivity of adolescent goal-directed learning. New open questions arising from this collection of work and emerging directions in structural brain imaging will be discussed. Collectively, this work has implications for tailoring environments to leverage adolescent strengths in motivated learning.

11.2 DEVELOPMENTALLY DISTINCT ARCHITECTURES IN TOP-DOWN CIRCUITS

Laura DeNardo*[1]

[1]*University of California Los Angeles*

Individual Abstract: The medial prefrontal cortex (mPFC) plays a key role in responding to threats. mPFC undergoes a uniquely protracted development, with changes in synapse density, cortical thickness, long-range connectivity, and neuronal encoding properties continuing into early adulthood. Models suggest that before adulthood, the slow-developing mPFC cannot adequately regulate activity in faster-developing subcortical centers, leading to elevated risk taking in adolescence. Increasing mPFC control over subcortical structures eventually allows adult behaviors to emerge. Yet it has remained unclear how a progressive strengthening of top-down control can lead to nonlinear changes in behaviour as individuals mature. To address this discrepancy, we monitored and manipulated activity in the developing brain as animals responded to threats, establishing direct causal links between frontolimbic circuit activity and behavior in juvenile, adolescent and adult mice. We uncovered multiple developmental switches in the behavioral roles of mPFC circuits targeting the basolateral amygdala (BLA) and nucleus accumbens (NAc). We show these changes are accompanied by axonal pruning coinciding with functional strengthening of synaptic connectivity in the mPFC-BLA and mPFC-NAc pathways, which mature at different rates. Our results reveal how developing mPFC circuits pass through distinct architectures that may make them optimally adapted to the demands of age-specific challenges.

11.3 FRONTAL CORTEX MICROCIRCUIT DEVELOPMENT AND THE SEARCH FOR AN ADOLESCENT SENSITIVE PERIOD

Madeline Klinger[1], Hongli Wang[1], Lung-Hao Tai[1], Linda Wilbrecht*[1]

[1]*University of California, Berkeley*

Individual Abstract: We often speak of an adolescent sensitive period, but it is not well defined. We can explore this construct in mice where we can measure neural circuit structure and function. Classic studies in the sensory cortices point toward increases in GABAergic inhibition in the neocortex as an initiating factor in sensitive period plasticity. Indeed, in the dorsal frontal cortices of mice, we find during week 3 to 5 of life there is an increase in inhibition onto principal neurons, as well as spine pruning, stabilization, and remodeling of axonal boutons. This begs the question, are mice better at learning at this age when compared to adults? We find that mice in this adolescent age range are faster at learning a (dorsal frontal cortex dependent) reversal task and also a go/no-go task that can be performed under a microscope. Imaging layer 2/3 neurons in the dorsal frontal cortices during our go/no-go task, we find adolescent neural activity starts higher and shows steeper declines with age and learning than in adults. After comparable expertise on the task was achieved in both groups, population data from adolescent brains enabled stronger decoding of stimulus identity than population data from adult brains. However, a similar fraction of cells encoded stimuli, choice, and outcomes at all stages of training. These data support and define a putative sensitive period in mice, while also revealing limitations that can inform our quest to define human sensitive periods in adolescence.

11.4 ADOLESCENT NEURODEVELOPMENT SUPPORTS THE EMERGENCE OF VALUE-BASED GENERALIZATION

Catherine Insel*[1], Natalie Biderman[1], Daphna Shohamy[1]

[1]*Columbia University*

Individual Abstract: As adolescents navigate their increasing independence, they encounter many new experiences that help them build a rich understanding of the world around them. How do adolescents generalize this expanding knowledge to make new decisions? We tasked participants aged 11-25 with making value-based decisions. Participants chose between every-day objects and received monetary rewards. Objects were sampled from 32 distinct categories which paid out different amounts (e.g. balloons=80¢, masks=20¢). We tested whether individuals generalized category value to guide decisions when they were presented with novel objects from categories that they had previously experienced. Adaptive generalization emerged with age, and younger adolescents were less likely to use category values to guide trial-by-trial decision making. Yet, younger adolescents still reported explicit awareness of the category values after the task. Thus, younger participants learned the category values, but they did not generalize this knowledge to guide novel decisions that maximized reward. Because retrieving and updating category knowledge relies on cortical systems that mature during adolescence, we examined how functional activity tracked category value signals. For adults, vmPFC activity tracked category value, but this was not the case for adolescents. Together, these findings demonstrate that value-based generalization emerges with age in tandem with ongoing neocortical development.

12. CHARACTERIZING CORTICAL BRAIN DEVELOPMENT IN AN AFRICAN CONTEXT: MEETING CHALLENGES AND EXAMINING CONTEXTUALLY RELEVANT ENVIRONMENTAL VARIABILITY

Dima Amso*[1], Khula Study Collaboration[2], Kirsty Donald[3]

[1]*Columbia University,* [2]*Multiple,* [3]*University of Cape Town*

Overall Symposium Description and Outline: Understanding the nature/nurture dynamics in infancy that set the stage for cognitive and social development presents a promising opportunity for neuroscientific discovery. However, most longitudinal investigations of these dynamics have been conducted in Western countries. It is not clear how generalizable these findings are to brain development in global contexts. Khula is a longitudinal study designed to characterize early brain development in the first 1000 days of life in an African context. We enrolled 394 mothers from Gugulethu in Cape Town, South Africa, and collected rich, multimodal, longitudinal data from 3-24 months of age.

In this Symposium, members of this multi-site collaboration will share emerging data on the pre- and early postnatal environmental influences that shape functional brain development. We focus this symposium on our EEG findings. In Paper 1, we discuss the challenges encountered when using nets not designed to accommodate diverse hair textures in EEG experiments. This challenge creates a potential bias in data collection, discouraging equitable science across hair textures and types. Having met this challenge, Khula went on to chart functional brain development as a function of environmental influences in the South African context. Paper 2 will ask how socioemotional environmental experience, in the form of caregiver predictability during dyadic interaction, shapes early attention behavior and neural oscillatory dynamics of top-down attention. Paper 3 will consider environmental variability at the level of the gut microbiome, and the mechanistic insight this can offer when understanding brain and cognitive development trajectories. Together, these data establish key insights into the prenatal and early postnatal experiences that shape development of this unique group of infants.

12.1 EVALUATING A NOVEL HIGH-DENSITY EEG SENSOR NET STRUCTURE FOR IMPROVING INCLUSIVITY IN INFANTS WITH CURLY OR TIGHTLY COILED HAIR

Nwabisa Mlandu*[1], Sarah A. McCormick[2], Lauren Davel[1], Michal R. Zieff[1], Layla Bradford[1], Donna Herr[1], Chloë A. Jacobs[1], Anele Khumalo[1], Candice Knipe[1], Zamazimba Madi[1], Thandeka Mazubane[1], Bokang Methola[1], Tembeka Mhlakwaphalwa[1], Marlie Miles[1], Zayaan Goolam Nabi[1], Rabelani Negota[1], Khanyisa Nkubungu[1], Tracy Pan[1], Reese Samuels[1], Sadeeka Williams[1], Simone R. Williams[1], Trey Avery[3], Gaynor Foster[3], Kirsten A. Donald[1], Laurel J. Gabard-Durnam[2]

[1]*University of Cape Town,* [2]*Northeastern University,* [3]*Magstim EGI*

Individual Abstract: EEG is an important tool in the field of developmental cognitive neuroscience for indexing neural activity. However, racial biases persist in EEG research that limit

the utility of this tool. One bias comes from the structure of EEG caps that do not facilitate equitable data collection across hair texture and type. Recent EEG collection solutions can be time-intensive, reduce sensor density, and are more difficult to implement in younger populations. The present study focused on testing EEG sensor net designs over infancy. Specifically, we compared EEG data quality and retention between two high-density saline-based EEG sensor net designs from the same company (Magstim EGI, Whitland, UK) within the same sample of infants (N = 35) from South Africa during a baseline EEG paradigm. We found that within infants, the modified tall sensor nets resulted in lower impedances during collection, including lower impedances in the key online reference electrode for those with greater hair heights (Mshort = 17.95, SE = 2.58; Mtall = 11.51, SE = 1.96; p = .019) and resulted in a greater number of usable EEG channels (Mshort = 91.98, SD = 3.72; Mtall = 95.38, SD = 2.71; t(34) = -4.28, p LESS THAN .001) and data segments (Mshort = 68.15, SD = 11.19; Mtall = 73.55, SD = 6.22; t(34) = -2.77, p = .009) retained during pre-processing. These results suggest that the modified tall sensor net design is useful for improving data quality and retention in infant participants with curly or tightly-coiled hair.

12.2 CHARACTERIZING THE EMERGENCE OF PHASE-AMPLITUDE COUPLING IN THE FIRST YEAR OF LIFE TO UNDERSTAND ATTENTION IN THE INFANT BRAIN

Tess Allegra Forest*[1], Khula Study Collaboration[2], Laurel Gabard-Durnam[3], Dima Amso[4]

[1]*University of Toronto,* [2]*Multiple,* [3]*Northeastern University,* [4]*Columbia University*

Individual Abstract: Attention develops a great deal across infancy and can be conceptualized as an ongoing competition for neural resources within and between bottom-up and top-down signals. Adult EEG data show that low-frequency top-down oscillations from anterior brain regions modulate higher-frequency bottom-up posterior oscillations via phase-amplitude coupling, or PAC. Adult and primate data show that the balance of top-down/bottom-up information shapes selective attention, such that stronger PAC results in stronger modulation of local, bottom-up signals. We therefore calculated longitudinal PAC during resting-state EEG (N=278) at 3, 6, and 12mos to offer novel insight into how attention is instantiated in the developing brain. Our results show that occipital alpha-gamma PAC decreases with age while frontal theta-gamma PAC increases, reflecting an expanding contribution of top-down on bottom-up brain function. And, across subjects, the rate of change in occipital compared to frontal PAC related to infant's attention in naturalistic contexts such that infants whose attention was more tightly coupled to shifts in the predictability of their environment showed accelerated developmental change in PAC. These results provide a compelling demonstration that more localized, bottom-up processing governs oscillatory activity in young infants, and longer-range top-down communication emerges later alongside behavioral evidence of top-down attention.

12.3 CHARTING TRAJECTORIES OF GUT MICROBIOME, COGNITION AND BEHAVIOR DEVELOPMENT

Guilherme Fahur Bottino*[1], Kevin S. Bonham[1], Emma Margolis[2], Khula Study Collaboration[3], Kirsty Donald[4], Laurel Gabard-Durnam[2], Dima Amso[5], Vanja Klepac-Ceraj[1]

[1]*Wellesley College,* [2]*Northeastern University,* [3]*Multiple,* [4]*University of Cape Town,* [5]*Columbia University*

Individual Abstract: The gut microbiome and the brain are intimately linked. Both undergo rapid changes early in life and both are shaped by numerous environmental factors. Emerging evidence suggests the gut microbiome may impact brain development through metabolism of neuroactive compounds. Here, we show associations between microbial taxa and their genes and their relationships to cognitive and behavioral outcomes within an African cohort. As a part of our analysis, we built a microbiome age model designed to track typical gut microbiome development by using 3000 infant gut metagenome samples, half of which were from low-resource settings cohorts. Our cross-validated model can predict the age of external samples with a correlation of 0.80. We show that 20% of input taxa carry most of the model capability. Those taxa carry genes responsible for the metabolism of neuroactive compounds. Some of these genes change dramatically in abundance between the 3- and 12-month time points in concordance with results obtained in Western cohorts. Furthermore, we show that some of these genes, such as those involved in tryptophan synthesis, were associated with maternal entropy, infant visual attention shifts, and the visual-evoked potential in early infancy, suggesting microbial metabolism in early life may have long-term effects on neural development.

Symposia
Monday, September 30
10:30 a.m. - 11:45 a.m.

13. DEVELOPMENTAL CHANGES IN CORTICAL EXCITATION-INHIBITION BALANCE THROUGH ADOLESCENCE AND FUNCTIONAL IMPLICATIONS FOR COGNITION

Andrew Westbrook*[1], Ashley Parr[2], Bart Larsen[3], Adriana Caballero[4], Finnegan Calabro[2]

[1]*Rutgers University,* [2]*University of Pittsburgh,* [3]*University of Minnesota,* [4]*University of Illinois at Chicago*

Overall Symposium Description and Outline: Adolescence is characterized as a period of significant cortical development, with rapid changes in local structure and function supporting the emergence of adult levels of executive functioning. Recent human and animal data have converged on a model of critical period plasticity, notably including a shift in the balance of cortical excitation and inhibition (E-I) resulting from synaptic pruning and an increase in inhibitory interneuron function. This shift has profound implications for neural dynamics and cognition, yet practical limitations have limited their direct investigation in the developing human brain.
In this Symposium, we take a fresh look at the functional implications of a shifting E-I balance by leveraging methodological developments in vivo and in silico. Our speakers employ a diversity of perspectives and multi-modal approaches, including human participants and animal models, imaging across time scales from milliseconds to years, and spatial scales from single neurons to the neocortex. Our talks will address major open questions including:

- What neurological events trigger the opening of the critical period in the adolescent cortex?
- What role do neuromodulators like dopamine play in shaping critical period development?
- What microcircuit changes underlie a shift in the E-I balance?

• What are the functional implications of a shift in the E-I balance for neural dynamics and for cognition?

• What can we infer about the E-I balance from non-invasive brain imaging methodologies?

We will address these questions in four talks highlighting recent findings, prompting inter-disciplinary cross-talk about how computational tools and other methods can be used to connect inferences about E-I balance and development across species. In the last 15 minutes, our Moderator will field questions with an eye towards the application of these methodological developments to future inter-disciplinary research.

13.1 HEURISTIC MANIPULATION OF THE E-I RATIO IN THE PREFRONTAL CORTEX OR VENTRAL HIPPOCAMPUS DURING ADOLESCENCE LEADS TO DISTINCT BEHAVIORAL ALTERATIONS IN ADULTHOOD

Adriana Caballero*[1], Eden Flores-Barrera[1], Srishti Dube[1], Amanda Orozco[1], Karim Mohamed[1], Kuei Y. Tseng[1]

[1]*University of Illinois at Chicago*

Individual Abstract: The upregulation of the calcium-binding protein parvalbumin (PV) in fast-spiking GABAergic interneurons is necessary for the maturation of GABAergic function and the adjustment of the excitatory-inhibitory (E-I) balance observed in cortical structures during adolescence. Of note, a loss of PV has been consistently observed in the hippocampus and prefrontal areas of schizophrenics' brains post-mortem, suggesting that inadequate levels of PV result in a disruption of inhibitory transmission within these structures. Inspired by these observations, we developed an experimental approach to manipulate the E-I balance of individual cortical structures using the partial depletion of PV by means of an shRNA infused directly in the ventral hippocampus or prefrontal cortex. Once adults, we evaluated the impact of PV downregulation in behavioral domains related to learning and sensorimotor gating. We found that disruption of the E-I ratio in the hippocampus or prefrontal cortex during adolescence results in mutually exclusive behavioral abnormalities in adults. These findings indicate that refinement of the E-I ratio in cortical structures during adolescence is necessary to support the acquisition of specific behaviors in adults providing a useful translational model to test the behavioral consequences of an E-I imbalance in cortical structures.

13.2 EVIDENCE FOR A REDUCTION IN THE CORTICAL EXCITATION-INHIBITION RATIO DURING ADOLESCENCE DERIVED FROM FMRI DATA

Bart Larsen*[1]

[1]*University of Minnesota*

Individual Abstract: Adolescence is hypothesized to be a critical period of development of association cortex, driven in part by maturing inhibitory circuitry and concordant reduction in the cortical excitation-inhibition ratio (E/I ratio). However, this hypothesis is largely based on findings from animal models. Translating these findings to human studies has been complicated by the limited ability to directly investigate changes in excitatory and inhibitory circuits using in vivo

neuroimaging approaches. In this talk, I will present two innovative, non-invasive imaging approaches that address this limitation using fMRI data. The first approach uses a GABAergic pharmacological fMRI dataset to empirically generate an fMRI biomarker of the E/I ratio. Applying this E/I biomarker to a large neurodevelopmental dataset reveals a reduction in the E/I ratio of association cortex during adolescence. The second approach employs a large-scale biophysically plausible model to estimate whole-cortex E/I ratio from fMRI data. When we apply this approach to a large neurodevelopmental dataset, we find a decline in the E/I ratio across the cortex during youth. Furthermore, our findings suggest a link between a lower E/I ratio and greater cognitive ability, with the strongest associations observed in association systems. This work jointly provides a significant step towards establishing adolescence as a critical period of cortical development in the human.

13.3 A ROLE FOR DOPAMINE-RELATED NEUROPHYSIOLOGY IN THE MATURATION OF PREFRONTAL CORTEX GLUTAMATE/GABA BALANCE DURING ADOLESCENCE

Ashley Parr*[1], Maria Perica[1], Finnegan Calabro[1], Will Foran[1], Chan-Hong Moon[1], Hoby Hetherington[2], Beatriz Luna[1]

[1]*University of Pittsburgh,* [2]*University of Missouri*

Individual Abstract: Changes in PFC excitatory (Glu) and inhibitory (GABA) balance (E/I) have been identified in human adolescence, potentially reflecting critical period plasticity. Animal models implicate adolescent increases in dopamine (DA) in regulating changes in E/I. We assessed the role of striatal tissue iron, reflecting DA neurophysiology, in the development of Glu/GABA balance from adolescence to adulthood. We obtained longitudinal 7T Magnetic Resonance Spectroscopic Imaging (MRSI) indices of PFC Glu/GABA via an oblique MRSI slice of 24x24 voxels using a J-refocused spectroscopic sequence, as well as striatal tissue iron via time-averaged and normalized T2* (nT2*; 8-min resting state) in 140 participants (86F, baseline age 10-30, 1-3 visits, 232 sessions). Striatal nT2* and PFC Glu/GABA balance increased during adolescence. Critically, nT2* moderated the relationship between Glu/GABA and age, suggesting differential effects of DA neurophysiology in adolescence through adulthood. Specifically, higher nT2* was associated with greater Glu/GABA imbalance in early adolescence, followed by steeper age-related increases in balance relative to low. These results may suggest that increased DAergic enhancement of excitatory inputs to PFC in adolescence may shift E/I out of balance toward excitation. As DA stabilizes, Glu may be downregulated via pruning, facilitating increases in Glu/GABA balance, supporting a model whereby increases in DA are involved in fine-tuning E/I balance in adolescence.

13.4 BRAIN CRITICALITY EMERGES WITH DEVELOPMENTAL SHIFTS IN EXCITATION-INHIBITION BALANCE, SETTING THE STAGE FOR COGNITIVE CONTROL IN ADULTHOOD

Andrew Westbrook*[1], Finnegan Calabro[2], Arthur-Ervin Avramiea[3], Klaus Linkenkaer-Hansen[3], Shane McKeon[2], Beatriz Luna[2]

[1]*Rutgers University,* [2]*University of Pittsburgh,* [3]*University of Amsterdam*

Individual Abstract: Adult brains, at rest, operate near criticality – at the boundary between super-critical, excitation-dominant regimes, and sub-critical, inhibition-dominant regimes, with radically divergent dynamics on either side. Dynamics which emerge right at criticality confer susceptibility, entropy, and information transmission, with profound implications for cognitive control. Enhanced information transmission, for example, should strengthen top-down control over sensorimotor regions, while greater susceptibility should bias flexibility over stability.
Here, we study dynamical properties of rest EEG recordings during N = 310 sessions from 169 healthy participants from 10 to 33 years old. Our analyses reveal that brains operate closer to criticality as they mature, as indexed by stronger long-range temporal correlations and higher bistability in band-limited amplitude. Moreover, relationships between amplitude and variability indicate a developmental shift towards decreasing excitatory versus inhibitory neurotransmission with age. Finally, as predicted, people whose brains operate closer to criticality show less stability during a memory-guided saccade task with more trial-wise variability in accuracy and reaction times. Also, higher excitation-inhibition ratios correspond with better top-down control in terms of higher anti-saccade accuracy. We conclude that developmental shifts in excitation-inhibition balance towards criticality set the stage for cognitive control in adulthood.

14. DEVELOPMENT OF CONNECTIVITY FROM INFANCY THROUGH CHILDHOOD: TYPICAL TRAJECTORIES AND RISK-RELATED ALTERATIONS

Yana Fandakova
University of Trier

Overall Symposium Description and Outline: Early childhood is associated with the emergence and establishment of key cognitive, emotional and social abilities that serve as the foundation for later learning and goal-directed behavior. Non-invasive neuroimaging studies have begun to elucidate the rapid pace of postnatal brain development accompanying those behavioral changes. In this symposium, we examine the development of functional brain connectivity from infancy through childhood, and discuss various pre- and perinatal risk factors that are associated with alternations in the functional architecture of the brain. The speakers will focus on different aspects of functional connectivity, ranging from age- and experience-related changes in the organization and strength of whole-brain networks, to connectivity development of particular brain regions (i.e., hypothalamus, amygdala, hippocampus). Links between individual differences in connectivity development and concurrent and future behavioral outcomes will be discussed. Together, the talks highlight key insights into the emergence and plasticity of functional brain organization during early childhood.

14.1 FUNCTIONAL NETWORK GROWTH DURING INFANCY AND BEYOND: TYPICAL TRAJECTORIES, RISK-RELATED ALTERATIONS, AND IMPLICATIONS FOR OUTCOMES

Wei Gao*[1]

[1]*Cedars-Sinai Medical Center*

Individual Abstract: The first few years of fetal and postnatal development hosts the most dynamic and consequential brain growth in human life. The timed nature of this most dynamic process implies that, unfortunately, subtle alterations in the wrong direction may cascade into major deviations down the road, potentially leading to various developmental problems and/or disorders. Thus, it is crucial to better understand both the typical growth trajectories and alterations related to different risk factors, especially those modifiable ones, to help guide effective intervention/optimization strategies and minimize adverse outcomes in this cascading process. I this talk, I will focus on early brain functional network development and review both typical growth trajectories of the brain's emerging functional networks and alterations related to different risk factors including prenatal drug exposure, maternal depression, familial risk of autism, among others. Links between these network development events and concurrent/future behavioral outcomes will also be discussed to improve our understanding of the interactive brain-behavior development process during this critical period. Challenges and future directions will be discussed at the end.

14.2 CONNECTIVITY SCAFFOLDS FOR MENTAL FUNCTION

Zeynep Saygin*[1]

[1]*Ohio State University*

Individual Abstract: What determines functional specialization in the human brain? I'll present experiments that investigate how early-developing connectivity drives specialization and subsequent behavior. First, I'll demonstrate how a pre-reader's brain connectivity scan can pinpoint where that same child's visual word form area (VWFA) for orthography/reading will develop 2 years later, after they learn how to read. Our results in neonates further demonstrate how connectivity (specifically with language cortex) earmarks the eventual location of the VWFA and other cortex; moreover, the congenital absence of canonical language cortex impacts the later development of the VWFA. In contrast to this proto-organization, we also find immature and broadly-tuned connectivity in neonates, specifically for subcortical nuclei within amygdala and hippocampus, as well as domain general cortical networks supporting cognitive control. This prolonged development may offer insight into experience-based mechanisms and we are investigating plasticity of these networks in children playing their first season of tackle football. Finally, I'll present ongoing experiments that use connectivity as potential biomarkers to predict individual differences in future behavior, offering powerful strategies for understanding the emergence and plasticity of mind and brain.

14.3 DISRUPTED TASK-INDUCED RECONFIGURATION DURING COGNITIVE CONTROL IN CHILDREN WITH ADHD

Jessica Cohen*[1]

[1]*University of North Carolina at Chapel Hill*

Individual Abstract: ADHD is characterized by altered functional brain network organization and dynamics. Much extant research has investigated how average, or static, functional brain network organization assessed during the resting state is disrupted in ADHD, but little is known about how network organization reconfigures in response to cognitive task demands or how it

dynamically shifts across time. This talk will present research examining how functional brain network organization and dynamics flexibly reconfigure across rest and two cognitive control tasks in children with ADHD and typically developing (TD) children aged 8-12 years. Using graph theoretical methods to assess stable aspects of network reconfiguration, across rest and the task-based states children with ADHD had significantly reduced network segregation globally (modularity) and increased network integration between default mode and visual networks (node dissociation index). Further, network segregation of the frontoparietal network (within-module degree) decreased from rest to task in children with ADHD but increased in TD children. Using the edge timeseries approach, children with ADHD had significantly more dynamic functional connectivity within and across default mode and dorsal somatomotor networks, specifically during task performance. Taken together, this research provides novel insight into how context-specific, context-general, and timescale-dependent functional connectivity patterns are altered in children with ADHD.

14.4 INVESTIGATING HYPOTHALAMIC CONNECTIVITY IN EARLY DEVELOPMENT: INSIGHTS AND IMPLICATIONS

Jerod Rasmussen*[1]

[1]*University of California, Irvine*

Individual Abstract: Motivated behaviors are essential for survival, yet when aberrant, they underlie many adverse mental and physical health outcomes. In animals, the hypothalamus orchestrates behaviors like reward-seeking and threat avoidance by utilizing its access to peripheral signals that relay contextual information about the body's states and needs. However, our understanding of the developing human hypothalamus, particularly how early-life stress impacts its structure, function, and connectivity, remains incomplete. This talk will offer early insights into hypothalamic connectivity in newborn brains, showcasing data on developmental plasticity in the context of perinatal risk factors such as maternal obesity, smoking, and pre-term birth, and discuss their implications for future health outcomes and research directions.

Symposia
Monday, September 30
2:45 p.m. - 4:00 p.m.

15. PRECISION BRAIN MAPPING FOR DEVELOPMENTAL COGNITIVE NEUROSCIENCE

Arielle Keller*[1]

[1]*University of Pennsylvania*

Overall Symposium Description and Outline: Human neuroimaging studies have historically relied on a "one-size-fits-all" approach to functional brain mapping. By spatially co-registering fMRI data to a structural image that is then spatially warped to fit a standard template, this

approach relies on the assumption that all brains share a 1:1 correspondence between structure and function. Studies from multiple laboratories have found this assumption to be false, demonstrating that the mapping between structure and function varies substantially across individuals. Group-averaged atlases of functional brain regions and networks therefore smear away this rich inter-individual variability in the size, shape, and spatial location of functional brain regions, motivating the field to shift toward the use of precision functional mapping techniques to derive brain maps that are unique to each individual. This shift in the field is critically important for developmental cognitive neuroscience research for two reasons. First, group-averaged brain atlases are typically defined in adult populations, making the spatial warping approach especially problematic for studies of infant, child and adolescent development. Recent developmental studies have shown that, not only does functional brain network organization tend to be highly variable in youth, it also tends to change over the course of development. Second, many of the higher-order cognitive functions that are the focus of developmental cognitive neuroscience research rely on spatially-distributed networks that tend to exhibit the most inter-individual heterogeneity of all large-scale brain networks. Recent studies have shown that variability in the spatial organization of networks supporting cognition is associated with cognitive task performance, an effect which may be aliased into studies of functional connectivity. This symposium will focus on recent developments, challenges, and future potential for precision brain mapping in developmental cognitive neuroscience.

15.1 INTER-INDIVIDUAL VARIABILITY OF FUNCTIONAL BRAIN NETWORK ORGANIZATION IN CHILDHOOD REVEALED BY PRECISION FUNCTIONAL MAPPING

Deanna Greene*[1]

[1]*University of California, San Diego*

Individual Abstract: Precision functional mapping (PFM) via the collection of large amounts of fMRI data from individual people is improving our understanding of individual variability in functional brain organization. Our lab has established feasibility of this method in children, successfully collecting PFM data from twelve 8-12 years olds and obtaining 60-340 minutes of high-quality, low-motion resting state fMRI data per child. Here, I describe how we use this unique dataset to interrogate individual features of brain network organization in children. As previously demonstrated in adults, children's functional brain networks follow broadly similar organization, yet with measurable and reliable individually unique features. Surprisingly, we find that inter-individual variability in functional connectivity is lower in children compared to adults. That is, children are more similar to each other than adults are to each other, suggesting refinement in individualized functional network organization over development. The functional brain networks with the greatest inter-individual variability include higher-level control networks compared to sensorimotor processing networks. These findings demonstrate the power of PFM to interrogate individual-level brain function in children and to provide new insights about the development of individual differences in functional brain organization.

15.2 PRECISION FUNCTIONAL IMAGING IN INFANTS USING MULTI-ECHO FMRI AT 7T

Julia Moser*[1]

[1]*University of Minnesota*

Individual Abstract: The ability to reliably and precisely map functional brain organization in individuals has provided an important platform for a host of discoveries in recent years in adults. However, little is known about the ontogeny of these individual differences in brain functional organization during the earliest periods of human development. Special practical and methodological considerations are necessary to successfully acquire data with suitable spatial precision and reliability to tackle this question. High field (7T) imaging can achieve a level of precision that allows to uncover details of connectivity patterns in infants that might get obscured in lower field 3T data due to the larger voxel sizes, relative to the smaller brains. This is particularly true for subcortical networks whose development has major relevance in neurobiological models of psychopathology. In addition, improved data acquisition strategies like multi-echo data acquisitions and their special properties in early infancy and improved denoising strategies like targeted removal of thermal noise, further facilitate precision imaging by improving data reliability and stability of personalized network solutions. This talk will showcase initial results from precision functional mapping at 3T and 7T in infants in their first weeks of life and highlight how methodological advancements help to facilitate this line of research.

15.3 PRECISION MAPPING OF FUNCTIONAL BRAIN NETWORKS IN INDIVIDUALS WITH DEPRESSION

Charles Lynch*[1]

[1]*Weill Cornell Medicine*

Individual Abstract: Precision functional mapping is the practice of delineating functional brain areas or networks and studying brain-behavior relationships within individuals, as opposed to at the group-level, typically using a large amount of fMRI data per-subject acquired longitudinally. In this talk, I describe how we applied precision functional mapping in deeply-sampled adults with major depression who were studied up to 1.5 years, and found that the salience network is expanded nearly 2-fold in cortex due to borders of the network shifting outwards and encroaching upon neighboring functional systems. This expansion was trait-like – stable over time, unaffected by mood state, and detectable in a separate sample of children scanned before the onset of depression symptoms later in adolescence. In contrast, functional connectivity between different pairs of frontostriatal salience network nodes was state-dependent and tracked fluctuations in distinct symptoms (anhedonia, anxiety) within individuals over time. Together, these findings reveal new patterns of functional network topography and connectivity that are neural traits and states, respectively, characteristic of depression, and highlight the utility of deeper characterizations of functional neuroanatomy and behavior within individuals as an alternative to studying population-level central tendencies.

15.4 PERSONALIZED FUNCTIONAL BRAIN NETWORK TOPOGRAPHY REFLECTS CHILDHOOD ENVIRONMENTS AND COGNITION

Arielle Keller*[1]

[1]*University of Pennsylvania*

Individual Abstract: Individual human brains are highly unique, with substantial inter-individual differences in the size, shape, and spatial location of functional brain regions, known as "functional topography." As functional brain networks develop gradually throughout childhood and adolescence alongside the maturation of cognitive functions, these individual differences in functional topography become increasingly pronounced, posing a challenge for developmental neuroimaging studies aiming to investigate common brain areas across individuals. Critically, brain networks that support higher-order cognitive functions tend to remain plastic for the longest duration and exhibit the greatest variability in functional topography of all large-scale networks. I will present two recent precision brain mapping studies leveraging spatially-regularized non-negative matrix factorization to define personalized functional brain networks. Rather than spatially warping a group-averaged brain atlas to each individual child's brain, this approach defines individual-specific atlases of seventeen large-scale networks, allowing functional topography to vary while maintaining interpretability. Multivariate patterns of personalized functional network topography reflect co-occurring features of childhood environments and are associated with youth cognition across domains. These findings replicate across large samples and further our understanding of individual trajectories of cognitive neurodevelopment.

16. INNOVATIONS IN TODDLER FUNCTIONAL MRI

Halie Olson*[1]

[1]*Massachusetts Institute of Technology*

Overall Symposium Description and Outline: As a society, Flux is brought together by a desire to understand human brain development – and one of the most exciting and theoretically interesting developmental periods is toddlerhood. Toddlers undergo rapid and remarkable changes across cognitive domains, and toddlerhood is a key opportunity for early diagnosis and monitoring of developmental disorders. FMRI offers great potential for characterizing developmental change in brain function, and yet, there is a bit of a "black hole" in the fMRI literature when it comes to toddlers. It is notoriously difficult to acquire sufficient amounts of high-quality fMRI data from this age group. Our symposium brings together four groups, each pioneering approaches to fMRI in toddlers. The talks will present cutting edge advances in methodological approaches, sensitive and age-appropriate paradigms, and the potential clinical relevance of toddler fMRI, across a range of sensory and cognitive domains. While this symposium is centered around toddlers, we believe that the key questions and takeaways – making our neuroimaging tools more accessible to difficult-to-study populations, grappling with individual differences, and connecting behavioral changes to brain function – are applicable across developmental cognitive neuroscience.

16.1 PASSIVE VIEWING FMRI DATA IN AWAKE 2-3 YEAR OLDS: METHODS AND INSIGHTS INTO EARLY FUNCTIONAL BRAIN DEVELOPMENT

Catherine Lebel[1], Aliza Jaffer[1], Kathryn Manning*[1], Claire Donnici[1], Xiangyu Long[1]

[1]*University of Calgary*

Individual Abstract: Much work has focused on brain development in infancy and older childhood, but functional brain changes during the toddler/preschool years remain relatively poorly understood. These years are especially important, as they represent a time when behavioural challenges often first become apparent. We have used a passive viewing approach, where children select movies to watch, to collect awake fMRI data in a large group of toddlers, including typically developing children born pre-pandemic and children born during the COVID-19 pandemic; both from prospective pregnancy cohorts that measured prenatal maternal distress. In this session, I will briefly discuss our behavioural methods for obtaining awake fMRI in toddlers and our current success rates. I will then discuss insights that this data has yielded related to prenatal maternal distress (i.e., anxiety and depression).

Prenatal distress is common and can have long-term impacts on child health and behaviour. Our data show that prenatal anxiety is associated with changes to amygdala functional connectivity in toddlers born pre-pandemic, and that the substantially elevated prenatal distress (both anxiety and depression) seen during the COVID-19 pandemic is associated with functional brain network changes in toddlers in our Pregnancy during the COVID-19 Pandemic study. Both studies show functional brain changes that may represent mechanisms via which prenatal maternal distress ultimately impacts child behaviour.

16.2 USING FMRI TO STUDY LANGUAGE COMPREHENSION IN AWAKE TODDLERS

Halie Olson*[1], Emily Chen[2], Evelina Fedorenko[1], Rebecca Saxe[1]

[1]*Massachusetts Institute of Technology,* [2]*Stanford University*

Individual Abstract: Toddlers undergo rapid and remarkable changes in their language comprehension and production, but the neural underpinnings of this developing capacity for language are not fully understood. Thus, we developed a toddler-friendly fMRI task that manipulates both language comprehensibility (forward versus backward speech) and context (child-directed monologue and observed dialogue) using a block-designed task with videos from Sesame Street. To date, we have attempted to scan 70 toddlers between the ages of 18-36 months, resulting in a sample of N=16 toddlers with sufficient usable data (M(SD)=31.5(3.36) months, range=25-36 months). I will discuss preliminary results showing: (1) group-level language responses particularly in the left anterior temporal cortex, (2) left-lateralized language-evoked activation in our sample, which did not differ from an adult sample scanned on the same task, and (3) individual-level activation within canonical left-hemisphere language regions by condition, using individually-defined functional regions of interest iteratively defined and tested in held-out data (in N=10 toddlers with multiple usable task runs). Our preliminary results suggest that it is feasible to study language processing using a task-based design in awake toddlers, and provide initial evidence for similarities with the neural correlates of language comprehension in adults.

16.3 USING FMRI TO STUDY AUDITORY PROCESSING AND LANGUAGE DEVELOPMENT IN TODDLERS AND PRESCHOOLERS WITH AUTISM

Annika Linke*[1], Adriana Rios[1], Judy Mahmalji[1], Meagan Herrera[1], Madison Salmina[1], Alexandra Boxberger[2], Molly Wilkinson[2], Michaela Cordova[2], Ralph-Axel Müller[3], Inna Fishman[3]

[1]*San Diego State University,* [2]*SDSU/UC San Diego Joint Doctoral Program in Clinical Psychology,* [3]*San Diego State University; SDSU/UC San Diego Joint Doctoral Program in Clinical Psychology; SDSU Center for Autism and Developmental Disorders*

Individual Abstract: Altered sensitivity to sounds despite normal peripheral hearing is common in children with autism spectrum disorders (ASD) but whether and how it is related to language skills is not well understood. We have been using fMRI acquired during natural nocturnal sleep to characterize the functional maturation of auditory processing in toddlers and preschoolers (18–65 months old) with and without ASD and its relationship to language development. Language skills in our ASD cohort with successful fMRI (n=79) range from nonverbal to hyperlinguistic, illustrating that natural sleep MRI allows inclusion of children more representative of the autistic population than in previous neuroimaging studies. Importantly, the quality of fMRI data acquired during natural sleep is high and did not differ between children with ASD and age-matched controls. Expected hemispheric asymmetries in auditory cortical processing (responses to natural complex sounds) and functional connectivity are observed in typically developing children but not in those with ASD. Further, reduced hemispheric asymmetry was related to language skills measured directly and with caregiver report. Our results support the hypothesis that atypical auditory processing is related to language development in children with ASD and highlight that fMRI research in toddlers and preschoolers is not only feasible but will help to increase our understanding of the mechanisms linking brain and behavior in neurodevelopmental disorders.

16.4 IMMERSIVE VIRTUAL REALITY FOR INTERACTIVE TODDLER FMRI STUDIES

Tomoki Arichi*[1]

[1]*King's College London*

Individual Abstract: The MRI scanner environment is claustrophobic and noisy and thus challenging for certain populations like young children, who may become afraid or cannot keep still during image acquisition. Clinical MRI scans are therefore often acquired in sleep or during induced sedation, and very little MRI research is conducted with toddlers despite it being a key time for behavioral development and the brain's emerging framework of structural and functional connectivity.

We have developed a novel MRI compatible Virtual Reality (VR) system which immerses the child in an interactive virtual world and thus distracts them entirely from the surrounding MRI environment. The system consists of a light-tight 3D printed headset which contains 2 MR compatible video cameras. Video content is presented from a MRI compatible projector and audio content via noise canceling headphones. Continuous interaction (by holding gaze to trigger choices or character interaction) and measurement of visual attention whilst using the system is achieved through eye tracking and an adaptive calibration free gaze estimation algorithm that is robust to subject movement. Residual image artifacts are addressed with motion robust image acquisition

and reconstruction. Tailored content has been developed through workshops with families using Unity which enables easy customization. The system has enabled ~20 minutes of scanning with children 2-3 years old including high resolution anatomical and fMRI images.

Poster Session I

Saturday, September 28

4:00 p.m. - 5:30 p.m.

S1. INVESTIGATING THE RELATIONSHIPS BETWEEN ACADEMIC SELF-CONCEPT AND ATTENTION USING EEG INTER-SUBJECT CORRELATION

Philip Hernandez*[1], Madison Bunderson[1], Neha Rajagopalan[1], Vani Dewan[1], Suanna Moron[1], Jean Chun[1], Blair Kaneshiro[1], Bruce Mccandliss[1]

[1]Stanford University

Background: Academic Self-Concept (ASC), or how one perceives their ability relative to academic subjects (specifically) or academics (generally), develops as students progress through schooling. This self-perception is formed via a person's experiences with academics and appraisals by influential others (Shavelson et al., 1976). ASC has implications in academic performance and career selection (Marsh et al., 2005; Krannich et al., 2019). Despite this link between ASC and performance, the interplay of selective attention (necessary for academic performance) and ASC remains largely unexplored, especially in naturalistic settings. This pre-registered study will utilize post-hoc survey data and electroencephalography inter-subject correlation (EEG-ISC) to examine attention to audio excerpts from various academic domains and literary genres. EEG-ISC, proposed as a neural index of engagement (Dmochowski et al., 2012), has been linked to preferences (Dmochowski et al. 2014), attentional states (Ki et al., 2016), and learning outcomes (Cohen et al., 2018) in studies involving naturalistic stimuli.

This study has broad implications for work tracking self-concept development and attention in naturalistic academic settings. Should a link between ASC and measures of attention exist at the adult level, further studies could examine this relationship as students progress through school, where evidence suggests ASC is more malleable (Marsh et al., 2005). Further studies would allow for both better understanding of when students are at risk for losing interest in a subject and investigations of possible interventions. Rather than using metrics of ASC and ISC as Methods: to classify students as at-risk, lessons and systems of instruction could be evaluated and redesigned based on knowledge of student engagement.

Methods: 128-channel EEG was recorded from participants (18-35 years old, fluent in English) as they listened to audio excerpts from different academic domains and genres. The audio excerpts were presented across 9 separate modules, each centering one academic domain/genre. Modules lasted approximately 4 minutes and consisted of either one long excerpt or several short excerpts. After the study, participants were sent a survey probing general academic self-concept as well as domain-specific academic self-concept.

EEG-ISC will be calculated for each module using an established pipeline wherein data will be filtered using Reliable Components Analysis to maximize correlation across trials (see Dauer et

al., 2021). Correlation of filtered single trials of data will produce a measure, for each academic domain, of the extent to which each participant's neural signature correlates with others in the group. Academic self-concept scores will be calculated for a general self-concept and domain-specific academic self-concepts (Math, Science, English, History).

Results: N/A

Discussion: We present two hypotheses:

H1: Increased domain specific academic self-concept is positively correlated with individual measures of EEG-ISC for excerpts related to that domain.

To test this hypothesis, we plan to examine the correlation of each participants' ISC score for each module with the relevant domain-specific ASC. ASC scores will be analyzed using two methods the first assumes ASC scores are an absolute measure and uses raw composite scores. The second assumes that ASC scores are relative, and transforms student scores relative to the range of values a student used when responding to items, thus normalizing each participant's range.

H2: General academic self-concept is positively correlated with higher measures of EEG-ISC in traditional academic domain excerpts (Math, Science, English, History), but not elective academic domain (musical) excerpts.

To test this hypothesis, we plan to examine the correlation of each participants' ISC score for a module with a students' academic self-concept. ASC scores will be analyzed using two methods, absolute and relative, as described above.

S2. AGE- AND SEX-DEPENDENT EFFECTS OF GLOBAL AND WITHIN-NETWORK INTEGRATION IN SLEEP-DEPRIVED VERSUS WELL-RESTED INDIVIDUALS: APPLICATION OF FUNCTIONAL PRINCIPAL COMPONENT ANALYSIS ON RESTING-STATE FMRI DATA

Jasper Laca*[1], Emilio Laca[2], Tiffany Ho[1]

[1]University of California, Los Angeles, [2]University of California, Davis

Background: Functional principal component analysis (fPCA) is a statistical tool used for analyzing functional data, where observations are functions rather than discrete values. In contrast to conventional assessments of functional connectivity patterns, which predominantly use pairwise correlations, fPCA offers an alternative framework to understand brain connectivity by partitioning it into orthogonal functional components (fPCs), representing its main modes of variation. The implications of using this method to identify age-related effects of clinical biomarkers is therefore enormous.

Methods: We explored fPCA to analyze resting-state fMRI data in an open-source dataset, The Stockholm SleepyBrain Project, where each of 84 participants (ages 20-75; 44 female) was tested after partial sleep deprivation (SD, 3 hours of sleep) and after unrestricted sleep (WR) in a crossover design and underwent MR scanning during each condition (152 scans total). Each MR session included one 8-minute resting-state fMRI scan (TR=2.5 s) with eyes open. Previous analysis of this data failed to detect significant SD effects on brain connectivity, offering an opportunity to highlight the sensitivity of fPCA analyses to perturbations in brain state. As age and sex have also consistently been strong predictors of resting-state fMRI patterns, we sought to test what effects, if any, they had on the fPCA results. Resting-state fMRI data were aggregated and

preprocessed with FSL 6.0.7.5, including skull stripping and registration to the Harvard Oxford Cortical Atlas (48 cortical regions). Voxel values were averaged by region, yielding 48 time-series per participant, per session. The time-series were then standardized within each subject's region and session and subjected to fPCA with the 'fdapace' package in R. Loadings (correlations) of each region on each of the first 3 fPCs (equivalent to ~ 75% avg. cumulative fraction of explained variance, FVE) were averaged by 11 resting-state networks (defined a priori by the authors). Absolute values of averages were used as an index of within-network integration (WNI). WNI was analyzed with a mixed-effects model including sex, age, sleep deprivation condition, and network as fixed effects, using subject and session within subject as random effects. Networks that are highly integrated have regions with loadings of equal sign and large absolute value on the same fPC.

Results: On average, 11.2 fPCs explained 99.3% of total signal variance (FVE) under SD whereas 13.1 fPCs were necessary to reach the same threshold for those who were WR ($p=0.05$). This result may reflect a greater overall functional cohesion or global network integration in the cortex during SD, consistent with previous research. The first fPC, or mode of variation, showed that average overall WNI tended to be lower for SD subjects, compared to their WR counterparts ($p=0.084$). Additionally, a significant interaction effect was observed between age and network ($p=0.013$, $F(10,1480)=2.26$). Younger subjects had greater WNI than their older counterparts in the auditory ($p=0.05$, $t(270)=1.97$), default mode ($p=0.077$, $t(270)=1.78$), and salience networks ($p=0.006$, $t(270)=2.78$) The second fPC showed a significant main effect of age ($p=0.016$, $F(1,80)=6.02$), indicating that younger subjects tended to have greater overall WNI compared to the older subjects in the study. Finally, the third fPC exhibited a significant interaction effect between SD-WR and network ($p=0.013$, $F(10,1480)=2.24$), mostly due to the WR group exhibiting greater WNI in auditory ($p=0.088$, $t(517)=1.71$), language ($p=0.020$, $t(517)=2.34$), salience ($p=0.041$, $t(517)=2.05$), and sensorimotor networks ($p=0.003$, $t(517)=3.03$) compared to the SD. Interestingly, in this fPC, females had more WNI, across all networks, than males ($p=0.052$, $F(1,145)=3.84$).

Discussion: These results serve as a proof-of-concept for the use of fPCA in fMRI analysis as a novel tool to understand psychological mechanisms and conditions affecting the developing brain.

S3. ACUTE AND CHRONIC CHILDHOOD STRESSORS AND RESTING-STATE FUNCTIONAL CONNECTIVITY IN YOUNG ADULTS

Lydia Jacobs*[1], Melissa Hansen[1], Nick Steele[2], Jordan Strack[1], George M. Slavich[3], Michael L. Thomas[1], Emily C. Merz[1]

[1]Colorado State University, [2]Duke University, [3]University of California, Los Angeles

Background: Early life stress is frequently associated with various aspects of neurodevelopment (Burghy et al., 2012; Herringa et al., 2013), including alterations in functional connectivity in neural networks such as the salience network (SN), central executive network (CEN), and default mode network (DMN) (Chahal et al., 2022; Holz et al., 2023). Early life stress has often been operationalized using childhood trauma or cumulative adversity during childhood. Yet, childhood adversity varies along multiple dimensions (McLaughlin et al., 2014). An important distinction has long been made between acute and chronic stressors, with evidence suggesting that these two types of stress have different effects on neural function (McEwen et al., 2016). To investigate this

possibility, we examined how acute and chronic childhood stressors were related to resting-state functional connectivity (rsFC) in the SN, CEN, and DMN in young adults.

Methods: Participants were typically developing 18- and 19-year-olds (N = 46, 70% female) from socioeconomically diverse backgrounds. Approximately one month after participants completed a session in which they reported on their childhood experiences, they completed an MRI session, which included a resting-state fMRI scan. Acute and chronic stressor exposure was measured using the Stress and Adversity Inventory for Adults (Adult STRAIN) (Slavich and Shields, 2018), a self-report measure completed on a computer that asks about the frequency, duration, timing, and severity of exposure to major stressors. Summary scores reflecting the amount of exposure to acute (e.g., car accident, relationship break-up, death of a loved one) and chronic stressors (e.g., financial difficulties, neighborhood danger, unfair treatment due to race or ethnicity) through age 18 were used in analyses.

Functional connectivity between major hubs in the DMN, SN, and CEN was computed using the CONN toolbox (Whitfield-Gabrieli and Nieto-Castanon, 2012). Specifically, seed-to-seed connectivity was measured between the dorsolateral prefrontal cortex (dlPFC) and posterior parietal cortex (PPC) for the CEN; anterior insula and dorsal anterior cingulate cortex (dACC) for the SN; and medial PFC and posterior cingulate cortex (PCC) for the DMN (Menon, 2011). Multiple linear regression analyses were run in R to examine the associations of acute and chronic stressor exposure with rsFC between these hubs, controlling for age, sex, parental education, head motion, and proportion of passed attention checks on the STRAIN.

Results: Results indicated that experiencing more early-life chronic stressors was significantly associated with decreased rsFC between the anterior insula and dACC (β = -.04, p = .02) but was not associated with rsFC between the dlPFC and PPC (β = .01, p = .57). Greater acute stressor exposure was not significantly associated with rsFC (e.g., for rsFC between the dlPFC and PPC: β = .01, p = .12). There were no significant associations of chronic stressor exposure (β = -.002, p = .90) or acute stressor exposure (β = .003, p = .65) with rsFC between the medial PFC and PCC.

Discussion: These findings are consistent with the notion that acute and chronic stress have different neural signatures, which aligns with previous work (McEwen et al., 2016). They start to shed light on the potentially different patterns of neural processing associated with navigating short- and long-term stress across childhood and adolescence. Chronic stress, in comparison to acute stress, has been more strongly associated with negative health outcomes. Findings from our study suggest that chronic stress may overtax coping resources, leading to weakened connectivity in the SN, which is needed for detecting salient stimuli in the environment and switching between tasks (Menon, 2011). The associations between chronic stress and rsFC in the SN may be due in part to alterations in brain plasticity processes such as synaptic pruning during sensitive periods of brain development.

S4. DOES FUNCTIONAL CONNECTIVITY BETWEEN THE FRONTOPARIETAL NETWORK AND SUBCORTICAL STRUCTURES IMPACT THE ONSET OF MENTAL HEALTH PROBLEMS THROUGH EMOTION REGULATION STRATEGIES?

Courtney Cooper*[1], Florence Breslin[2], Zsofia Cohen[1], Gabriella Atencio[1], Jennifer Watrous[1], Kara Kerr[1]

[1]Oklahoma State University, [2]Oklahoma State University Center for Health Sciences

Background: Literature has identified functional connectivity (FC) between the frontoparietal network (FPN) and reward-related regions (e.g., caudate) and between the FPN and amygdala as important in emotion regulation (ER) during adolescence. Maladaptive ER strategies (e.g., expressive suppression, the restriction of emotions) have been linked to psychopathology. Subcortical structures that are responsible for emotions, reward processing, and executive control develop and mature at varying rates throughout adolescence, which plays critical role in emerging adolescent psychopathology. While previous research has identified bidirectional relationships between brain activity, ER, and psychopathology, the literature is limited on whether ER may mediate these relationships during adolescence. This study examined the role of expressive suppression as a mediator of FC in subcortical structures responsible for emotions, reward processing, and executive control predicting psychopathology. We hypothesized that 1) FC between the FPN and reward system and between the FPN and amygdala would predict expressive suppression, 2) expressive suppression would predict externalizing and internalizing symptoms, 3) FC between the FPN and reward system and between the FPN and amygdala would predict externalizing and internalizing symptoms, and that 4) expressive suppression would mediate the relationships between FC of the FPN and reward system predicting internalizing and externalizing symptoms and the relationships between FC of the FPN and amygdala predicting internalizing and externalizing symptoms.
Methods: Using the Adolescent Brain Cognitive DevelopmentSM (ABCD) Study (release 5.1; pending release of 6.0 with full Year 4 sample), we conducted mediation analyses in a stepwise manner. Participants with a T-score less than 65 on internalizing and externalizing symptoms on the Brief Problem Monitor (BPM) at Year 3 (youth ages 12-13, Y3) were included to assess the development of mental health symptoms over time. Values for rsFC between FPN and the reward system (i.e. average of the NAcc, caudate, pallidum, and putamen) and between FPN and amygdala were averaged across the right and left hemispheres at Year 2 (youth ages 11-12; Y2). The expressive suppression items in the Emotion Regulation Questionnaire were averaged at Y3. Raw symptom scores for internalizing and externalizing scales on BPM at Year 4 (youth ages 13-14; Y4) were used to capture emergent psychopathology. The models assessed direct effects of rsFC at Y2 with expressive suppression at Y3 (hypothesis 1), suppression at Y3 with externalizing and internalizing symptoms at Y4 (hypothesis 2), and rsFC at Y2 with externalizing and internalizing symptoms at Y4 (hypothesis 3). Sex, age, ethnicity, family income, parent education, family ID and scanner ID were entered in models as covariates.
Results: There were no significant mediation models (all ps > .05). rsFC between the FPN and reward-related regions (b=0.01, SE=0.07, p=.89) and between the FPN and amygdala (b=-0.02, SE=0.03, p=.59) did not predict expressive suppression. Expressive suppression was predicted with externalizing symptoms (b=0.21, SE=0.04, p < .001) and internalizing symptoms (b = 0.23, SE=0.05, p < .001). Sex was a significant covariate, so an exploratory analysis examining sex differences across all models was conducted. For females only, expressive suppression predicted internalizing symptoms (b=0.38, SE=0.08, p < .001), and rsFC between the FPN and reward-related regions predicted externalizing symptoms (b=5.07, SE=2.43, p < .05).
Discussion: This study provides insight into the sex differences among the susceptibility of developing symptoms of psychopathology based on ER strategies. Considering increasing rates of psychopathology in adolescents, future research efforts should aim to further examine to examine sex differences in the role of ER strategies on mental health.

S5. A LONGITUDINAL STUDY OF CANNABIS USE AND DEFAULT MODE NETWORK RESTING-STATE FUNCTIONAL CONNECTIVITY IN ADOLESCENTS

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Background: Cannabis use in late adolescents and adults has been linked with weaker default mode network (DMN) resting-state functional connectivity (RSFC). Cross-sectional studies have demonstrated that cannabis users show weaker RSFC between nodes of the DMN compared to non-users and that these changes persist even after a month of abstinence from cannabis. However, the use of cross-sectional designs in previous studies precludes any causal inferences. Furthermore, the analyses conducted were not designed to distinguish whether the observed differences in RSFC were related to within-person changes or to stable trait-like differences in cannabis use.
Methods: To address these gaps, RSFC and cannabis use data (frequency of use with the Detection of Alcohol and Drug Problems in Adolescents) collected at three timepoints (baseline, 24, and 48 months) during a five-year longitudinal study, Neuroventure, in a sample of 150 adolescents (aged 12-14 at entry; female=82) will be used to model the development of RSFC in the DMN and the impact of cannabis use across adolescence. Latent growth models will be employed to model the relationship between change in cannabis use and change within in mean DMN RSFC as well as in specific region of interest pairings of ten ROIs selected to be consistent with regions demonstrated to belong to the DMN in the literature. Once growth trajectory is established, temporal precedence will be explored using a random-intercept cross lagged panel model to separate the between- from the cross-lagged within-subjects relationships. Data collection and preprocessing of the functional MRI data has been completed. Mean network RSFC scores as well as ROI to ROI connectivity scores have been computed. Analyses are underway and will be completed by Flux.
Results: A preliminary growth model with latent growth factors for mean RSFC and cannabis use as a time varying covariate indicates that mean RSFC increases across adolescence (b=0.011, p=0.034).
Discussion: The planned analyses will clarify the relationships between cannabis use and these changes in DMN RSFC across adolescence.

S6. ABCD FUNCTIONAL TOPOGRAPHY SHOWS MINIMAL SNP HERITABILITY

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Background: Recent studies have uncovered individual variation in functional topography across functional brain networks. While such variation is associated with clinically relevant outcomes like ADHD and depression, the genetic and environmental sources of this variation remain unknown. Disentangling genetic and environmental influences on brain development is critical for discovering plausible biological causal mechanisms of mental health to facilitate the development of genetic prediction models for these traits. Doing so requires mapping genetic sources of variation, such as single nucleotide polymorphisms, to brain functional and structural measures (e.g. functional connectivity, brain volume, or task activation), such that mechanisms between

genetics and brain functional/structural organization are elucidated. Prior research on brain heritability have focused on twin studies, but such studies often suffer from a "heritability gap" compared to biological estimates of heritability, such as single nucleotide polymorphism (SNP). Here, we examined SNP heritability of individual functional topography in the Adolescent Brain Cognitive Development (ABCD) study dataset. We use a novel method-of-moments approach, adjusted heritability (adjHE) to estimate heritability while adjusting for nested complex effects, such as site and socio-demographic factors. We compare these estimates with estimates of subcortical volume heritability, in order to provide a known reference.

Methods: ABCD (N~6,000) imaging data were derived from the ABCD-BIDS Community Collection for baseline sessions using the ABCD 2.0 release. Per participant, probabilistic maps from ABCD-BIDS processed data were generated using a template matching approach. Functional topography was estimated as surface area, which was calculated per network. Structural hippocampal and cerebellar volume were derived from the freesurfer-5.3.0-HCP derivatives. ABCD genomic data were derived from a smokescreen assay, typically used for addiction research. Genomic data were processed using a standardized genomic pipeline, and SNP variations were imputed across the genome using the Michigan Imputation Server. SNP heritability was estimated using AdjHE as well as the gold standard GCTA approach for functional topography (i.e. every network's surface area) as well as for brain volume measures.

Results: We found significant heritability for cerebellar (h2 = 60%) and hippocampal (h2 = 50%) brain volumes. This finding is consistent with prior results from UK Biobank and replicates estimates from prior twin studies. By way of comparison, heritability for functional topography was minimal. Most networks converged towards zero heritability, with only sensorimotor lateral (SML; h2 = 5%), sensorimotor dorsal (SMD; h2 = 3%), and Visual (Vis; h2 = 1%) networks converging on any heritability estimate. This substantially differs from twin estimations in large samples like HCP (N~1,000), which show substantially larger estimates (h2 > 50% heritability).

Discussion: Taken together, the results suggest little "heritability gap" for structural volumes and a large "heritability gap" between SNP and twin estimates of functional topography. Several factors can account for this gap mechanistically. Twin heritability overestimate the true heritability due to incorrect modeling of genetics and shared environmental effects; SNP heritability estimate may represent a more accurate value. More interestingly, twin estimates incorporate interacting effects of epistasis and epigenetics, where the environment can interact with biology and heritability may be less tractable, i.e. linked to the genome. In addition, SNP variation is but one measure of genome-wide additive variability, and ignores higher-order gene-gene interactions, or effects of other biological factors, such as copy number variants (CNV) or gene expression patterns. Future studies should expand on genomic and twin studies to further elucidate underlying biological mechanisms for mental health.

S7. FUNCTIONAL CONNECTIVITY PATTERNS OF CAUDAL AND ROSTRAL RED NUCLEUS DERIVED FROM HIGH FIELD FMRI DATA

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Background: In humans and other primates, the red nucleus (a subcortical region of the brain which is caudal to the thalamus and is involved in movement) is divided into the caudal/magnocellular red nucleus (mRN) and the rostral/parvocellular red nucleus (pRN) based on both cell type distribution and structural connectivity. While these substructures have defined roles in quadrupedal animals, their functional roles in humans are not well studied. Interestingly, it has been found that the mRN is more structurally prominent in the fetal and neonatal brain while the pRN is more structurally prominent in the adult brain. The reasons for this difference are unknown.
Because the entire RN has an average diameter of only 5 mm in adults, it is difficult to study in a functional capacity. However, the advent of high field (7T) fMRI allows for this structure to be functionally imaged with a much higher signal-to-noise ratio than ever before. It also can be used to find functional connectivity patterns between the rest of the brain and the pRN or mRN, none of which have yet to be characterized. Unsupervised clustering techniques allow for characterization of these regions based solely on their functional connectivity patterns with a reduced possibility of human bias and are better able to account for individual differences in RN topography than most other techniques.

Methods: 80 minutes of high field (7T) fMRI data were collected within a single adult participant (tr=1.75, voxel size=1.6mm3) and were preprocessed using the pipelines fMRIprep (version 23.2.2) and XCP-D (version 0.5.2). Dense connectivity matrices were calculated between 91,282 vertices using only low motion data (FD < 0.2). Manual structural parcellations of the red nucleus were used as the region of interest (ROI) for future analyses. Sub-clustering within both the left and right red nucleus was performed using k-means clustering based on functional connectivity/correlations with the rest of the brain. A seed map analysis was performed on each identified cluster to characterize functional connectivity between the cluster and the rest of the brain.

Results: At k=4, the clusters that emerged were consistent with the left pRN, the right pRN, the left mRN, and the right mRN. All voxels in each cluster were contiguous with each other. Each subcluster qualitatively resembled its opposite hemisphere counterpart. Notably, both left and right pRN had stronger functional connectivity to the cortex than left or right mRN. This is consistent with the literature which finds that the pRN receives more afferent projections from the cerebral cortex than the mRN in non-human primates.

Discussion: This research validates the use of unsupervised clustering algorithms in the RN. However, the larger benefit is being able to analyze functional connectivity of the pRN and mRN. This has the potential to provide insights as to why the mRN is more prominent in infancy while the pRN is more prominent in adulthood.

S8. HIGHER-ORDER VISUAL AREAS SHOW AGE-RELATED DECREASED CONNECTIVITY WITH PREFRONTAL AND SENSORY-MOTOR REGIONS IN CHILDREN WITH AUTISM

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Background: Prominent theories of autism suggest autism-associated differences in visual-motor integration (VMI) may disrupt learning of motor and social skills typically acquired by observation and imitation. Supporting these theories, children with autism spectrum disorder (ASD) show robust differences in motor tasks reliant upon dynamic VMI (e.g., ball-catching and motor imitation) and anomalous visual-motor connectivity between higher-order visual areas (HOVA) and sensory-motor cortices (SMC). Similarly, congenitally blind adults show an altered pattern of decreased HOVA connectivity with non-visual sensory regions of interest (ROIs) (SMC and primary auditory cortex; A1), but a "compensatory" increase in connectivity between HOVA and prefrontal cortex (PFC) areas, relative to sighted adults. In the current study, we hypothesized that children with ASD would show a connectivity pattern similar to blind adults with decreased HOVA-SMC/A1 connectivity but increased HOVA-PFC connectivity, relative to typically developing (TD) children. We further hypothesized that HOVA connectivity would show diagnosis-by-age effects and correlations with Praxis skills, often developed through imitation.
Methods: The sample included 440 children, 139 ASD (24 girls) and 301 TD (95 girls) aged 8-12 years, collected at a single site, the Kennedy Krieger Institute. Praxis was measured using the Florida Apraxia Battery modified for Children. Resting-state fMRI (rs-fMRI) was acquired on a 3T Philips scanner. Participants were included if there was ≥5 minutes of continuous usable data (< 3mm of translation and < 3° of rotation). Seed-based analyses were performed using an in-house pipeline, which included nuisance regression (aCompCor). Inter-regional functional connectivity was assessed between HOVA, A1, SMC, and PFC ROIs as defined in a previous study (Tian et al., 2024). Diagnosis-by-ROI interactions were examined using a multiple linear regression model. Separate multiple linear regression models were applied to each ROI to examine diagnosis and diagnosis-by-age interaction effects. Handedness, IQ (GAI), sex, and head coil were included as covariates in the model.
Results: No diagnosis-by-ROI effect (HOVA-PFC vs. HOVA-SMC/A1) effect was observed (both $p=0.97$). For individual ROIs, significant diagnosis-by-age interactions were observed for HOVA-PFC ($p=0.02$), such that connectivity decreases with age for TD but increases with age for ASD. A significant diagnosis-by-age effect was also observed for HOVA-SMC FC ($p=0.02$) with a trend-level interaction effect for HOVA-A1 FC ($p=0.05$). Further, relative to TD, children with ASD showed decreased HOVA FC for all ROIs (ASD < TD, all $p\leq0.05$). Because HOVA FC differences were similar across ROIs, an average HOVA connectivity score was calculated (mean HOVA FC) to examine correlations with VMI tasks. Associations with Praxis revealed a significant diagnosis-by-mean HOVA FC interaction for Praxis percent total correct ($p=0.03$), where increased mean HOVA FC was associated with better praxis for ASD, but worse praxis for TD.
Discussion: Our findings suggest diagnostic group differences in HOVA FC with prefrontal and non-visual sensory ROIs. Our stated hypothesis of greater HOVA-PFC FC than HOVA-A1/SMC for ASD, relative to TD children was not supported. However, we observed a pattern of HOVA FC that increased with age in ASD but decreased with age for TD. Differences in HOVA FC correlated with praxis, such that decreased HOVA FC was correlated with worse praxis scores in ASD, but better praxis scores in TD.

S9. EFFECTS OF FAMILY RESOURCES ON AMYGDALA RESTING-STATE FUNCTIONAL CONNECTIVITY AND YOUTH EMOTIONAL AND COGNITIVE ADJUSTMENT IN EARLY CHILDHOOD

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Background: Developmental neuroscience models have emphasized the role of frontal limbic circuitries in early socioemotional regulation for children (Banks et al., 2007). Socioeconomic stressors, such as household poverty or neighborhood disadvantage, have been found to negatively affect the development of frontal limbic resting-state functional connectivity (rs-FC) networks, which support positive emotion regulation (Ramphal et al., 2020; Ip et al., 2022). Given the significant effects socioeconomic adversity may have on neural networks in early childhood, identifying protective factors, such as family support and access to resources, can inform strength-based approaches to early identification and intervention (DeJoseph et al., 2024).

Methods: The present study will examine how resting state functional connectivity between the amygdala and frontal regions is associated with internalizing and externalizing symptoms. We will also examine whether sources of family social support (Family Support Scale; Dunst et al., 1986) may serve as a protective factor, supporting the relationship between brain function and youth functioning. Our sample consists of 59 youth ages 3 to 8 (Mage =5.24, SDage=1.08) from diverse racial/ethnic (47% non-White) and socioeconomic backgrounds. Youth completed resting-state functional magnetic resonance imaging (rsfMRI) scans while watching a movie of their choice. Data quality was assessed using Framewise Integrated Real-time MRI Monitoring (FIRMM) software. The amygdala was used as a seed region for rs-FC analyses, given associations with socioeconomic factors and risk for psychopathology (Merz et al., 2018). Functional connectivity between the amygdala and 11 frontal-limbic areas were used as our regions of interest. Parents completed the Behavior Assessment System for Children (BASC-3; Reynolds, 2010) to report on youth internalizing and externalizing behaviors. Child gender, age, and family income-to-needs ratio were included as covariates in all models.

Results: We found that increased family support was significantly associated with decreased rates of internalizing problems (B= -.57, p=.008). Family support was not significantly associated with youth externalizing symptoms. Additionally, in support of our hypotheses, we found that higher reports of family support were related to increased rs-FC in frontal limbic regions such as the lateral orbitofrontal (B= .0007, p= .02) and medial orbitofrontal (B= .0008, p= .03), controlling for household income. Related to youth psychopathology, we found increased rs-FC between the amygdala-hippocampus was significantly associated with increased internalizing problems (B= 184.25, p= .01). Decreased rs-FC between the rostral middle frontal-amygdala was related to increased internalizing symptoms (B= -202.55, p= .02).

Discussion: Taken together, the results of the present study highlight the importance of considering sources of socioeconomic and familial support, not just adversity, when examining patterns of neural functioning in early childhood. We found that sources of support were more robustly associated with child brain and socioemotional development, than looking at family income alone. Sources of social support (i.e., extended family members, close friendships, community connections) play an important role in shaping frontal limbic connections, which underlie emotion processing and regulation, potentially protecting against risk for internalizing mental health problems. These findings contribute to a growing body of literature seeking to understand associations between socioeconomic factors, neural correlates of emotion regulation, and risk for psychopathology during an important developmental period.

S10. ALTERATIONS OF WHITE MATTER CONNECTIONS WITHIN VISUAL CORTEX IN CHILDREN WITH NEUROFIBROMATOSIS TYPE 1 AND READING DISABILITIES: A CONNECTOME-WIDE STUDY

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Background: Children with Neurofibromatosis Type 1 (NF1) and reading disabilities (RD) have shared cognitive profiles with children with idiopathic reading disabilities (IRD). It is not clear whether the neural mechanisms supporting reading processes differ between children with NF+RD and IRD. While phonological deficits are observed in both NF+RD and IRD, visuospatial deficits appear to be specific to NF+RD (Cutting et al., 2010). Examining brain regions known to support language/reading and visuospatial processing in both NF+RD and IRD may provide insights as to the nature of deficits in each RD group at the neural level. While altered white matter connections within those regions have been reported in the IRD population, comparisons between NF+RD and IRD on their white matter connections have not been explored yet. Therefore, the current study investigated the structure of whole-brain white matter connectomes in NF+RD, IRD, and typically developing controls in regions that support language/reading and visuospatial processes.
Methods: A total of 78 children between 8 to 19 years of age were included in this study and grouped as NF+RD (N = 28), IRD (N = 20), and age-matched control (N = 30). Following whole-brain tractography based on diffusion weighted images, each participant's whole-brain connectome was constructed using the Automated Anatomical Labeling template for cortical parcellation. Connections between any pair of parcels were weighted as the number of streamlines normalized by the total volume of the two parcels. Functional segregation measures, including clustering coefficient (CC) and local efficiency (LE), were calculated for the visual and auditory area, respectively. Communication efficiency from visual area to auditory area and reading network regions was evaluated based on two communication models: navigation and diffusion. Mixed ANOVA analyses were conducted to examine differences in those network measures across the three groups, with hemisphere as a within-subject variable. Age and sex were included as covariates in each AVOVA.
Results: For the functional segregation measures (CC and LE), a group-by-hemisphere interaction was significant in the visual area. Post-hoc analyses revealed that functional segregation measures were lower in the NF+RD group than the control group. In addition, a significant group effect was found in the auditory area. Post-hoc analyses revealed that both NF+RD and IRD groups were lower on the two measures than the control group in the auditory area. Regarding communication efficiency, when applying the navigation model, a significant group effect showed less effective communication from visual area to auditory area and reading network in NF+RD than IRD and control groups. Communication efficiency following the diffusion model presented no group effect.
Discussion: The present study revealed specific alterations of white matter connections in visual brain regions in the NF+RD group, while both NF+RD and IRD showed alterations in the auditory area. These findings are consistent with behavioral observations. Further, less effective communication between the visual area and other systems, including the auditory area and the entire reading network in the NF+RD group, indicated that the alterations within the visual area may be linked to altered functions in other reading-related areas. Overall, these findings suggest distinct neural mechanisms for reading difficulties in NF+RD as compared to IRD that mirror behavioral patterns, and there should be distinct intervention plans for NF+RD and IRD.

S11. PRELIMINARY ASSOCIATIONS BETWEEN KNOWN RISK FACTORS FOR SUBSTANCE ABUSE AND A NEUROMARKER OF PROBLEM CANNABIS USE

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Background: Cannabis use is extremely common and associated with clinically significant negative outcomes for a subset of users, yet risk factors for problem-level use and related harms remain poorly understood. Elucidating brain-based risk factors for problem cannabis use can facilitate the development of targeted prevention and early intervention approaches. Using a data-driven, whole-brain, machine-learning approach, connectome-based predictive modelling, we recently identified a neuromarker of problem-level cannabis use in a non-clinical sample of college students (N=191), i.e., the problem cannabis use network, which was found to predict addiction severity and treatment outcome in an independent clinical sample of individuals entering treatment for cannabis use disorder (N=33). Here, we aim to investigate how this neuromarker relates to other known risk factors for addiction prior to cannabis use onset using baseline data from the Adolescent Brain Cognitive Development (ABCD) study.

Methods: Problem cannabis network strength was extracted from functional connectivity matrices computed using a 268-node whole brain atlas from ABCD baseline monetary incentive delay (MID) task data. Participants were included in the current analyses for whom usable neuroimaging data was available (N=5,270, with framewise displacement less than .15mm, symmetrical matrices, no missing nodes, outliers excluded). Spearman correlations were used to examine associations between network strength and impulsivity (UPPS, BIS/BAS) and internalizing and externalizing symptomatology (CBCL). T-tests were used to assess whether network strength varied based on parental history of alcohol and drug abuse.

Results: Stronger problem cannabis network strength was associated with higher impulsivity (UPPS Lack of Planning rho=0.04, p=0.005), as well as increased internalizing (rho=0.03, p=.016) and externalizing (rho=0.03, p=.022). Network strength did not differ significantly between individuals with and without a parental history of alcohol or substance use problems. There was also no significant correlation between network strength and other impulsivity subscales of UPPS.

Discussion: These preliminary results suggest that the strength of the problem cannabis network relates to other known risk factors for substance use, even early in adolescence, prior to cannabis use onset. Future analyses will explore whether these associations will increase in magnitude at later time points as more psychiatric symptoms and substance use emerge, as well as examine how problem cannabis network strength develops over time among ABCD participants who go on to use cannabis relative to those who do not. If this network is found to distinguish those who go on to develop cannabis use problems, it may be a viable target for novel prevention and intervention initiatives to mitigate cannabis-related harms for individuals at high risk.

S12. CHARACTERIZING INTER-INDIVIDUAL DIFFERENCES OF THE SOMATO-COGNITIVE ACTION NETWORK (SCAN) IN CHILDREN USING PRECISION FUNCTIONAL MAPPING

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Background: The accurate characterization of individuals' functional brain network organization is important for understanding individual differences in behavior and cognition, how these individual differences develop, and how they deviate from typical development in clinical populations. Precision functional mapping (PFM) - the dense sampling of individuals with hours of fMRI data - allows for highly accurate and reliable measures of functional connectivity and the characterization of inter-individual differences in functional networks. Recent work using PFM data has identified nodes with distinct connectivity that interrupt effector-specific locations in primary somatomotor regions of the brain, named the somato-cognitive action network (SCAN). The discovery of the SCAN has improved our understanding of how the brain integrates motor control with action planning and goal-directed movement. While this work included PFM data from one child, a more thorough characterization of inter-individual differences and similarities of the SCAN in children has not yet been reported.
Methods: The current work identifies the SCAN in a PFM dataset of 12 children (one child from the previously published work) between the ages of 8 and 11 years old (M=9.9 years). Each child in the dataset had between 1 to 5.5 hours (M=3 hours) of fully processed resting state fMRI data after motion censoring at .2mm framewise displacement (FD).
Results: We show inter-individual differences of the spatial location and within-network functional connectivity of the SCAN in this set of children. Probabilistic maps (along with PFM-created cortical parcels) demonstrate core regions of the SCAN with high consistency across children. Investigating functional connectivity between the SCAN and other cortical functional networks demonstrated strong connectivity with the cingulo-opercular/action-mode network (CON/AMN) - a network involved in goal oriented cognitive control - in all children, but with substantial inter-individual variability. Further, we demonstrate that previously reported subcortical integration zones (subregions within subcortex where multiple functional networks converge) are also functionally connected to the SCAN. Finally, we discuss potential clinical applications where identifying individual-specific localization of the SCAN may lead to non-invasive clinical applications (such as cortical target sites for transcranial magnetic stimulation).
Discussion: Through a better characterization of individual differences in the makeup and functional connectivity of the SCAN in children, this work has the potential to translate to neurodevelopmental disorders that involve the interaction of motor and cognitive control networks, such as Tourette syndrome and tic disorders.

S13. EXPLORING ADOLESCENT BRAIN NETWORK DYNAMICS USING GRAPH THEORY MEASURES

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Background: Adolescence marks a critical period of brain maturation, with significant changes occurring in networks associated with cognitive control and reward processing. However, the precise developmental trajectories of these networks and their relationship to substance use remain poorly understood. To address this gap, we utilize data from the Neuro Venture Trial, a

longitudinal neuroimaging study involving 150 adolescents. The data was collected over 3 time points at (12, 15 and 18 years of mean age).

Methods: Resting state functional connectivity measures were derived after pre-processing the time series data in fmriprep. Nilearn package was used to derive standardized correlation scores (Fishers exact Z-scores) of ROI couples based on the 300 ROI network based Seitzman atlas Parcellation. The seitzman atlas provides functionally derived cortical and sub-cortical network parcellations like the default mode, salience, reward, visual, attention, fronto-parietal, auditory, singulo-oppercular, somatomotor, ventral attention, medial- temporal and parieto medial functional networks. Participation coefficient, a graph theory measure which captures the nuances of network interaction was computed using the BCTPy toolbox. The participation coefficient of a node measures the extent to which it is connected to nodes in other networks, beyond its own network. It gives us an opportunity to understand the modularity and integration of brain networks through development.

Results: Linear mixed-effects model analysis was run to examine the effects of time and networks on participation coefficient scores for the 13 functionally parcellated networks. The model included a fixed effect for time, networks and their interaction, as well as subject-specific random intercepts to account for individual variability. The analysis yielded significant main effects for both time ($F(1, 5073.8) = 29.5021$, $p < 0.001$) and network ($F(12, 4950.7) = 24.4239$, $p < 0.001$), indicating that both factors have a significant impact on Participation coefficient scores. Additionally, a significant interaction effect between time and network was observed ($F(12, 4950.7) = 6.7729$, $p < 0.001$), suggesting that age related changes in participation coefficient scores varies depending on the specific network. We saw trajectories of network either decreasing in participation coefficient (reward, fronto-parietal, medial temporal), or having no change (default-mode, auditory, visual, dorsal attention) in their participation coefficients.

Discussion: The heterogeneity observed in adolescent brain networks reflects the complex interplay between modularity and interestedness as the brain matures. Some networks exhibited higher modularity like the reward network, indicating a more segregated organization, while others showed no significant changes. This heterogeneity underscores the dynamic nature of brain development and highlights the diversity of developmental trajectories across different brain networks.

S14. THE IMPACT OF SOCIOECONOMIC HARDSHIP ON SUICIDAL-RELATED RISK VIA SLEEP DURATION: THE MODERATING ROLE OF THE DEFAULT MODE NETWORK

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Background: Adolescent suicide rates are globally on the rise, with suicide as the second leading cause of death among this age group. Socioeconomic hardship (SES-H) is a psychosocial stressor that is linked to suicidal-related risk in youth. However, the underlying behavioral and neurobiological mechanisms are less clear. In this project, we test the hypothesis that sleep health, a critical bio-regulatory process that facilitates neural restoration and growth, mediates this association. In addition, we test how individual differences in resting-state functional connectivity in the Default Mode Network (rs-FC DMN) may moderate the risk link between SES-H and

suicidal ideation via sleep duration. Our study focuses on the within-DMN connectivity, given that DMN plays a crucial role in self-referential thinking and future planning and has been strongly linked to depression and suicidal ideation (Guàrdia-Olmos et al., 2022; Malhi et al., 2020).

Methods: Hypotheses were tested in Mplus using data from the Adolescent Brain Cognitive Development study, an ongoing and multi-site longitudinal study (47.8% female; Mage at baseline= 10.1). The sample's racial-ethnic composition was 52.0% European American, 15.0% African American, 20.3% Latino(a), 2.1% Asian/Pacific Islander, and 10.5% Other. SES-H at baseline was measured using a latent factor to capture the multi-dimensional nature, including caregivers' marital status, employment status, education level, family material deprivation, income-to-poverty ratio, and neighborhood area deprivation index. All neuroimaging data were pre-processed at baseline. A higher score means a higher average correlation across all regions within the DMN network and, thus, higher within-rsFC DMN. The parent reported the child's sleep duration at a one-year follow-up. Suicidal ideation was cumulatively measured using the Youth Diagnostic Interview for DSM-5 at one-year and two-year follow-ups. Covariates, including youth age, race, sex and movement in the scanner, sleep duration, and suicidal ideation at baseline, were controlled in all analyses. Multi-level modeling was used to account for the clustering effects of participants within families. Additionally, propensity weights were employed to mitigate potential selection bias in the ABCD sampling and recruitment process. A Johnson-Neyman plot was generated to probe the significant interaction effect.

Results: Our results showed that the latent construct of SES-H at baseline had a great model fit, and all factor loadings were significant. SES-H significantly predicted shorter sleep duration (β= .23, $p < .001$). SES-H ($\beta = .14$, $p < .01$) and shorter sleep duration ($\beta = .04$, $p < .05$) significantly directly predicted higher suicidal ideation. The mediation analyses suggested that shorter sleep duration mediated the association between SES-H and suicidal ideation. In addition, the indirect effect of SES-H on suicidal ideation via shorter sleep duration, conditional on within-DMN rsFC, was significant. Specifically, the interaction between SES-H and within-DMN rsFC significantly predicted sleep duration ($\beta = -.03$, $p < .05$) and suicidal ideation ($\beta = -.03$, $p < .05$). Accordingly, for participants with increased levels of within-DMN rsFC (97.5% of participants), the effect of SES-H on shorter sleep duration was decreased. These results suggested that the increased within-DMN rsFC was a protective factor and buffered the risk link of SES-H on suicidal ideation via shorter sleep duration.

Discussion: Our study provides valuable insights into the neurobiological mechanism that underpins the link between SES-H and suicidal risk, as well as the protective role of DMN connectivity. Such knowledge will inform preventive and intervention programs that aim to reduce suicidal-related risk during adolescence and later in adulthood, particularly for individuals who have been exposed to socioeconomic disadvantages.

S15. THE ASSOCIATION BETWEEN ADRENARCHE TIMING AND EMOTIONAL BRAIN FUNCTION IN PREADOLESCENTS FROM THE ADOLESCENT BRAIN COGNITIVE DEVELOPMENT STUDY®

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Background: Puberty is a period of substantial development, including hormonal changes and massive reorganization of brain circuits supporting emotion regulation. Mental and behavioral disorders have been known to be characterized by negative emotion dysregulation and reactivity, which increase in prevalence with the passage through puberty. Yet, the first symptoms for many children emerge between seven and 11 years, before the pubertal rise in gonadal hormones. However, neuroscience research to date has mainly focused on gonadarche, the later phase of puberty associated with increases in sex steroid hormones. In comparison, the possibility that brain function relating to negative emotional dysregulation and/or reactivity may be linked to the adrenarche rise in androgens has been little explored. This line of research will significantly enhance our understanding of how pubertal development is linked to dysregulated emotion disorders.

Objective: the current study examined the concurrent associations between the the adrenarche timing, as indexed by DHEA levels controlling for age, and negative emotional reactivity in the amygdala and hippocampus during emotional n-back task, and intrinsic resting-state connectivity between the fronto-parietal network and amygdala, implicated in emotion regulation using the Adolescent Brain Cognitive Development Study®, Data Release 4.0. (ages 9 to 10 years old). It is expected that the more advanced adrenarche timing, as evidenced by higher DHEA levels, would be associated with greater brain activities in the amygdala and hippocampus during negative emotion processing, while those hormone levels may be associated with reduced connections between fronto-parietal network and amygdala, implicating emotion dysregulation.

Methods: Analyses used baseline sample data from the ABCD study, a longitudinal study of children aged 9-10 years from 22 sites across the United States. Data were obtained from the NIMH Data Achieve, Curated Annual Release 4.0. According to several recommended inclusion criteria for neuroimaging (i.e., resting-state functional connectivity, fMRI), behavior (i.e., emotional n-back) salivary hormone data (i.e., DHEA), the final data set consisted of n= 554 preadolescents (M±SD: 10.15 years ± 0.46).

Results: Several multiple linear regression analyses revealed that the adrenarche timing (i.e., DHEA level controlling for age) was a significant, concurrent predictor for brain activity in the bilateral amygdala and hippocampus during negative emotion processing while controlling for parental annual income, self-reported pubertal development status, and handedness ($R2 = 0.01$, $p < .01$). Further, the adrenarche timing was a significant, concurrent predictor for reduced resting-state functional connections between the fronto-parietal network and right amygdala, indicating inefficient emotion regulation ($R2 = 0.01$, $p < .01$).

Discussion: These results suggest the advanced adrenarche development is related to greater emotional reactivity but inefficient emotion regulation. Future work should longitudinally assess these associations through adolescence and examine associated emotion regulation behavior and psychopathology.

S16. ASSESSING THE WAYS IN WHICH ADOLESCENT BRAIN CONNECTIVITY DIFFERS ACROSS YOUTH

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Background: Adolescence is a unique period of the lifespan in which brain function continues to be influenced by environmental factors thought to contribute to the emergence of psychopathology. This sensitive period of brain development necessitates a comprehensive understanding of the relative importance of a diverse array of environmental exposures to developing brain function. Using resting-state functional connectivity (RSFC) as a proxy to measure spontaneous brain function, our goal was to employ a data driven approach to determine which factors most strongly account individual differences in brain connectivity across youth and the degree to which this association replicates.
Methods: Data from an independent Discovery (N = 2,316) and Replication (N = 2,263) baseline ABCD Study datasets were utilized. Both datasets included RSFC and participant scores for 649 variables across 12 predefined categories (socioeconomics, screen time, cognitive abilities, demographics, culture/environment, physical health, mental health, social adjustment, substance use, parenting, personality, and medical history). Principal component analysis (PCA) was conducted on the Discovery RSFC data and 416 principal components were extracted, each representing unique (orthogonal) ways in which youth brain function differs across people. The participant scores from each component were correlated with the corresponding dataset's behavioral scores from each of the 649 variables. The Replication RSFC data was projected onto the same 3-dimensional space as the Discovery data and the scores for each extracted principal component were similarly correlated with each of the 649 variables in the replication set.
Results: The first principal component, representing the primary way in which youth brains differ, was most strongly associated with socioeconomic variables. These include measures such as the child opportunity index, and assessments of the child's residential area in terms of population density, crime and poverty rates, income, and educational resources. Furthermore, socioeconomics accounting for the greatest variation in brain function is highly reproducible in the first principal component ($r = 0.903$, $p < 0.001$). Other reproducible ways in which youth brains differed across the first 10 principal components included variables related to screen use ($r = 0.12$, $p < 0.001$) and sleep ($r = 0.104$, $p < 0.001$). Variable rankings across the first 10 principal components were highly reproducible ($r = 0.61$).
Discussion: Socioeconomic variables had the strongest association with the primary way in which youth brains differ, followed by screen use and sleep. Future research is needed, especially longitudinally using ABCD data, to further evaluate the mediating factors linking socioeconomics with brain connectivity over time.

S17. EARLY PARENTING INTERVENTION IN INFANCY CHANGED WHITE MATTER CONNECTIVITY IN ADOLESCENCE: A RANDOMIZED CONTROLLED TRIAL AMONG CHILD PROTECTIVE SERVICES INVOLVED YOUTHS

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Background: A responsive and nurturing caregiving environment is foundational to brain development. The Attachment and Biobehavioral Catch-up (ABC) intervention is a home-visiting, empirically supported parenting intervention implemented during infancy. The ABC intervention

aims to improve responsiveness among parents of vulnerable young children. A previous preliminary study examining the causal effect of the ABC intervention has demonstrated that 10-year-old children whose parents received the ABC intervention in infancy showed increased white matter connectivity compared to a control group. The intervention differences were localized to the left inferior fronto-occipital fasciculus, left inferior longitudinal fasciculus, right superior longitudinal fasciculus, right arcuate fasciculus, and the body of the corpus callosum. These white matter fasciculi provide critical support to communications between brain regions underlying emotional and executive functions. Adolescence is marked by significant myelination processes and previous studies have linked experiences of childhood maltreatment to alterations in white matter connectivity in adolescence; therefore, there is a need to examine whether receiving the ABC intervention in infancy, relative to a control intervention, influenced white matter connectivity in adolescence, extending the causal effects from middle childhood. The purpose of the present follow-up study was to investigate whether the intervention differences observed in middle childhood persisted into adolescence and to provide further evidence for the long-term effects of the ABC intervention on white matter connectivity.

Methods: A total of 101 adolescents participated in this follow-up study, including 69 adolescents whose parents were referred from Child Protective Services (CPS) in infancy and randomized to receive the ABC (N = 37) or a control intervention (N = 32) and 32 comparison adolescents who did not have any CPS involvement history. All participants underwent diffusion MRI scanning at age 14 (M = 14.34, SD = .39). A whole brain connectometry was conducted with fractional anisotropy (FA) as the principal white matter microstructural index. To test intervention differences, we regressed the FA maps on intervention assignment (ABC vs. control) while controlling for CPS involvement history, scanning age, and sex assigned at birth. Significant results were evaluated based on an FDR threshold of .05 after applying 10,000 randomized permutations.

Results: Results showed that adolescents whose parents received the ABC intervention had increased white matter connectivity relative to the control intervention counterparts (FDR = .000031) as indexed by FA. The intervention differences (ABC > control) were localized to segments of the commissure fibers, including the anterior occipital and temporal commissure, the body, tapetum, and forceps major of the corpus callosum. In addition, there were differences observed in segments of the association fibers, including the left and right arcuate fasciculus, the right frontal parahippocampal, frontal-parietal, and paraolfactory cingulum, the right extreme capsule, the left and right inferior frontooccipital fasciculus, the left and right inferior longitudinal fasciculus, the left middle longitudinal fasciculus, and the right superior longitudinal fasciculus. No significant results were found in the ABC < control contrast.

Discussion: We demonstrated causal effects on white matter connectivity approximately 12 years after receiving the ABC intervention. We not only replicated results from a previous preliminary study conducted during middle childhood but also uncovered new patterns of intervention effects specific to adolescence. These findings underscore the significance of improving parenting during infancy in shaping white matter connectivity during adolescence, providing further evidence for the long-term benefits of the ABC intervention.

S18. INTRINSIC FUNCTIONAL NEUROCIRCUITRY OF THE BED NUCLEUS OF THE STRIA TERMINALIS IN EARLY INFANCY

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Background: Anxiety disorders are highly prevalent and are associated with significant impairments in social, academic, and occupational functioning. Cross-species research has identified the bed nucleus of the stria terminalis (BNST) as a critical neural substrate for anxiety phenotypes. In rodents, the BNST has extensive connections to other limbic regions—including the amygdala, hypothalamus, and hippocampus, playing a critical role in sustained fear states and stress responses. Imaging studies in human adults reveal similar anatomical and functional connectivity, as well as integrative and regulatory functions in emotional and stress-related processes. However, we know little about the BNST's development in early human life. To address this gap in the developmental neuroscience of the BNST, we aimed to characterize: 1) BNST circuitry in early infancy and 2) associations between prenatal stress, BNST connectivity, and infant negative affect (an anxiety risk factor).

Methods: We collected approximately 10 minutes of low-motion fMRI data from infants aged ~4 weeks and aimed to map the whole-brain resting-state connectivity of the BNST. Resting-state fMRI data was obtained from 79 infants ages 2.29-6.86 weeks. Data were processed using Nibabies and XCP-D, with a framewise displacement (FD) threshold of 0.2 mm and bandpass filtering 0.01-0.1 Hz. Data from 35 infants were excluded due to excessive motion or < 5 minutes of low-motion data, leaving 44 infants with high quality (mean FD after censoring=0.11 mm) for analysis. The location of the BNST was traced on the 0-2month MNI infant template using the manual protocol developed by Theiss et al. (2017). Participant level seed-to-voxel correlation maps and the group-level analysis (family-wise error rate < .05) were conducted using Nilearn. For aim 2, maternal levels of stress during pregnancy was obtained using the Perceived Stress Scale. infant negative affect was measured at age 6 months using the Infant Behavior Questionnaire-Short Form and minutes of crying from 32 hours of home recordings. Covariates in analyses included sex, infant age at scan, maternal age, and FD.

Results: We found significant connectivity between the BNST and bilateral amygdala (extent=325 voxels, peak location=[58, 72, 30], FWER $p < .05$). Greater maternal stress in pregnancy was associated with lower BNST–amygdala connectivity in infants (β=-0.48, 95%CI[-0.85, -0.11], p=.013). Higher BNST–amygdala connectivity was associated with less 6-month infant crying (β=-0.38 95%CI[-0.74, -0.02], p=.041), but not associated with 6-month parent-reported negative affectivity (β=-0.02 95%CI[-0.39, 0.43], p=.920).

Discussion: We found evidence, for the first time, that functional connectivity between the BNST and amygdala is present in early infancy. Our exploratory analyses indicated a potential link between prenatal perceived stress and BNST–amygdala connectivity, and suggests BNST–amygdala connectivity may be relevant for negative affect in later infancy.

S19. MACHINE LEARNING TO PREDICT THERAPY ENGAGEMENT IN YOUNG CHILDREN USING FNIRS

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Background: Artificial Intelligence (AI) has penetrated many sub disciplines of mental health research, from neuroimaging to diagnostic accuracy. While a variety of studies and softwares have

shown beneficial results, there remains a paucity of AI applications to early childhood populations. A lack of comprehensive treatment routing criteria and accessible resources in early childhood has prevented approximately half of children who suffer from a mental health disorder from receiving needed treatment. There is hence enormous potential for AI to efficiently process multimodal data and provide concise analyses to address early childhood underdiagnosis and undertreatment. In combination with the emergence of fNIRS as a portable and non-invasive alternative to expensive neuroimaging techniques, AI could help provide personalized insights to clinicians on mental health diagnoses and treatment routing from a child's brain scan during a short therapeutic-based task.

Methods: The current study explores the possibility of this precision-based model by first determining if AI algorithms can accurately classify fNIRS activation patterns of a child engaging in a therapy-like activity, versus an interpersonal non-therapeutic control condition. Children (N = 95) were randomly assigned to a coloring task that prompted emotion-related thoughts and speech, designed to mimic a therapy-like interaction, or a control condition that consisted of a similar coloring activity but without emotion-related prompts.

Results: Multiple machine learning models accurately classified whether a given child was engaging in a psychotherapy task from their in-vivo neural activity with AUC scores from 0.93 - 0.98. Feature importance of the models revealed higher variability of lateral prefrontal cortex activity in children who were instructed to think about and articulate angry emotions in the therapy-like task.

Discussion: This study demonstrated the ability for simple machine learning models to capture distinct neural correlates of emotion-related thoughts and predict therapy engagement from a short brain scan. Leveraging fNIRS and AI for real-time therapeutic interactions has the potential to elucidate emotion regulation abilities in children and develop a more personalized, neuroscience-informed approach to clinical intakes, therapy routing and treatment response monitoring.

S20. DIFFUSION-WEIGHTED IMAGING SENSORIMOTOR DIFFERENCES IN CHILDREN WITH PRENATAL ALCOHOL AND TOBACCO EXPOSURE

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Background: The human nervous system is designed to process and integrate multisensory inputs efficiently to promote the development of self-regulation and motor skills. During development of the sensory receptors and their associated sensory processing networks in utero, there are critical periods where exposure to neurotoxins such as alcohol and/or tobacco have the potential to significantly impact their development. While it is well established that impaired learning and attention, emotional regulation, fine and gross motor skills, and hyperactivity are associated with prenatal alcohol exposure (PAE), the link between disrupted sensory processing networks and its impact on these cognitive and behavioral deficits is less well known. Here, we will describe changes in white matter networks of sensorimotor integration in children with PAE and/or prenatal tobacco exposure (PTE) in utero using multimodal neuroimaging and clinical assessments of sensory and motor functions.

Methods: The data reported comes from a subsample of the approximately 6,000 South African children whose mothers reported on drinking behavior during pregnancy as part of the Prenatal Alcohol, SIDS and Stillbirth (PASS) Network. In this subsample, 332 PASS participants aged 8-12 years at enrollment, participated in multimodal neuroimaging and assessment of cognitive and sensory functions. Additionally, early life experience was assessed for maternal (i.e., age, nutrition, parity, mental health, co-substance use, stress) and environmental (i.e., primary measures of socioeconomic status (SES), access to resources) risk factors, measured during childhood/adolescence. Analyses involved the main effects of PAE and PTE on mean tract volume, tract density, and fractional anisotropy of various thalamocortical sensorimotor networks.
Results: After false-discovery rate (FDR) correction, PAE was associated with disruptions in mean FA in projections from the thalamus to parietal lobes, decreased track volume from the thalamus to the posterior cingulate cortex (pcc), and decreased track density in projections from the thalamus to the somatosensory cortex. PTE was associated with decreased track volume from the thalamus to the dorsal medial prefrontal cortex (dmPFC). There were no PAE x PTE interactions that survived FDR correction.
Discussion: PAE was associated with disruptions in the white matter tracts responsible for shuttling sensory data from the thalamus to the parietal lobe, specifically the somatosensory cortex. This is an area where initial mapping of the body occurs and faulty sensory data could lead to altered body maps, altered sense of self, and a poor basis to develop complex motor plans. Additionally, PAE impacted the development of the PCC, which contains several cognitive functions including memory and spatial processing. Finally, PTE lead to decreased development of the dmPFC, where the development of the sense of self and emotion regulation is thought to reside. Together, these findings suggest that PAE and PTE alter developing sensorimotor networks that might contribute to the impaired fine and gross motor development noted in children with PAE.

S21. MILD VIDEOGAMING IS ASSOCIATED WITH ENHANCED COGNITIVE PERFORMANCE AND MENTAL HEALTH IN CHILDREN.

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Background: It is estimated that by the end of 2023 there will be over three billion active videogamers (VGs) worldwide. According to a recent American Psychological Association survey, more than 90% of children in the U.S. play videogames, a significant increase from an estimated 70% of children VGs in 2013, when the American Academy of Pediatrics (AAP) recommended limiting entertainment screen-use to < 2h/day (AAP, 2013). While prior research links videogaming with adverse cognitive, behavioral and mental health outcomes in children, these studies were conducted in relatively small datasets, limiting their power to investigate videogaming exposure hours including the specific < 2h/day AAP recommendation. We have recently shown, using the large Adolescent Brain Cognitive Development (ABCD) study® dataset, that videogaming for ≥3h/day is associated with enhanced cognitive performance in children but also higher attention problems, depression, and attention-deficit/hyperactivity disorder scores, albeit well below clinical thresholds, compared to non-videogamers (NVGs). To investigate these effects in children who spend less time videogaming, we compared mental health and cognitive

measures as well as BOLD signal during a working memory N-Back fMRI task in the ABCD Study, defining samples of 9- and 10-year-old children who play < 1h/day, 1-2h/day, 2-3h/day and ≥3h/day and NVGs (0h/day).

Methods: Participants completed a screen time survey asking how much time they "Play video games on a computer, console, phone or other device (Xbox, PlayStation, iPad)?". Videogaming hours were self-reported for a typical weekday and weekend day, from which videogaming hours/day were derived. Outcomes of interest included mental health scores from the Child Behavior Checklist (CBCL), cognitive scores from the NIH Toolbox® cognition battery, in addition to working memory performance and region-based cortical BOLD signal from the N-back fMRI task (available for approximately half the sample). These outcomes were compared across the groups using linear mixed models with, age, sex, race/ethnicity, combined parental income, TV watching, parental monitoring, and sibling status as nuisance covariates, and scanner site as a random effect. FDR-corrected p values < .05 were considered significant.

Results: VGs who play < 1h/day (N=5824) and 2-3h/day (N=1024) did not have higher CBCL measures (uncorrected-p > 0.055) compared to NVGs (N=1711), while VGs who play > 3h/day (N=1233) had higher scores than all groups on attention, depression and ADHD. Mild and moderate VGs (< 3h/day) were the best performers on the NIH toolbox cognitive tasks compared to NVGs, scoring significantly better on pattern recognition and Flanker tasks, and having higher fluid and total IQ scores. Importantly, 1h/day VGs scored higher than all groups on card sorting and picture memory tests, had the highest IQ scores and lower externalizing, depression and conduct disorder scores compared to NVGs. Lastly, all VGs groups (< 1h/day: N=4306; 1-2h/day: N=1631; 2-3h/day: N=711; 3h+/day: N=750) performed significantly better on the N-back task and showed higher neural activation on the 2-back vs. fixation contrast compared to NVG (N=1278) in bilateral precuneus and the right precentral gyrus.

Discussion: The present findings strongly support the AAP recommendations and further show that 1h/day or less of videogaming is associated with better cognitive performance and mental health in children. The enhanced performance on the N-back task, coupled with higher neural activation in cortical brain regions playing a critical role in working memory and visuospatial attention, support the hypothesis that these areas exhibit a practice effect associated with the cognitively demanding videogaming.

S22. TESTOSTERONE MODULATES THE NEURAL DYNAMICS UNDERLYING MOTOR CONTROL IN A SEX-SPECIFIC MANNER IN TYPICALLY DEVELOPING YOUTH

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Background: The neural oscillatory dynamics serving motor control have been well-characterized in adults, and there is a growing body of literature investigating the development of these neural

processes across the lifespan. However, the extent to which sex hormones such as testosterone alter this development during the pubertal transition period is less understood.

Methods: Sixty-eight typically developing adolescents (36 female, mean age: 13.08 years) completed a motor sequencing paradigm during high-density magnetoencephalography (MEG) and provided a saliva sample. Salivary testosterone levels were determined using commercially available assay kits, and the resulting concentrations were log transformed to normalize for analysis. To evaluate behavioral performance, we performed ANCOVAs separately on each metric (i.e., accuracy, reaction time, and movement duration) with sex as a between-subjects factor and testosterone and age as covariates. MEG data were transformed into the time-frequency domain and significant sensor-level neural responses were imaged using a beamformer. To evaluate sex-specific effects of testosterone on whole-brain voxel-wise data, we performed ANCOVAs using the Statistical Parametric Mapping (SPM) toolbox with sex as a between-subjects factor, testosterone as a covariate of interest, and age as a nuisance covariate. Peak voxel values were extracted from regions exhibiting significant sex-by-testosterone interactions, which were correlated with behavioral metrics to assess neurobehavioral relationships.

Results: Hormone assays revealed a main effect of age on testosterone, such that testosterone levels increased with age. Behaviorally, there were no differences in performance by sex. There was a main effect of testosterone on reaction time above and beyond the effects of age, such that youth with greater testosterone were faster to respond. Whole-brain analyses revealed significant sex-by-testosterone interactions on beta oscillations in higher-order regions. In the left anterior prefrontal cortex, right dorsomedial prefrontal cortex, and left temporoparietal junction, greater testosterone levels were associated with weaker beta oscillations (i.e., smaller decrease in power from baseline) in males and not related to beta responses in females. In the inferior frontal gyrus, females exhibited stronger beta oscillations with higher testosterone, while males exhibited no relationship between testosterone and beta responses. Finally, weaker beta oscillations in the inferior frontal gyrus were associated with greater accuracy across all participants.

Discussion: We found that testosterone differentially modulated the neural oscillatory activity serving motor control in prefrontal and parietal cortices by sex, and that neural activity in the inferior frontal gyrus was related to behavioral performance. Regions of the frontoparietal network, including the TPJ and prefrontal cortex, have been linked to the allocation of attentional resources, and the prefrontal cortex has been implicated in top-down control of motor behavior. These processes are essential to accurate planning and execution of motor actions; thus, our findings in higher-order regions in this sample are not surprising, as these cortical areas undergo a protracted developmental trajectory extending beyond that of primary sensorimotor areas. Notably, our findings of weaker beta activity with increased testosterone in higher-order regions may reflect such refinement, reflecting decreased reliance on higher-order responses in males. Testosterone increases throughout puberty in both sexes and plays a role in functional refinement of prefrontal circuitry throughout the pubertal transition. As such, a possible explanation of our sex-specific findings is that we are capturing the functional refinement of top-down circuitry only in males, changes which may have already occurred in females, who typically develop one-to-two years earlier.

S23. UNRAVELING DEVELOPMENTAL VARIABILITY IN FUNCTIONAL SELECTIVITY AND SPATIAL LOCALIZATION OF HIGH-LEVEL VISUAL REGIONS OF THE VENTRAL TEMPORAL CORTEX

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Background: The brain is a patchwork of regions, each devoted to different mental functions. Some of the most robust and replicable regions include high-level visual areas within ventral temporal cortex (VTC), such as the word-selective visual word form area (VWFA), face-selective fusiform face area (FFA), and object-selective posterior fusiform sulcus (PFS). Face and object regions show category selectivity very early in development, whereas word regions develop after literacy. These regions show high inter-subject variability in adults, but how does the variability of the selectivity and location of these regions change with age? In this study, we use cross-sectional and longitudinal data to examine developmental changes in variability of the functional selectivity and location of high-level visual regions.
Methods: We collected structural data and two runs of a high-level visual localizer from 72 children and 56 adults. 29 children were scanned at two timepoints (ages 4-12). Longitudinal groups were motioned matched on framewise displacement. We defined functional regions of interest (fROIs) for the VWFA, FFA, and PFS fROIs in each participant using one run of data and calculated selectivity to the preferred category in independent task runs. Next, we calculated Center of Mass (CoM) of each fROI within that individuals' ventral temporal cortex, determining how far along on anterior-posterior axis and medial lateral axis the fROI was located (and therefore accounting for anatomical variability and/or size differences in this cortex across age and individuals). We calculated a coefficient of variation (CV) per child in reference to each adult for both selectivity and center of mass (CoM). We correlated CV with age to see if this variation systematically varied throughout development. We also compared the location in CoM of each fROIs across our cross-sectional sample (split into age groups of 3-6, 6-9, 9-12, and adults). We also calculated how far off each child was from the mean (zscore) and performed longitudinal comparisons to see if this individual variability held across timepoints or whether selectivity and CoM changed across time as it did for the cross-sectional sample.
Results: We found that inter-individual variability in left word-selectivity (lVWFA) increased with age while bilateral face-selectivity (FFA) decreased with age. The variability in center of mass of the lVWFA (along the medial-lateral dimension) also increased with age, while the bilateral FFA decreased with age. Almost all fROIs were more lateral in younger children than older kids and adults. These developmental trajectories were also mirrored in the longitudinal comparisons.
Discussion: In sum, we find that specialization to faces is more variable in children as compared to adults, in both selectivity and location, showing convergence over development. Word specialization diverges over development (with literacy), becoming increasingly variable in both location and selectivity. There exists a medial-lateral shift of general high level visual specialization within individual across time, and cross-sectionally with age, suggesting that brain growth along the ML axis within the ventral temporal cortex may lead to changes in relative location of this specialization across development.

S24. DIFFERENCES IN NEURAL ACTIVATION PATTERNS WHEN CHILDREN READ NARRATIVE VERSUS EXPOSITORY TEXTS

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Background: Reading comprehension ability is positively associated with life outcomes, including higher levels of academic achievement, job performance, and mental health (Aro et al., 2019), but current estimates suggest most fourth-grade students are reading below proficient levels (National Center for Education Statistics, 2022). Student reading comprehension suffers even more when reading expository, or informational, texts compared to narrative texts, or stories (Best et al., 2008). This difference in comprehension has been shown to relate to text characteristics that are unique to each genre (McNamara et al., 2011), but limited research exists on whether genre impacts the neural circuitry related to reading (Aboud et al., 2019). The purpose of the current study was to investigate both shared and unique neural regions that are activated during reading expository compared to narrative text reading.
Methods: To explore this research question, a subset of fMRI data from a larger longitudinal study were analyzed. During the fMRI session, 87 typically developing third-graders (age M = 9.43, SD = 0.39) read one narrative and one expository passage, sectioned into 4 blocks of ~ 30 seconds each and presented in 1–5-word phrases at a time. For baseline conditions, participants also 1) read scrambled-word phrases that were matched on word type and count and 2) viewed a fixation cross. Repeat phrases that required a button press were included in both true passages and scrambled baseline blocks to gauge attention. After the scanning session, participants answered 4 questions about each passage to gauge comprehension. General linear model analyses for contrasts of interest were conducted in SPM12 in MATLAB.
Results: Compared to viewing the fixation, reading both narrative and expository passages activated canonical reading areas, including the occipitotemporal region (OT), precentral gyrus, left inferior frontal gyrus (IFG), and bilateral superior temporal sulcus (STS). Participants showed reduced Default Mode Network (DMN) activation during passage reading, including the posterior cingulate cortex (PCC), precuneus, and bilateral inferior parietal lobe (IPL). In addition to these overlapping regions, distinctive patterns of activation for each passage type were observed. Specifically, reading narrative passages compared to expository passages revealed increased activation of areas within the DMN, including the bilateral IPL, PCC and anterior cingulate cortex (ACC). Correlations in behavioral measures and activity are currently being explored to determine whether neural activation patterns during expository or narrative reading predict subsequent reading comprehension or relate to individual differences in cognitive factors related to reading (e.g., executive function and/or oral language).
Discussion: Preliminary results indicate both common and unique neural circuits are involved in reading different text types (i.e., expository and narrative). These results are in alignment with previous research that has determined different neural requirements and connectivity patterns for different types of discourse and may suggest unique cognitive processes that correspond with reading each genre type.

S25. ALTERED NEURAL DYNAMICS SERVING VISUAL ENTRAINMENT IN CHILDREN WITH HEARING LOSS

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Background: Individuals with profound or complete hearing loss exhibit cross-modal neural plasticity, whereby neural structure and function related to an individual's unaffected senses (e.g., vision, touch) are altered. However, the research is scarce on individuals with mild-to-severe hearing loss, including children who are hard-of-hearing (CHH) and thus whether these alterations in sensory-related neural dynamics persist in those with significant residual hearing that can be further restored with hearing technology (i.e., hearing aids) is unclear. Recent work suggests that CHH have elevated neural responses to somatosensory stimulation compared to children with normal hearing (CNH), however, it remains to be seen whether this pattern can be extended to other modalities (e.g., the visual system). The objective of this pilot study was to characterize the neural dynamics underlying visual entrainment in children who are hard-of-hearing (CHH) relative to children with normal hearing (CNH).

Methods: A total of 40 participants aged 7-15 years (13 females), including 17 CHH and 23 CNH, received passive 15 Hz flickering visual stimulation presented centrally for 1000 ms with an inter-trial interval of 2750-3750 ms during magnetoencephalography (MEG). MEG data were preprocessed, epoched, and coregistered with MRI, and then trial-wise data was transformed into the time-frequency domain using complex demodulation. Stimulus-induced entrainment responses were identified and source imaged using beamforming. Peak occipital visual entrainment responses were identified, and the time course of power at 15 Hz was extracted and submitted to a linear mixed-effects model, with hearing status (CHH, CNH) and time (i.e., 50 ms windows from 0-1000 ms) as fixed variables. Finally, relationships between visual entrainment and behavior were assessed.

Results: Linear mixed effects modelling revealed significant main effects of time ($p < .001$) and significant group*time interaction ($p < .001$), such that CHH showed a more positive response slope relative to CNH. Follow-up test revealed that CHH and CNH do not differ in their peak latency ($p = .821$) or full-width half maximum ($p = .454$), suggesting the nature of the significant interaction is likely due to hyper-responsivity than faster activation. Surprisingly, follow-up testing showed no significant correlations between neural response characteristics (power, slope) and neuropsychological data.

Discussion: In this study, we found significant alterations in the 15-Hz visual entrainment dynamics in CHH relative to CNH, suggesting the neural dynamics underlying early visual processing are aberrant in children with hearing loss. Future studies should probe the nature of these visual alterations in the context of attention and multisensory integration.

S26. CHILDHOOD MALTREATMENT IS ASSOCIATED WITH STRESSOR-EVOKED PARAVENTRICULAR HYPOTHALAMIC, DORSAL BED NUCLEUS OF THE STRIA TERMINALIS, AND NUCLEUS OF THE SOLITARY TRACT ACTIVITY: A 7-TESLA STUDY

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Background: Childhood maltreatment dysregulates stress reactivity, however, underlying neural mechanisms are not well understood. Subcortical regions proximal to stress control have been

difficult to examine using MRI due to their small size and location. The paraventricular nucleus of the hypothalamus (PVN) is uniquely capable of proximal control over neuroendocrine (HPA) and autonomic stress responses. The ventral bed nucleus of the stria terminalis (vBNST) directly modulates PVN function and receives dense viscerosensory, noradrenergic signaling from the brainstem nucleus of the solitary tract (NST) that collateralizes to the PVN. The dorsal BNST (dBNST) innervates the vBNST, and all of these forebrain regions are preautonomic, innervating the brainstem and NST to control autonomic responses to stress. Thus, these regions form a core, "central visceral" stress-control circuit, that is also implicated in affective processes and disorders. Our goal was to use 7-Tesla (7T) derived, in-house created probabilistic atlases to extract stressor-evoked activity and examine relationships with childhood maltreatment and deprivation.

Methods: Participants were young adults (mean age=26.3) from a transdiagnostic, abuse-enriched sample. Probabilistic atlases were derived from manual segmentations using high resolution, structural 7T MPRAGE and 2D gradient echo (Sibbach BSF 2023) sequences. Functional MRI data were acquired using a 1.3mm isotropic EPI sequence (TR = 2500ms). Stressor-evoked activity was elicited via an adapted, performance-titrated Multisource Interference Task (mild cognitive stress) and parameter estimates were extracted with the 20% probabilistic atlases inverse normalized (n=155). Hierarchical regression analyses were performed covarying for age, sex, and race, examining childhood maltreatment (MACE Multiplicity score) and socioeconomic deprivation (parental education level reverse coded). We also evaluated whether findings survived adulthood variables (traumatic events, socioeconomic status, negative life events). Curvilinear relationships were examined using squared terms for maltreatment and deprivation variables.

Results: Regression analyses revealed a significant linear relationship between childhood maltreatment and PVN stressor-evoked activity (standardized $\beta = 0.240$, $p = 0.015$) in the full model with the adulthood variables. There was also a significant relationship between childhood maltreatment and dBNST stressor-evoked activity (st $\beta = 0.298$, $p < 0.001$). A significant curvilinear relationship was found between childhood maltreatment and NST stressor-evoked activity (st $\beta = 0.518$, $p = 0.014$). Both dBNST and NST findings were more robust and remained significant in the full model. No relationships were found with vBNST or socioeconomic deprivation.

Discussion: Childhood maltreatment was associated with greater PVN, dBNST, and NST stressor-evoked activity. This may indicate that childhood maltreatment may predominantly shape preautonomic circuitry with perhaps more secondary effects on viscerosensory pathways, which may serve more modulatory roles in stress control. These findings may provide novel neural insights into childhood maltreatment-related risks for affective symptoms.

S27. NEGATIVE URGENCY MEDIATES THE EFFECT OF FAMILY CONFLICT ON CANNABIS POSITIVE EXPECTANCY: THE MODERATING ROLE OF ANTERIOR CINGULATE CORTEX

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Background: Family conflict is a stressful rearing environment linked to the development of drug use vulnerabilities in youth, including expectancy for drug use. Extant research shows that negative urgency, a trait predisposing individuals to react impulsively to negative emotions, mediates this

link. However, this mechanism may be modulated by between-person differences in saliency-related neural activation patterns. Therefore, we aimed to examine the influence of the anterior cingulate cortex (ACC) during reward processing and its specific role in moderating the indirect longitudinal association between family conflict and cannabis positive expectancy via negative urgency.

Methods: Three waves of data were taken from the Adolescent Behavior and Cognitive Development (ABCD) study (baseline, 2-year [T5], and 3-year follow-ups [T7]). The final sample included 6,638 youths (47.8% female; Mage = 10.1). Self-reported measures include the family conflict subscale (Family Environment Scale), the negative urgency subscale (Impulive Behavior Scale), and the cannabis positive/negative expectancies subscales (Marijuana Effect Expectancy Questionnaire). Reward-processing neural activation was recorded via fMRI. Hypotheses were tested using structural equation modeling (SEM) in Mplus version 7.3. Specifically, measurement models were assessed through confirmatory factor analysis (CFA), and longitudinal change in cannabis expectancies (T5 – T7) was modeled using latent change scores. Path analysis was employed in the structural model to test the moderated-mediation hypothesis. Finally, the Johnson-Neyman approach was used to probe interaction effects and identify regions of significance.

Results: Our results indicated that family conflict predicted increases in cannabis positive expectancies through increases in negative urgency ($\beta = .017$, $p < .001$, CI [.045,.069]). Notably, increased activity in all four regions of the ACC at T5 (bilateral caudal and rostral) was found to exacerbate the effect of negative urgency on the increase in cannabis positive expectancy ranged from $\beta = .008$ to $\beta = .062$ with corresponding confidence intervals widening from [.041, .122] to [.001, .081]. The proportion of participants showing this pattern varied significantly across the regions, with 31.8% to 44.8% displaying enhanced ACC activity linked to increased cannabis expectancies.

Discussion: Findings underscore the importance of understanding the neural context that may buffer or exacerbate the impact of emotional and environmental stressors on substance use expectancies during adolescence. The ACC's potential moderating role opens avenues for targeted interventions that could reduce the risk of substance use by addressing the neural correlates of impulsivity and expectancy in the context of stressful rearing environments.

S28. ASSOCIATION OF NEURITE DENSITY IN LIMBIC BRAIN REGIONS WITH WEIGHT GAIN IN YOUNG CHILDREN WITH ATTENTION-DEFICIT HYPERACTIVITY DISORDER AND TYPICALLY DEVELOPING CHILDREN.

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Background: Childhood obesity has been and remains a significant public health concern, and its manifestation has been associated with psychological comorbidities and behavioral disorders, such as attention-deficit/hyperactivity disorder (ADHD; Rankin et al., 2016). One proposed mechanism for the link between ADHD and an increased risk for developing pediatric obesity is poor self-regulation, a skill that is often impaired in children with ADHD and is associated with the function of the dopaminergic (DA) and limbic systems. DA and limbic system function has also been documented to motivate eating behavior. Indeed, microstructural differences such as greater

cellularity in the nucleus accumbens (NAcc) and insula, downstream targets of dopaminergic neurons in the ventral tegmental area, have been linked with diet-induced weight gain and increases in waist circumference in typically developing adolescents (Rapuano et al., 2020). These authors proposed a particular mechanism: a hypersensitive DA system increases the probability of eating a high calorie diet, which is associated with an increased neuroinflammatory response. This response, indicated by increased glial cellularity in NAcc, is indirectly measured in vivo using the restriction spectrum imaging (RSI) modeling of diffusion-weighted imaging (DWI) data. However, the mechanisms underlying these associations remain unclear for high-risk children (such as those with ADHD). Further, we do not know whether such risk indicators can be detected earlier in development. Here, we examined the association between diet-induced weight gain and DA system neurite density in the NAcc and insula in younger typically developing children and in children with ADHD.

Methods: The sample consisted of 71 typically developing 4-7-year-olds, and 85 4-7- year-old children diagnosed with ADHD. Children's waist circumference and body fat percentage were measured, and they participated in an MRI scanning session, including behavioral assessments. ADHD diagnosis was confirmed by two clinicians and multiple raters (parents and teachers). We used restriction spectrum imaging (RSI) to measure restricted normalized signal fraction (RNT) from a diffusion-weighted imaging (DWI) scan, which provides an index for cellularity in the DA and limbic system regions of interest (replicating the method from Rapuano et al., 2020). To investigate the associations between RNT and the two outcome measures, waist circumference and percent body fat, we used FEMA whole-brain voxelwise analysis and ROI analysis using robust regression.

Results: We failed to replicate Rapuano's main effect showing that neurite density in the NAcc region predicts waist circumference or percent body fat. However, the whole-brain FEMA analysis indicated significant associations in bilateral anterior insula ($p < .005$, corrected). No interaction effects by diagnostic group were indicated.

Discussion: We demonstrated that greater neurite density in the anterior insula was associated with the obesity measures of waist circumference and percent body fat in a large cohort of 4- to 7-year-old children. This fails to replicate the findings from Rapuano et al., 2020, which analyzed an older cohort of children using the same DWI acquisition and measures. The results suggest greater importance for limbic structures in early development for pathways toward pediatric obesity. Structural development of striatum may become more important as children develop into adolescence.

S29. CANNABIS EXPOSURE REDUCES HIPPOCAMPAL GROWTH

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Background: Adolescence is a period of significant biological and behavioral transformation. During this developmental period, youth typically initiate substance use, most commonly with alcohol, nicotine/tobacco products, or cannabis. This substance use initiation, and subsequent patterns of use, have biological ramifications, including impacting brain development—specifically orbitofrontal cortex, medial temporal lobe and insula connectivity and cortical thickness. Much of the current research focuses on non-use versus high or dependent use—missing

the impact on a typically developing youth. The Adolescent Brain Cognitive DevelopmentSM (ABCD) Study utilizes a longitudinal design to have baseline brain scans prior to the onset of substance use, with follow-up scans every 2 years. This design allows for the analysis of self-reported initiation and use between the imaging timepoints to assess changes in brain development among individuals with early and low-level substance use patterns. While studies assessing volumetric brain changes within the hippocampus, parahippocampal cortex, and insula during adolescence have reported mixed results for high levels of substance use, we aimed to assess potential differences within these brain regions among a population with early initiation to substances.

Methods: Utilizing the 5.1 data release of the ABCD study, we measured total volume growth of the hippocampus, parahippocampal gyrus, and insula (Year 4 follow-up – Baseline). At the Year 4 follow-up, all Methods: of administration of cannabis, alcohol, or nicotine were combined to create dichotomous variables of total cannabis, total alcohol, and total nicotine use, as well as poly substance use (yes use or no). Poly substance use is limited to just cannabis, alcohol and nicotine. Linear regression models were completed covarying for sex, race/ethnicity, age, caregiver education, and total whole brain volume at baseline, with random effects for family and scanner serial number (as a proxy for site). Subjects were excluded from the analysis if their MRIs did not meet QC, their scans were outside of a 42–54-month window or if they did not have complete self-report surveys.

Results: The current 5.1 data release contains approximately half of the ABCD study sample, this analysis, n=2,711. Within this sample, 42 subjects had consumed alcohol, 121 had some exposure to nicotine, and 84 had exposure to cannabis. Among those who reported cannabis use, there was a significant reduction of 45.88mm3 in hippocampal growth Year 4 (ages 13-14) – Baseline (ages 9-10), $p < 0.05$. There were no significant findings for alcohol or nicotine on the hippocampus, nor was there a significant impact on the insula or in the parahippocampal gyrus by any of the substances.

Discussion: Substance use initiation has been a hallmark of adolescence for decades, but we are now being to understand the impact on brain development. Longitudinal within subject studies, such as ABCD, give key insight into brain changes within an individual as they grow and develop, and for some begin using substances. Social acceptability, legal status, and legal access have created additional opportunities for cannabis use nationally. Empirical evidence for regular cannabis use during the teen years leading to subsequent reductions in IQ. This reduction does not recover, even after stopping use. One potential pathway for this is through reduction in hippocampal growth during a critical developmental stage. The hippocampus is critical for learning and memory. Although the current Year 4 data has a sufficient sample of substance use, pending the release of the ABCD 6.0 dataset, we will repeat the model in the full sample.

S30. UNDERGRADUATE RESEARCHER

Ashley Becker*[1], Diana Smith[1], Alison Rigby[1], Terry Jernigan[1], Anders Dale[1]

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Background: Cognitive performance is known to be associated with multiple patterns of cortical brain structure; however, the exact nature of these relationships is not fully understood. By using a large, longitudinal sample such as the Adolescent Brain Cognitive Development Study (ABCD Study), regional effects correlated with cognitive development, as measured by the NIH Toolbox

Cognition Battery, are more likely to be detected. NIH Toolbox tasks are sorted into two categories: fluid cognition (one's adaptability to new situations) and crystallized cognition (task-specific knowledge gained over time). Previous work with ABCD data has found unique regional effects between fluid versus crystallized cognitive tasks and vertex-wise measures of cortical surface area and cortical thickness in 9–11-year-olds, with regional differences between tasks better differentiated when controlling for sociodemographic factors. This study builds on these findings by analyzing the voxel-wise regionalized correlations of brain morphometry and NIH Toolbox Task scores, and the interaction effect between task scores and age.

Methods: Data was provided by the ABCD 5.0 release, which included NIH Toolbox Task scores and imaging data from the baseline (n=11,727), 2-year (n=10,649), and 4-year (n=4,652) follow-ups. We used Fast Efficient Mixed Effects Algorithm (FEMA) to run linear mixed effects models determining the correlation between restricted normalized total signal fraction (RNT) and the uncorrected task score of interest. Crystallized intelligence was measured using the uncorrected composite, oral reading, and picture vocabulary scores. Fluid intelligence was measured using the uncorrected flanker, picture, and pattern scores. Separate nested models were run for each task score to determine the impacts of controlling for sociodemographic factors. Initial models included age, scanner information, and the uncorrected toolbox task score. Final models also included sex, principal components, race, income, and parent education as fixed covariates. All models included a random effect of family. Additional sets of nested models were run including an interaction term between age and toolbox score.

Results: Main results are from the model including scanner information, sex, genetic principal components, race, household income, and parent education. Crystallized tasks had a higher correlation with brain morphometry than fluid tasks. The crystallized composite score (maximum z-statistic of 8.26) had a stronger association with brain morphometry than oral reading recognition (maximum z-statistic of 6.93) and picture vocabulary (maximum z-statistic of 7.48). The pattern task (maximum z-statistic of 7.14) had the highest association with brain morphometry out of the fluid tasks. All cognitive tasks were positively associated with the ventral diencephalon, putamen, thalamus, and cerebral white matter tracts. The reading task had an additional positive association in the left hippocampus, and the picture vocabulary score was positively associated with the pallidum. Further analysis of whether the change in relationship between cognitive scores and brain morphometry over time is best described with a linear or non-linear model will be further explored in the final presentation.

Discussion: NIH Toolbox Task scores are positively correlated with both shared and unique regions. These effects are strongest in crystalized scores. Accounting for sociodemographic covariates decreases z-statistic scores for all tasks studied, but they remain significant and regional effects become more apparent. The negative interaction between task scores and RNT also becomes highly localized after accounting for sociodemographic factors. This research helps elucidate the nature of the longitudinal relationship between cognition and brain structure on the regional level. Further work can be done to explore development over other voxel-wise metrics.

S32. LARGER CAUDATE VOLUME IS ASSOCIATED WITH MORE PERSISTENT CHILDHOOD IRRITABILITY

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Background: Normative in preschool age children, irritability declines as children progress through adolescence, paralleling the development of emotion regulation skills. When irritability persists into middle childhood and adolescence, it (1) amplifies impairment associated with numerous psychiatric problems and (2) signals risk for future and more severe psychopathology. Irritability affects up to 20% of youth with even subclinical levels of irritability associated with significant functional impairment. Youth with elevated irritability symptoms demonstrate aberrant gray matter volume in subcortical regions important for emotion and behavior regulation, yet the direction of effects is inconsistent across regions and prior studies. Notably, Black and Latine youth of lower socioeconomic status have been largely excluded from previous neuroimaging studies of childhood irritability. We hypothesize that subcortical volume differences will be observed in Black and Latine youth with and without persistently high childhood irritability.
Methods: The current study examined associations between the volume of 7 subcortical regions implicated in emotion and behavior regulation (thalamus, caudate, putamen, pallidum, hippocampus, amygdala, accumbens) and trajectories of irritability across middle childhood in a sample of 280 Black and Latine youth (Mean Child Age at MRI= 17.26 years, SD = 1.41; 145 girls; Mean Maternal Years of Education =11.96, SD = 2.19) enrolled in a prospective birth cohort. Irritability was measured using item-level parent-report data from the Child Behavior Checklist and Conners Parent Report Scales conducted at children's ages 7, 9, and 11 years. All item responses were rescaled to 0–1 with higher scores indicating more irritability. Responses were then averaged across scales at each age point to create a composite irritability score (range=0–1). Latent class mixture modeling identified subgroups of youth by trajectories of irritability across the 3 timepoints, using R package lcmm. Logistic regression tested associations between irritability class and volume of each subcortical region (averaged across right and left hemispheres; 7 total tests), controlling for child age at scan, sex assigned at birth, total intracranial volume, and mother's years of education as a proxy for socioeconomic status.
Results: A two-class solution (persistently high irritability vs. persistently low irritability) was determined to be the best fitting model according to multiple goodness of fit indices (Akaike information criterion (AIC), Bayesian information criterion (BIC), maximum log-likelihood, and the posterior probability of the latent classes). Larger caudate volume (β= 0.00067, p=0.04) was associated with belonging to the persistently high irritability class. Associations between grey matter volumes of all other regions tested were nonsignificant.
Discussion: Our findings are consistent with previous studies implicating caudate volume in childhood irritability but counter to those implicating other subcortical regions, such as the amygdala and putamen. Black and Latine youth in our epidemiological sample demonstrate different patterns of brain morphometry associated with childhood irritability than previously reported samples of predominantly white youth from high socioeconomic backgrounds. Ongoing analyses will examine whole brain morphometry measures. Future studies should examine the predictive power of brain morphology and irritability trajectories to later symptoms of anxiety and depression, common adult endpoints for childhood irritability.

S33. SEA HERO QUEST, SPATIAL NAVIGATION AND THE HIPPOCAMPUS IN YOUTH WITH TYPICAL DEVELOPMENT AND WITH DOWN SYNDROME

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Background: Spatial navigation is a complex cognitive function we all use to efficiently get from place to place. Successful navigation activates several brain regions, notably the retrosplenial cortex [1]. Since hippocampal neurons project to the retrosplenial cortex via the thalamus, the hippocampus may be an upstream contributor to navigational success. People with Down syndrome (DS) must navigate the world each day with impaired hippocampal function [2] and smaller hippocampal volumes [2]. Thus, we aim to determine whether hippocampal subfield and medial temporal lobe (MTL) volumes contribute to spatial navigation outcomes in typically developing (TD) youth and youth with DS. We predict that volumetric differences in CA3 and CA1 will relate to spatial navigation differences in the group with DS, who may be engaging different MTL regions than TD youth to accomplish navigation.

Methods: Participants were 18 youth with DS (mean age = 16.7, SD = 3.6, 11 male) and 20 youth with TD (M = 16.2, SD = 3.4, 9 male), recruited following IRB guidelines. In total, 72% identified as White, 26% Hispanic, and 1% African American. Spatial navigation abilities were measured using Sea Hero Quest (SHQ), a tablet-based navigation game with progressively more challenging levels. Verbal crystallized intelligence was assessed with the KBIT-II. High-resolution T2-weighted magnetic resonance images were collected on a 3T Seimens scanner with a 32-channel head coil. All hippocampi were manually segmented in ITK-SNAP v.3.8.0 [3], and subfield volumes from 2 trained raters' results were compared with a Pearson correlation. All reported regions were above 95 % concordance. Average volumes were used in subsequent analyses in R Studio. Bootstrapped t-tests were used to characterize group differences on all measures. ANOVA models were used to assess the contributions of hippocampal subfields to spatial navigation separately in each group for play duration at a level that was neither the easiest nor the hardest and had no attrition. Variables met assumptions for ANOVA testing; covariates were, age, KBIT-II verbal, and sex.

Results: On average, the TD group navigated the SHQ level in 24.49 seconds (SD = 6.8). The DS group's mean was 73.3 seconds (SD = 90.1), a significant difference, t = 2.26 (p=.002). Considering the accuracy of the SHQ flare level, the TD group's mean was 2.55 (SD = 0.52), and the DS group's mean 1.86 (SD = 2.30). This difference was not significant, t = -1.86 (p=.134). The play duration ANOVA for youth with DS showed a statistically significant relationship only for KBIT-II verbal, $F = 8.09$ ($p < 0.05$). However, the same model for TD youth showed that the largest share of variance related to age, $F = 10.60$, ($p < 0.01$); while play duration was significantly related to CA1 volume at the 0.05 alpha level, F = 4.6 (p=0.05); and also had a significant amount of variance due to sex, $F = 7.9$ ($p < 0.05$). CA3 volumes were not significant in either model, all $p > 0.05$.

Discussion: Although youth with DS had a longer average navigation duration, we found no statistical difference between the two groups' flare accuracy, suggesting youth with DS might have a relatively spared sense of direction. The relationship of right-side CA1 volumes and SHQ play duration in TD youth indicates a potential benefit of a smaller hippocampal CA1 subfield for navigational efficiency that is, however, not extended to the group with DS. Our study's findings show a modest relationship between hippocampal volumes and spatial navigation abilities in TD youth only, indicating that youth with DS may be challenged to use memory to help with navigational tasks. Our findings could hold implications for developing targeted occupational therapies to improve navigational skills and overall quality of life in individuals with DS and other neurodevelopmental conditions defined by hippocampal abnormalities.

S34. ASSOCIATIONS BETWEEN PRETERM BIRTH AND MICROSTRUCTURE AND MORPHOLOGY OF THE ADOLESCENT BRAIN

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Background: Preterm birth affects approximately 1 in 10 births worldwide. Despite improvements in neonatal care, individuals born preterm remain at risk of a wide spectrum of neurodevelopmental impairments including cognitive, motor and language deficits. The severity and nature of neurodevelopmental impairments is strongly negatively associated with gestational age at birth (GA). Much of the focus has been on infants born extremely preterm, however less is known about the neurodevelopmental trajectories associated with moderate to late preterm birth. In this study we examined whether very- and late preterm birth may be differentially associated with adolescent brain development compared to youth who were born full term.

Methods: We assessed structural and diffusion MRI data from 13129 observations from 7319 unique participants, aged 9-16 years, from the Adolescent Brain and Cognitive Development (ABCD) study (release 5.1). Observations included baseline, 2 year and 4 year follow up data. GA was determined via caregiver survey. 11312 individuals were born at full term (FT, 37-40 weeks GA), 1438 were born late preterm (LPT, 33-36 weeks GA), and 379 were born very preterm (VPT, 28-32 weeks GA). The ABCD study design excluded individuals born before 28 weeks GA.

We assessed voxelwise, whole-brain (i) microstructure using restricted normalised isotropic (RNI) and restricted normalised directional (RND) indices from restriction spectrum imaging, measures related to cellularity and neurite coherence, respectively; and (ii) morphology using the Jacobian determinant (JA), derived from nonlinear image registration which transforms each scan from native space to a common atlas space, and is a voxelwise measure of local tissue volume.

To study the associations between GA and brain microstructure and morphology, and allow for nonlinear effects, univariate general additive mixed effects models were applied at each voxel, and associations were modelled with a natural spline function. We controlled for fixed effects of age, sex, household income, parental education, ethnicity, top 10 genetic principal components, scanner ID and software, and included random effects of subject and family.

Results: Associations between GA and microstructure and morphology were nonlinear and had distinct spatial distributions. Greater GA was associated with greater RNI and lower RND in the centrum semiovale, bilaterally. The relationship between GA and RNI was nonlinear and monotonically increasing. The steepest slope, marking the strongest association, was between 34 and 37 weeks GA. In the same region, the relationship between GA and RND was nonlinear and non-monotonic. There was a slight positive association between GA and RND between 30 and 34 weeks gestation and monotonically decreasing at all other GA. As with RNI, the slope was steepest between 34 and 37 weeks GA.

JA analysis showed that higher GA was associated with greater local tissue volume in the cortical grey matter, in particular the insula, parietal, temporal and frontal lobes. The relationship between GA and JA increased monotonically, with greatest slope between 30 and 34 weeks GA. The associations between JA in the white matter and subcortical grey matter were non-monotonic and varied across brain structures.

Discussion: These results show that even moderate preterm birth is associated with brain imaging markers of the intracellular environment and macroscopic tissue volumes into adolescence. The

different imaging phenotypes assessed here were affected differentially. This may reflect the vulnerability of different cerebral pathways and cell types to insult during the third trimester or adaptive, compensatory processes.

S35. CORTICAL MORPHOMETRY IS UNIQUE IN AUTISM COMPARED TO TYPICAL, ADHD AND OTHER CLINICAL CONDITIONS

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Background: Understanding the neurobiological underpinnings of developmental disabilities is crucial for tailored interventions. Anatomical MRI measures of cortical morphometry such as cortical thickness, sulcal depth, etc., may provide predictive power in our understanding of developmental disabilities. However, large-scale studies often face methodological variability and lack clinical outcome enrichment, e.g., the Adolescent Brain Cognitive Development (ABCD) Study.
Methods: To address the current limitations, we aggregated data from six datasets, including Healthy Brain Network (HBN), ABIDE I, ABIDE II, ABCD, Oregon Health and Science University ADHD (OHSU ADHD), and OHSU ASD, some of which are enriched for psychopathology and processed them uniformly using the ABCD-HCP pipeline. Cortical thickness, surface, and sulcal depth were parcellated using the HCP template. NeuroCombat was employed to harmonize multi-site datasets, mitigating batch effects. A two-way ANOVA to compare the diagnostic groups revealed significant differences across different ROIs and groups, including autism, ADHD, control, and clinical diagnosis.
Results: While differences were observed in cortical morphology across various ROIs and groups, significant differences between autism and all other groups were found only in the right-hemisphere ROIs of 47s and 6mp.
Discussion: This underscores the importance of focusing on specific brain regions to enhance our understanding of the neurobiological basis of autism.

S36. INDIVIDUAL DIFFERENCES IN HIPPOCAMPAL VOLUME IN RELATION TO SLEEP MORPHOLOGY

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Background: Sleep architecture, particularly features of nREM sleep, has been associated with cognitive development in early childhood. During development, slow wave sleep (SWS), slow wave activity (SWA; delta in nREM), sleep spindles, and brain regions that support critical cognitive functions such as memory follow distinct trajectories. The proportion of time spent in SWS decreases while the depth of SWS (SWA) and spindle density increase. In parallel, the

hippocampus matures and episodic memory ability emerges. Both continue to develop across childhood into adulthood.

Objective. To explore the relations between the nREM sleep morphology and hippocampal volume in preschool-aged children, furthering our understand of sleep's relationship with neural regions fundamental to memory during a distinct developmental period of neuroplasticity.

Methods: Preschool age children (N = 32; M= 4.25 years, SD=0.56 years, Range=3.26-5.77 years) underwent ambulatory polysomnography during a daytime nap. Expert scorers delineated individual sleep states in 30s epochs. SWA amplitude envelopes were extracted using a custom MATLAB program (PSGPower) a T1-weighted magnetic resonance imaging (MRI) scan was used to assess the size of the hippocampal head, quantified by volumetric analysis using Freesurfer 6.0.
Results: Our analyses revealed a significant positive correlation between the size of the hippocampal head and the percentage of time spent in SWS ($r(31) = 0.46$, $p = 0.01$). This relationship remained robust even when controlling for age, with partial correlation analysis yielding a coefficient of $r(30) = 0.28$, $p < 0.05$. However, the relationship between SWA and hippocampal head volume was not correlated ($r(29)=0.005$, $p = .98$).
Discussion: The observed correlation between hippocampal head size and the SWS underscores the intertwined nature of brain structure and sleep architecture in early childhood development. These results reinforce the idea that SWS may play a pivotal role in the development of the hippocampus and sleep dependent consolidation. However, the amount of time spent in SWS may be more impactful than the SWA, underscoring further need to investigate SWS's function during development. As more nuanced analyses of relations between slow oscillations and sleep spindles may yield greater insight, these analyses will be included in our presentation.

S38. THE ROLE OF BILINGUALISM IN GRAY MATTER VOLUME DIFFERENCES IN ADHD

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Background: Attention Deficit Hyperactivity Disorder (ADHD) is a common neurodevelopmental disorder characterized by inattentive, hyperactive or impulsive symptoms and attributed to dysfunction of the cortico-striato-thalamo-cortical-loop (Barkley, 2006). Prior studies report relatively less gray matter volume (GMV) in ADHD in basal ganglia, thalamus, and prefrontal cortex (Nakao, et al., 2011; McGrath and Stoodley, 2019). Prior studies have not taken bilingualism into consideration, even though constant selection of one language while inhibiting the other may result in heightened executive control (EC) in bilinguals (Green et al., 1998); and bilinguals have more GMV than monolinguals in regions associated with EC (Schug et al., 2022). Here we tested whether an early bilingual experience affects the prevalence rate of ADHD and its behavioral and neuroanatomical manifestations.
Methods: We selected children from the Adolescent Brain and Cognitive Development Study based on a standard score of around less than 70 on Matrix Reasoning and less than 70 on Picture Vocabulary tests. Demographic surveys were used to select cultural early Spanish-English bilinguals and native English monolinguals. ADHD was determined using less than 65 on the Child Behavioral Checklist (CBCL) Attention Syndrome Scale (Controls < 65). Prevalence rate was calculated for these participants. Next, propensity matching was used to equate all four groups on

socioeconomic status, Matrix Reasoning, and Picture Vocabulary scores and resulted in 59 Bilingual ADHD, 57 Bilingual Control, 55 Monolingual ADHD, and 59 Monolingual Control participants aged 9.5 years. Performance on EC tasks was tested using a 2x2 ANOVA for the Toolbox Flanker Task and the Toolbox Dimensional Change Card Sort Task. Structural magnetic resonance images underwent voxel-based morphometry in SPM12 (Ashburner and Friston, 2000) and a 2x2 ANOVA (with age, sex, CBCL Anxiety/Depression Syndrome Scale, total GMV, and study site as covariates of no interest) to test for the main effects of Diagnostic Group, Language Background:, and their interactions (voxel-wise height threshold $p < .005$ uncorrected, cluster-level extent threshold $p < .05$ FDR).

Results: Prevalence of ADHD was significantly lower in bilinguals (6.6%) than monolinguals (7.7%). The ANOVA on the Toolbox Flanker Task yielded no results and the ANOVA on the Toolbox Dimensional Change Card Sort Task revealed a main effect of Diagnostic Group (ADHD < C; $F(1,240) = 4.79$, $p = .030$), but no further results. For GMV, there was a main effect of Diagnostic Group, a main effect of Language background, and no interactions. The group with ADHD had less GMV than Controls in left thalamus (and more GMV in right angular and middle temporal gyri). The Bilinguals had more GMV than Monolinguals in bilateral inferior occipital cortices, precuneus, and postcentral gyri; left calcarine fissure, inferior parietal lobule, thalamus, supplementary motor area, insula, and inferior frontal gyrus; as well as right superior temporal gyrus, posterior cingulum, parahippocampal gyrus, inferior orbitofrontal gyrus, and gyrus rectus. There were also regions where Monolinguals > Bilinguals, too numerous to report here. Results were similar when entering medication as a covariate of no interest.

Discussion: While lower prevalence of ADHD in Bilinguals indicates that an early dual-language experience may stymie ADHD, bilinguals did not show an advantage on either EC tasks. The left thalamus had less GMV in ADHD (vs. Controls), and more GMV in Bilinguals (vs. Monolinguals), suggesting an association with both ADHD and dual-language experience. Lack of an interaction here or elsewhere suggests that there is no differential effect of an early dual-language experience on ADHD.

S39. NEUROANATOMICAL BASES OF MATH INTERVENTION IN CHILDREN AND ADOLESCENTS WITH LOW MATH PERFORMANCE

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Background: Proficiency in early math skills is predictive of academic, financial, and social success (Geary, 2011). About 6-14% of children meet diagnostic criteria for dyscalculia or math disability (MD; Morsanyi et al., 2018), which is characterized by deficits in fluency and accuracy of calculation and arithmetic fact retrieval, despite adequate intelligence, instruction, and motivation (American Psychiatric Association, 2013). Math problem solving typically engages temporal, parietal and frontal regions (Dehaene and Cohen, 1997; Arsalidou et al., 2018), with alterations of these in MD (Peters and De Smedt, 2018). Studies also report less gray matter volume (GMV) in parietal (e.g. intraparietal sulcus), temporal (e.g. parahippocampal gyrus), occipital (e.g. middle occipital gyrus), and frontal regions (e.g. middle and inferior frontal gyri and anterior cingulate cortex), with few studies investigating cortical thickness (CT) and white matter volume (WMV). Here we examined which regions facilitate math gains brought about by intervention in children/adolescents with low math ability. Using multiple measures of neuroanatomy we tested

for (a) intervention-induced changes in brain anatomy; and (b) relationships between brain anatomy and changes in math performance after intervention.

Methods: Participants (N=59; 34 female; 8-12 years of age) with < 92 standard scores on Math Fluency or Calculation tests (WJ-III; Woodcock et al., 2001) received 90 hours of math tutoring over three weeks and 90 hours of reading tutoring over three weeks (order randomly assigned). Behavioral assessment and neuroimaging occurred prior to and after the interventions, yielding three observation points. Changes in performance were quantified by subtracting pre-intervention from post-intervention scores (Math Fluency, Calculation for math; Sight Word Recognition (TOWRE, 1999) and Word Attack (WJ-III) tests for reading). T1-weighted MPRAGEs were acquired on a 3T Siemens scanner. CAT12 (Gaser et al., 2022) was used to measure GMV, CT and WMV. Whole-brain analyses involved (a) a flexible factorial analysis with longitudinally preprocessed pre-math intervention and post-math intervention anatomical measures; and (b) a multiple regression analysis correlating anatomical measures prior to math intervention with changes in math scores over the intervention (controlling for IQ and age). Statistical significance was determined using the following threshold: voxel-wise height $p < .005$ uncorrected, and cluster-level extent $p < .05$ FDR.

Results: On average, participants made gains in Math Fluency ($F(1, 58) = 51$, $p < .05$) and Calculation ($F(1,58) = 33.21$, $p < .05$), but no gains in reading performance ($p > .05$) after math intervention. For neuroanatomical measures, there were (a) increases in GMV in cerebellar vermis III, vermis VI, and left lobule VI, decreases in CT in left insula, and no changes in WMV. There were no changes in these regions following the reading intervention. (b) There was a positive correlation between pre-intervention GMV in left inferior temporal gyrus and gains in Math Fluency (but not reading measures), and no such relationships for measures of CT or WMV.

Discussion: The math intervention resulted in gains specific to math performance, and changes in brain structure specific to the math intervention. Increased GMV in the cerebellum suggests involvement of a region that is associated with learning, although not with mathematical processing, per se. Thinning of the left insula could be attributed to the insula's role in arithmetic. Lastly, greater GMV in left inferior temporal gyrus prior to intervention supports greater gains, signaling a level of readiness for a positive response.

S40. MICROSTRUCTURAL INTEGRITY OF THE HIPPOCAMPUS DURING EARLY CHILDHOOD: RELATIONS WITH VISUOSPATIAL MEMORY

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Background: The hippocampus plays a vital role in episodic memory and changes rapidly during early childhood. In previous developmental studies, hippocampal volume has been weakly associated with memory performance (Botdorf, Canada, Riggins, 2022). However, some have suggested that integrity of the microstructure of the hippocampus (which reflects the presence and organization of neurons and glia) may be a better predictor of memory than volume (e.g., Ibrahim and Bennett, 2023). For example, one developmental study in 4- to 8-year-old children reported associations between integrity of hippocampal microstructure (measured via mean diffusivity) and

source memory performance even after controlling for volume (Callow et al., 2022). The present study aims to extend this previous work to a younger sample and with a visuospatial memory task.
Methods: Data are available from 15 children, Mage = 4.7 years, range 3-5 years, 73% female. All data collection is complete. Specifically, we will examine whether hippocampal mean diffusivity is related to visuospatial memory performance. To assess memory, children ≤ 48 months were presented with 9 images in a 3x3 matrix or children less than 48 months were presented with 12 images in a 3x4 matrix. The task had three phases; encoding, immediate recall and delayed recall. During encoding, children were asked to name the images and were then instructed to remember where they were located in the matrix. Each image was then covered by a blank image and children were asked to point to where each specific object was located. Feedback was given. During immediate recall, children were presented with the images and asked where in the matrix that image was located. No feedback was given. Finally, delayed recall, the children were asked to recall where each image was located after a 2-3 hour delay during which they either took a nap or stayed awake (a within-subjects manipulation). During the nap condition each child went through their typical naptime routine and, after waking, the child participated in 'delayed recall'. During the wake condition, children were instructed to play quietly in their typical nap environment. The wake condition lasted as long as the child's typical nap length after which the child participated in 'delayed recall'. Performance across conditions will be averaged for this poster. Neuroimaging data were collected using a Siemens 3 Tesla Magnetom Trio MRI scanner with a 32-channel coil. DWI will be processed using MRtrix3 commands or MRtrix3 scripts that link the FMRIB Software Library (FSL v6.0.1; Image Analysis Group, FMRIB, Oxford, United Kingdom; https://www.fmrib.ox.ac.uk/fsl/). First, physiological noise due to water molecules' thermal motion will be removed, followed by eliminating Gibbs ringing artifacts, bias field correction, and then brain extraction using the dwi2mask command. The FSL dtifit program will then be used to fit a diffusion tensor model of three eigenvectors and three eigenvalues to each brain voxel, as well as the mean diffusion (MD) tensor metric. A nonlinear warp will be calculated with the ANTS program (Avants et al., 2008) between the b0 diffusion image and each subject's T1 image and each MD map will then be registered to subject specific T1 space using the previously calculated warps. Average MD will then be extracted from each subject's hippocampal ROI's in T1 space.
Results: Regression analyses will then be conducted to examine relations between hippocampal mean diffusivity and memory performance. We will re-run analyses controlling for hippocampal volume to explore whether hippocampal microstructure is a better predictor of memory than volume. All analyses will be conducted for the whole bilateral hippocampus and, if significant, will be followed-up by separate analyses for anterior and posterior subregions to determine presence of any regional specificity.
Discussion: Memory data have been processed, DTI processing is near completion, however, analyses have not yet been completed.

S41. GRAY MATTER VOLUME DIFFERENCES IN CHILDREN WITH READING DISABILITY

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Background: Reading Disability (RD), or developmental dyslexia, is a common learning disability characterized by poor word decoding, thereby negatively impacting educational and vocational outcomes. Neuroanatomical studies of RD have reported relatively less gray matter volume (GMV) in left-hemisphere occipitotemporal, orbitofrontal/inferior frontal, as well as bilateral temporoparietal regions and cerebellum (Eckert et al., 2016; Linkersdörfer et al., 2012; Richlan et al., 2013), aligning with the phonological and orthographic processing deficits that characterize this language-based learning disability. However, consistency of results across these studies is weak, even for meta-analyses, and has been attributed to small, heterogeneous samples and lack of rigor during analyses (Eckert et al., 2016; Ramus et al., 2018). The current study addresses these limitations by utilizing a large sample representative of the US population and rigorous methods.
Methods: Using the Baseline data from the Adolescent Brain and Cognitive Development Study, we drew on native-English monolingual speakers with Matrix Reasoning > 85, NIH Toolbox Picture Vocabulary Test > 70, and no history of schizophrenia, bipolar disorder, autism spectrum disorder, and alcohol use disorder. We selected two RD groups of varying severity: those with a standard score of < 85 (16th percentile) or < 77.5 (5th percentile) on the Toolbox Oral Reading Recognition Test (TORRT) at Baseline and at 2-Year Follow-Up. Selection of the Control groups was based on a TORRT of > 90 at these two time points. Propensity matching ensured all groups were equated on socioeconomic status (SES; using household income) and Matrix Reasoning and resulted in a Control group (N=437) and an RD group below the 16th percentile (N=437); and a Control group (N=166) and an RD group below the 5th percentile (N=157). All groups were also matched on age (9.53 ± 0.5 years). Structural magnetic resonance images from Baseline data underwent standard voxel-based morphometry preprocessing in SPM12 (Ashburner and Friston, 2000). T-test were conducted to test for GMV differences between Control and RD groups with total GMV, SES, study site, ADHD, sex, and pubertal status as covariates of no interest (voxel-wise height threshold $p < .005$ uncorrected, cluster-level extent threshold $p < .05$ FDR).
Results: There was less GMV in the RD group reading below the 16th percentile compared to the Controls in right and in left lobule VIII of the cerebellum. Conversely, this RD group had more GMV than in Controls in the left lingual, superior orbitofrontal (extending into superior frontal) and superior frontal (extending into middle frontal) gyri. There was less GMV in the RD group reading below the 5th percentile compared to the Controls in cerebellar vermis VI (extending into left and right lobule VI), in right lobule VIII, in left putamen (extending into pallidum and insula) and in right putamen. Conversely, this RD group had more GMV compared to controls in the right postcentral (extending into the supramarginal) and right middle occipital (extending into the angular) gyri.
Discussion: Children with RD had less GMV in regions of the cerebellum associated with motor control. In severe RD, there was less GMV in regions of the cerebellum associated with cognition, bilateral putamen, associated with learning and memory, and left insula, associated with speech production. Noticeably absent were differences in those left-hemisphere language regions previously identified in studies of RD. More GMV in RD than Controls appears to depend on the severity of RD. These findings challenge the existing model of the neurobiological basis of RD, suggesting the need for a reevaluation of current perspectives.

S42. CAPTURING HETEROGENEOUS STRUCTURAL BRAIN PHENOTYPES FOR BETTER UNDERSTANDING OF NEURODEVELOPMENTAL DISORDERS: APPLICATION TO DOWN SYNDROME

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Background: Neurodevelopmental disorders are a diverse group of conditions characterized by atypical development of the brain, leading to impairments in cognitive, social, and emotional functioning. Despite significant research efforts, understanding the underlying neurobiology of NDDs remains a challenge. One key limitation is the inherent heterogeneity within these disorders. Individuals with the same NDD can exhibit a wide range of clinical and neuroimaging presentations. In this work, we present a novel approach that embraces the heterogeneity of both typical and atypical brain development. The approach detects and describes atypically appearing regions in structural MRI via a machine learning model that captures typical brain development. We applied this approach to a study of Down syndrome (DS) at school age. While DS is the most prevalent chromosomal disorder and a leading cause of intellectual disability, its neurobiology remains poorly understood and significant heterogeneity in DS has been observed.

Methods: We generated a descriptive map of typical brain phenotypes from 1600 typically developing subjects in the ABCD and HCP-D datasets with inclusion criteria: age 9-11, no CBCL subscale t-score > 1.5 standard deviation. Atypicality analysis was performed in a cohort of 28 DS children, age 7-12.

T1 and T2-weighted MRI data is processed via a traditional pipeline including brain masking. Training is performed solely on 80% of the typical MRI data (10% for validation, 10% for testing).

Our atypicality detection is performed by a local, patch-based extension of our Multiscale Score Matching Analysis (MSMA), which employs the gradient of the log-likelihood with respect to the typical MRI data. A grid-based self-organizing map (SOM) is fitted to the MSMA scores of typical data. This grid of brain MRI phenotypes captures the heterogeneity of typical brain appearance. DS data are then tested for atypicality and assigned to the best-fitting brain phenotype (according to their MSMA scores). The set of DS brain phenotypes is determined by selecting all phenotypes capturing at least 10% of DS subjects. Via MNI-reference space registration, DS brain phenotypes are compared by their average atypicality scores within AAL regions. A correlation analysis between atypicality/MSMA scores and cognitive assessment scores (CBCL, DAS/Differential Ability Scales, Vineland-II) within the major phenotypes is performed.

Results: Our MSMA atypicality analysis showed a 95% (sensitivity) detection of DS subjects with a 12% detection error. We observed 3 distinct DS brain phenotypes, with a single, major DS phenotype capturing 57% of DS subjects. Atypical brain regions at the major DS phenotype differ in their atypicality scores as compared to the other 2 minor DS phenotypes in several brain regions,

in particular across the cerebellum, the inferior and medial temporal regions, and the inferior frontal lobe regions. Regional atypicality scores at the major DS phenotype correlated significantly with CBCL depression and internalizing subscales, DAS recall-of-designs and spatial ability scores, as well as the Vineland communication subscale (higher atypicality = > worse scores). Stability analysis showed that this atypical DS brain phenotype description is stable with respect to phenotype grid size.

Discussion: We show that our MSMA atypicality approach successfully and stably computes a descriptive map of brain phenotypes that captures typical and atypical brain development. We correctly detect individuals with DS solely based on structural brain MRI, and identify three distinct DS brain phenotypes highlighting the inherent heterogeneity within DS. At the major DS phenotype, DS subjects showed atypicality scores that correlated with cognitive assessments. These findings suggest that capturing structural brain heterogeneity can provide valuable insights into the neuroanatomical correlates of both the core features and the variable presentations of DS.

S43. A BRAIN-TO-BRAIN EEG PILOT STUDY OF ADOLESCENT AUTISTIC FRIENDSHIPS DURING DYADIC COLLABORATION

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Background: A critical aspect of developing and maintaining friendships involves high-quality communication, particularly when working towards a shared goal (Brennan and Enns, 2015); however, there is limited work specifically exploring how autistic adolescents use communication during collaboration or play with their friends. The Diapix task (Engen et al., 2010) was originally developed for linguistic analysis of dyadic collaboration thus is a well-validated tool to measure communication effectiveness. Prior work using this task demonstrated that autistic children and adolescents are less likely to match prosody of their partner (Lehnert-LeHouillier et al., 2020; 2022) and similar phonetic convergence as neurotypical peers (Hong et al., 2022), yet no other work has looked at the brain correlates, let along the synchrony between both individuals.

Methods: Participants will include 10 autistic adolescents (aged 12-17 years) and their self-selected, co-enrolled friend. Each participant will come for two visits, such that they will complete procedures first with their friend and repeat the procedures with a stranger. Adapted from the DiapixUK study (Baker and Hazan, 2011), participants will work with a friend and stranger to find differences in two images. Participants will be shown a set of similar social images (i.e., people having a beach day) and a set of similar nonsocial images (i.e., objects placed around a room; custom made in Canva) and asked to work with their partner to find all the differences in the images. Each dyad will work to find as many differences as possible for 10 minutes, with social and nonsocial images alternating and counterbalanced across participants to ensure no order effects. High-density electroencephalography (EEG) will be collected using two MagStim EGI geodesic systems with heartrate simultaneously recorded (not used for current analyses). Raw data will be preprocessed and epoched into 500 ms bins. Data collection will be completed by August 2024 and analyze prior to Flux.

Results: We plan to extract frontal alpha asymmetry (FAA) as the natural log transformed absolute alpha power (8-12 Hz) for left relative to right [i.e., ln(right) – ln(left)] for each trial. Multilevel models will be used to evaluate the specificity of friends (first visit) versus stranger (second visit)

and effects of condition (social vs. nonsocial). MLM will be conducted using R (version 4.0.3). MLM for each outcome will be conducted through a systematic model building approach (i.e., null model to main effect model to model with moderator/s). Significance random effects will be allowed to estimate in each of the models. To accommodate repeated measures, models include a random intercept per participant and fixed effects of context (2: friend, stranger), diagnosis (autism, non-autism), condition (social, nonsocial), and the interactions. We predict that increased FAA will be observed for friends relative to strangers in all participants. We predict that this is likely to be moderated by condition and diagnosis.

Discussion: This study offers a methodological innovation by incorporating a task that will gather rich data surrounding moment-by-moment social interactions with friends and strangers. Using a real-time and interactive task (collaborative game), we will replicate different social scenarios that autistic adolescents would experience in real-world social interactions.

S44. COMPARING WHITE MATTER HYPERINTENSITIES BURDENS AMONG NEUROPSYCHOLOGICAL SUBGROUPS OF ADULTS WITH DOWN SYNDROME WITHOUT DEMENTIA

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Background: Persons with Down Syndrome (DS) develop dementia due to Alzheimer's disease (AD) and certain cerebrovascular diseases (CVD) in later life. Despite the heterogeneity in neuropsychological abilities in DS, it is unclear whether distinct neuropsychological phenotypes exist and whether they are related to CVD. This study explores heterogeneity in neuropsychological abilities by identifying neuropsychologically defined subgroups and their link with a neuroimaging CVD marker measured by white matter hyperintensity (WMH) in DS.

Methods: The sample included 174 adults with DS from the Alzheimer Biomarkers Consortium-Down Syndrome (ABC-DS) without dementia who underwent neuropsychological assessments and neuroimaging, including amyloid PET and MRI. A latent profile analysis (LPA) identified subgroups using age- and sex-adjusted standardized scores of 8 neuropsychological tests that evaluate episodic memory, executive processing and speed, visuospatial construction, and adaptive/maladaptive behaviors. Analysis of covariance (ANCOVA) compared the mean WMH burdens across the subgroups.

Results: 3 distinct subgroups were identified (AIC=3474.371; BIC=-3632.324; ICL=-3662.288; BLRT $p < 0.001$) characterized by 1) overall high performance with a relative weakness in episodic memory (29.3%); 2) average performance with a prominent strength in visual episodic memory (33.9%); 3) overall low performance with very low executive processing and maladaptive behavior (36.8%). The groups differed in age, % intellectual disability level, and % mild cognitive impairment (MCI). Global WMH burden significantly differed among the groups ($F(2,170)=3.060$; $p=0.049$; $\eta^2=0.032$), but the post hoc test presented no WMH burden difference

between pairs. Frontal ($F(2,170)= 3.898$; $p= 0.022$; $\eta^2=0.041$) and temporal lobes ($F(2,170)= 4.648$; $p= 0.010$; $\eta^2=0.050$) presented different WMH burdens between at least one pair of groups.
Discussion: Distinct subgroups identified by neuropsychological performance exist among adults with DS without dementia that are associated with age, intellectual disability, and MCI. The current study found global differences in WMH burden among the three subgroups in the frontal and temporal lobes. However, further studies are needed with a better hypothesis to investigate the differential associations between neuropsychological phenotypes and WMH and how that is associated with dementia due to AD in DS.

S45. CHILD SENSORY HYPERSENSITIVITY: PARENTAL INSECURE ATTACHMENT STATE OF MIND AND DISTRESS AS RISK FACTORS

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Background: Sensory hypersensitivity (HS), observed in children with a low neurological threshold (Dunn, 2007), has been associated with elevated cortisol levels (Nachmias et al. 1996), a greater activation of the central nervous system (Jagiellowicz et al., 2020) and anxiety (Carpenter et al., 2019). Studies indicate that maltreated children show high reactivity to stress and atypical sensory regulation (e.g., Maier, 2023). Although HS is a biological marker, it is likely that maltreatment, due to the high levels of stress it inflicts on children, chronically activates their central nervous system, giving way to sensory dysregulation. Maltreating parents are more likely to have lived themselves traumatic experiences during their childhood (Madigan et al., 2019) and show insecure or disorganized attachment states of mind and parental distress (Sauvé et al., 2021; Austin et al., 2020). Furthermore, parental distress could contribute to children's sensory difficulties through less effective emotional regulation and co-regulation of the child's sensory state (Bariola et al., 2011). The objective of this study is to examine whether maltreating parent's attachment state of mind has an indirect effect on child sensory hypersensitivity through parental distress.
Methods: The sample comprised 80 children aged between 0 and 5 years (Mage = 16.26 months, SD = 19.65; 58.8% boys) and their parents (Mage = 27.89, SD = 6.65) with substantiated maltreatment made by child protective services (CPS). With the help of a professional, parents completed the Sensory Profile questionnaire (Dunn, 1999), which measures child sensory hypersensitivity. Parents also completed the Parenting Stress Index (PSI; Abidin, 1995), assessing parental distress. The Adult Attachment Projective (AAP; George, West et Pettem, 1997) was administered to assess the parents' secure and insecure attachment states of mind.
Results: A regression with Process (Hayes, 2012) showed a significant direct effect of insecurity attachment state of mind on child HS ($b=0.81$, $p=0.001$), but not significant effect of attachment disorganization ($b= 0.31$, $p=0.21$). An indirect significant effect of attachment insecurity on HS via parental distress ($b=0.07$ CI -0.28, -0.001) was also found.
Discussion: Findings highlight the importance of addressing parental distress to reduce child's HS in maltreating families and the parent has an insecure state of mind.

S46. INVESTIGATION OF WHITE MATTER MICROSTRUCTURAL AND MACROSTRUCTURAL DIFFERENCES IN CHILDREN BORN PRETERM

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Background: Children born prematurely (< 37 weeks gestational age) face heightened risks for motor, behavioral, cognitive, and neurodevelopmental challenges. While diffusion MRI has investigated white matter development in preterm infants and adolescents, research during early childhood (ages 4-8) remains limited. Fixel-based analysis (FBA) offers a method to quantify and monitor alterations and developmental differences in white matter micro- and macrostructural properties.

Methods: In our study, we employed FBA to examine how fixel-based metrics (fiber density (FD), cross-section (FC), and a combination of these properties (FDC)) in major white matter bundles are associated with gestational age. We collected multi-shell diffusion MRI data from 83 preterm children (gestational age < 37 weeks; 45 females; mean age 5.43 years) and 138 full-term children (gestational age ≥37 weeks; 80 females; mean age 5.53 years), with a subset followed up after 12 months.

Results: Using linear mixed-effects models, we identified significant positive associations between gestational age and fixel metrics across most major white matter bundles, excepting the fornix bundles and inferior longitudinal fasciculi. Notably, while associations with fiber density were observed, the most pronounced effects were seen with fiber cross-section, emphasizing the impact of prematurity on macroscopic fiber bundle size development.

Discussion: Overall, our findings indicate widespread white matter alterations in prematurely born children during early childhood, with gestational age serving as a robust predictor of fiber tract-specific differences. Identifying the precise location and nature of white matter alterations in preterm birth could help understand associated neurodevelopmental outcomes

S47. TASK CONTROL NETWORK FUNCTION AS A POTENTIAL COMPENSATORY MECHANISM AND PREVENTION TARGET FOR CHILDREN WITH SUBCLINICAL OBSESSIVE-COMPULSIVE SYMPTOMS DURING COGNITIVE CONTROL

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Background: Subclinical obsessive-compulsive symptoms (OCS) are present in up to 19% of children and increase later risk for obsessive-compulsive disorder (OCD). Deficits in cognitive control functions like conflict and error monitoring are implicated in the pathophysiology of pediatric OCD, likely deriving from abnormal engagement of task control networks (i.e., frontoparietal [FPN], cingulo-opercular [CON]). However, less is known about cognitive control processes and their neural substrates in the development of subclinical OCS, limiting our understanding of the neurobiological similarities between OCS and OCD and effective prevention strategies. This is especially relevant during middle childhood, a period when cognitive control is maturing and associates with individual variability in CON and FPN function.

Methods: Children (8–12 years) with OCD (N = 72), subclinical OCS (N = 26), and healthy controls (HC; N = 55) completed the Multisource Interference Task (MSIT) while undergoing fMRI.
Participants identified the position of a target number among three digits, with the target position either congruent or incongruent with its value.

Results: Preliminary whole-brain analyses conducted at $p < .005$ in a subset of participants (N = 66) revealed that children with OCD and OCS displayed CON and FPN hyperactivation during error trials and CON hypoactivation during incongruent conflict trials, relative to HC youth. Furthermore, less symptom severity was dimensionally associated with more abnormal CON engagement during errors (i.e., right anterior insula hyperactivation; k = 223) and conflict trials (i.e., right dorsal anterior cingulate hypoactivation; k = 168) among youth with OCD and OCS, despite being associated with faster responding on conflict trials ($\beta = 3.74$, $p = .033$). These results suggest that conflict-related CON suppression and error-related CON engagement may be protective for children with subclinical OCS at risk for developing OCD and those with clinically significant illness.

Discussion: Given the considerable variability in symptom presentation in children with OCS and OCD, and of task control network function in middle childhood, we are currently employing unsupervised latent profile analysis (LPA) to identify participant clusters characterized by distinct patterns of MSIT-elicited activation in the CON and FPN for interference and error trials. LPA employs a categorical latent variable to accommodate the existence of multiple underlying distributions, making it ideal for modeling heterogeneous brain activity and likely improving the detection of individual differences in task control networks. HCs are being used as training data in the model estimation, which facilitates variance estimation and enables identification of atypical and typical brain activity. LPA will be completed before the 2024 Flux Congress, and we predict that they will reveal separable clusters of OC-affected children uniquely displaying (1) CON/FPN hyperactivity during errors, (2) CON/FPN hypoactivity during conflict, or (3) typical function. We further predict that abnormal brain function during error and/or interference will be associated with cognitive control deficits in children with OCD, but not subclinical OCS, given their in-tact behavioral performance. Identifying LPA-defined profiles of cognitive control network dysfunction may guide the development of treatments tailored to specific neurobiological profiles of OCD and/or inform strategies for preventing escalation of symptom severity in children with subclinical OCS.

S48. PEDIATRIC ANXIETY AND NEURAL-AUTONOMIC COHERENCE DURING SCARY MOVIE WATCHING

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Background: Anxious children display heightened peripheral physiological responses to threat (e.g., increased heart rate and perspiration), driven by alterations in autonomic balance. Moreover, evidence indicates the degree to which these peripheral signals are subjectively monitored is altered in anxiety. Traditional threat-paradigms outline that the amygdala, insula, and subgenual anterior cingulate form some of the key regions responsible for such communication with peripheral physiology. A more naturalistic approach to studying this response comes with the

introduction of scary movies. No study to date has used this approach to study neural-autonomic communication in pediatric pathological anxiety. In the current study, we compared healthy vs anxious children's physiological (i.e., skin conductance) responses at rest and during a scary movie. Next, we sought to investigate the extent to which coherence between brain activation and physiological responses in anxious children compared between conditions.

Methods: 23 children with an anxiety disorder and 32 healthy children between the ages of 8 to 17 (Mage = 14.36) participated. Participants underwent fMRI scanning during a scary movie with resting-state scans prior to and following the movie. Autonomic responding was assessed via skin conductance responses (SCR). We then extracted activation time series for amygdala, insula, and subgenual anterior cingulate and correlated these with skin conductance for each condition to produce measures of neural-autonomic 'coherence'.

Results: Addressing our first aim, a mixed-ANOVA revealed a significant effect of condition on skin conductance responses ($F(2, 110) = 7.33$, $p = .002$). T-tests revealed differences between the pre-movie resting state condition and scary movie across both anxious and healthy children drove this relationship ($p = .001$). When examining the association between brain activity and skin conductance, we found effects of condition in the coherence between SCR with the left amygdala and bilateral insula ($p < .05$) but did not detect effects in the bilateral sgACC. T-tests revealed differences between coherence in the scary movie resting state condition and the post-movie resting state condition drove this relationship. No models revealed evidence that diagnosis (anxious vs healthy) was significantly associated with skin conductance or coherence.

Discussion: Here, we found evidence that children's autonomic responses are altered during scary movie-watching, replicating findings from traditional cognitive-based fear paradigms. Next, we found altered coherence between neural and autonomic responding as a function of condition, though this did not differ by diagnosis. This suggests movie-induced states of anxiety impact neural-autonomic communication. This work highlights how scary movies are a useful paradigm for probing neural-autonomic communication. Future work should seek to elucidate the unique contributions of threat hypervigilance and interoceptive awareness, as well as continued exploration of these effects in pathological anxiety in driving these effects.

S49. INVESTIGATING THE NEUROBIOLOGICAL BASIS OF PSYCHOPATHOLOGY USING BI-FACTOR MODELS: RELIABLY GENERAL OR UNRELIABLY SPECIFIC

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Background: Despite sustained efforts to uncover the neurobiological basis of mental health disorders, finding links to specific syndromes using neuroimaging has remained challenging. Factors contributing to this include high comorbidity among disorders and heterogeneity within diagnostic categories. In response, the field has frequently adopted models that separate the shared (or general, transdiagnostic) and the unique (or specific) dimensions of psychopathology. Such bi-factor models offer the possibility to disentangle the general and unique biological underpinnings

of psychopathology. However, to investigate associations between individual differences in neurobiology and psychopathology such dimensions also require sufficient test-retest reliability. Here we evaluate the reliability of 11 published bi-factor models in two large developmental datasets of adolescents from the global north and south and investigate the impact of reliability on their associations with brain function.

Methods: We used items from the Child Behaviour Checklist (CBCL) to fit 11 bi-factor models in the ABCD (n = 6972, ages 9-10 at baseline, mean retest interval = 12 months) and BHRC (n = 772, ages 6-14 at baseline, mean retest interval = 8 months) datasets. CBCL items were configured to load on a single general factor and a varying number of specific factors as defined in the literature. Test-retest reliability was then assessed using correlation, after regressing out participant age, timepoint and their interaction. Sensitivity analyses were performed using alternative reliability metrics (omega and factor determinacy) and shorter retest intervals. Next, we used resting-state functional connectivity to predict general and specific factors in the ABCD using linear ridge regression within nested 2-fold cross-validation using matched discovery (n=3,525) and replication (n=3,447) samples. Bi-factor models were fit in Mplus, separately in each sample to avoid data leakage and improve replicability. Preprocessed resting-state fMRI data were acquired from the ABCD BIDS Community Collection and parcellated using the Glasser atlas. All reliability and prediction analyses were repeated with standard CBCL summary scores to compare with factors.

Results: For all 11 models, the general "P" factor captured most variance across CBCL items (ECV ABCD = 0.57-0.78; ECV BHRC = 0.6-0.79) and had generally higher test-retest reliability (rABCD = 0.7-0.76; rBHRC = 0.55-0.59) than specific factors (rABCD = 0.36-0.61; rBHRC = 0.14-0.47). Despite the favourable psychometric properties, p-factors could be predicted (meanR2 = 0.012) with a comparable prediction accuracy to externalising (meanR2 = 0.013) and attention (meanR2 = 0.01) factors. Notably, p-factors were highly correlated with CBCL total problems summary score (r = 0.88-0.97). They also showed equivalent reliability (r = 0.76) and prediction accuracy (R2 = 0.015) to total problems, as well as other factors like attention, externalising, social problems and rule-breaking that combine all sources of variance and ignore the multidimensional structure parsed by the bi-factor models. Finally, regions most informative to prediction (regression weights) were highly similar between P factors and total problems (r = 0.48).

Discussion: Here we demonstrate that while capturing most of the reliable variance in CBCL, general psychopathology factors showed comparable associations with brain connectivity to specific factors and summary scores. Across all bi-factor models, many specific factors displayed low test-retest reliability that substantially attenuated associations, making comparisons between factors hard to interpret. These results suggest that deeper phenotyping is necessary to better characterise the variance unique to specific dimensions. Finally, while bi-factor models are better suited to address phenotypic complexity and heterogeneity in psychopathology, to date, general factors exhibit predictive utility comparable to that of the CBCL total summary score.

S50. NEUROBEHAVIORAL INDICES OF INTIMATE SELF-DISCLOSURE AND DEPRESSION RISK IN THE CONTEXT OF SOCIAL MEDIA USE IN ADOLESCENT GIRLS

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Background: The rise of social media in the lives of adolescent girls provides unprecedented opportunities to share personal details with others. Engaging in self-disclosure on social media can engender closeness, but it can also result in social rejection and invalidation, established risk factors for depression, at a scale not otherwise experienced offline. This project will examine whether social media use moderates the link between neurobehavioral indices of intimate self-disclosure and depressive symptoms in adolescent girls.
Methods: For this study, I will focus on Aims 2a and 2b of my pre-registered dissertation research [https://osf.io/n6y37] using data from the NIH-funded Transitions in Adolescent Girls Study (N=174, baseline ages 10-13 years). I will utilize an innovative and validated neuroimaging task that captures the neurobehavioral indices of intimate and superficial self-disclosure, in conjunction with measures of social media use and depressive symptoms. This study has two primary hypotheses: social media use will significantly interact with 1) the frequency of intimate self-disclosure decisions, and 2) neural activation in affective decision-making regions – medial orbitofrontal cortex (mOFC), dorsomedial prefrontal cortex (dmPFC), dorsolateral prefrontal cortex (dlPFC) – during intimate self-disclosure decisions to predict depressive symptoms. Together, these regions of interest (ROIs) affect socio-affective decision-making through subjective valuation, self-regulation, and social cognition. While the interaction between social media use and neurobehavioral indices of intimate self-disclosure will better predict changes in depressive symptoms than models testing social media and depression alone, the directionality of the neural effects will vary by ROI.
Results: Data collection is complete and all analyses will be completed by the conference. Functional MRI data was preprocessed using field-consensus procedures via fMRIPrep. Mean parameter estimates of BOLD activity in a priori ROIs (mOFC, dmPFC, dlPFC) will be calculated as an average across every voxel in the ROI defined by the Glasser (2016) parcellation, for each participant, for each task condition (intimate, superficial). Multiple comparisons across ROIs will be corrected. The contrast of interest is the neural activity indexed by the BOLD response evoked during intimate versus superficial self-disclosure decisions. Social media use was measured by self-report and passively detected screen time, and will each be tested as moderators. The primary outcome of interest is depressive symptoms measured by self-report. Covariates will include age and socioeconomic status. Using multi-level modeling, I will separately test the interaction between a) duration of social media use and frequency of intimate self-disclosure decisions and b) social media use and neural (mOFC, dmPFC, dlPFC) indices of intimate self-disclosure decisions as it relates to depressive symptoms, controlling for baseline depressive symptoms.
Discussion: The overarching objective of this project is to advance our knowledge of whether intimate self-disclosure in adolescent girls represents a unique risk factor for depression in girls, especially in the context of high social media use. By identifying modifiable behaviors that confer risk for depression in the context of social media use, this project will inform future work on early prevention and intervention for depression in adolescent girls.

S51. AMYGDALA-ANTERIOR CINGULATE CONNECTIVITY DURING MOVIE-WATCHING IN ANXIOUS YOUTH

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Background: Anxiety is estimated to affect one third of the general population during their lifetime and approximately 9.4% of children experience pathological anxiety. Yet, our understanding of the fundamental neural underpinnings of anxiety remains limited. Conventional neuroimaging Methods: that utilize threat of shock have outlined an amygdala-anterior cingulate circuit that may drive aberrant fear responses. Little is known about the extent to which these effects are present in more naturalistic conditions.
Methods: Here, we utilized resting-state and suspenseful movie-watching paradigms to assess anxiety-potentiated changes in functional connectivity between the amygdala and anterior cingulate in clinically anxious (n=36) and non-anxious (n=45) youth. We predicted that: 1) anxious youth will exhibit increased engagement of left amygdala-dACC connectivity during the movie; 2) anxious youth will exhibit increased engagement of right amygdala-ACC connectivity during the movie; 3) this heightened response will be sustained following the movie for the anxious participants.
Results: 2 (HVs vs. Patients) x 3 (pre-movie resting state, movie-watching, and post-movie resting state conditions) repeated measures ANOVA on amygdala-ACC functional connectivity demonstrated no significant main effects of condition ($F(1.78, 131.95) = 0.866$, $p = 0.412$), Diagnosis ($F(1, 74) = 0.994$, $p = 0.322$), or interaction effects ($F(1.78, 131.95) = 1.283$, $p = 0.279$) on left amygdala-ACC functional connectivity. Similarly, analysis of the right amygdala functional connectivity revealed no significant main effects of Condition ($F(1.68, 124.28) = 1.315$, $p = 0.270$), Diagnosis ($F(1.68, 74) = 0.000774$, $p = 0.978$), or significant interaction effects ($F(1.68, 124.28) = 2.472$, $p = 0.098$). These results indicate that right amygdala-ACC connectivity may not be influenced by anxiety disorders or task conditions in the present sample.
Discussion: Contrary to findings from the task-based literature, we did not detect significant differences in amygdala-ACC functional connectivity between healthy volunteers and anxious youth across conditions. Our results suggest that amygdala-ACC functional connectivity may not be sensitive to differences in movie-evoked anxiety nor pathological levels of anxiety. We encourage future research to expand this search to other circuitry and incorporate dynamic features of the movie stimuli into functional connectivity. Additionally, as opposed to the present cross-sectional approach, investigating the longitudinal trajectories of these networks in youth may provide insight into the development and progression of anxiety within individuals. Moreover, investigating samples across a wider spectrum of diagnoses, including youth with comorbid anxiety and depression, could yield valuable insights into the underlying neural mechanisms of affective disorders.

S52. RESTING-STATE EEG POWER IN CHILDREN WITH AUTISM, ADHD AND CO-OCCURRING DIAGNOSES: INTERACTIVE AND ADDITIVE EFFECTS

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Background: Autism and Attention-Deficit/Hyperactivity Disorder (ADHD) have a high rate of co-occurrence and overlapping behavioral features. In addition to behavioral presentations, there

are also proposed overlapping neurobiological processes including altered patterns of functional brain network activity, such as top-down/bottom-up processing and excitatory/inhibitory (E/I) imbalances. Resting-state EEG (rsEEG) is a tool which can measure neurophysiological differences and allows greater understanding of heterogeneity within clinical diagnoses and their co-occurrence. Resting-state EEG has been used in both autism and ADHD research and is a focus of exploration in the Autism Biomarker Consortium for Clinical Trials. The aim of this preliminary analysis was to investigate the individual and additive impacts of autism and ADHD diagnoses on rsEEG power spectral features compared to neurotypical children.

Methods: Continuous EEG data were recorded from participants across four groups (autistic without ADHD, N=44; ADHD, N=47; autistic+ADHD, N=41; neurotypical, N=39), ages 36m-96m (69m +/- 14.9), while children watched a video of floating bubbles to elicit rsEEG. Data were preprocessed using HAPPE. Absolute power was calculated across four frequency bands (theta, alpha, beta, and gamma) and four brain regions (frontal, central, parietal, and occipital). Absolute power values were then log transformed and those values were used to calculate relative power values. Diagnostic group differences in rsEEG power were tested using linear models controlling for developmental quotient, sex, age, and stimulant usage. Finally, correlations between rsEEG and autism- and ADHD-related behaviors were assessed using parent report on the Social Responsiveness Scale, 2nd Edition (SRS-2) and the ADHD Rating Scale (ADHD-RS), respectively.

Results: Results indicated that compared to neurotypical children, autistic children had higher relative occipital beta power ($p=0.015$), and children with ADHD had increased absolute parietal beta ($p=0.018$). Co-occurring autism and ADHD was associated with lower relative power in frontal alpha ($p=0.032$) and central alpha ($p=0.034$) compared to typical controls. Among the autistic children with co-occurring ADHD, increased relative parietal beta power was associated with higher scores on the ADHD Rating-RS ($p=0.013$), which was not found in the autism- and ADHD-only groups.

Discussion: Results indicate an additive effect in frontal and central alpha leading to decreased power in autistic children with co-occurring ADHD and increased occipital/parietal beta in autism-only and ADHD-only groups, respectively. Furthermore, increased power in parietal beta was associated with increased ADHD-related behaviors in the autistic children with co-occurring ADHD. These findings align with previous research reporting reduced fronto-central relative alpha power and increased occipital beta power associated with autism, as well as increased parietal beta in ADHD groups. These results also map onto associations between these bands and differences in neural control networks and behavior (i.e., top-down control). These findings suggest that EEG power differences previously established are accentuated in the combined group, potentially indicating extra-additivity when there is co-occurrence of autism and ADHD. Future research should further examine the nature of additive effects between these diagnostic groups to better understand heterogeneity in existing biomarker research and serve as a starting point for developing a co-occurring diagnostic biomarker.

S53. SEX AND AGE EFFECTS IN CHILDREN WITH ADHD WITH AND WITHOUT COMORBID OPPOSITIONAL DEFIANT DISORDER ON HOT AND COLD EXECUTIVE FUNCTION

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Background: Oppositional defiant disorder (ODD) is the most common comorbidity in children with attention deficit/hyperactivity disorder (ADHD). Improved characterization of clinical features and cognitive/emotional neurobehavioral functioning in ADHD with and without ODD from childhood through adolescence is important for understanding the clinical phenotype and developmental progression to inform intervention. This study expands the limited existing literature examining subjective symptom measures of ADHD and emotion dysregulation and objective task-based measures of "hot" executive function (EF; e.g., delay discounting [DD], frustration tolerance) and "cold" EF (e.g., inhibition, response variability, working memory) in children with ADHD with and without comorbid ODD relative to typically developing (TD) youth and testing for sex and age interactions from childhood to adolescence.

Methods: Participants include 372 youth ages 8-17 years classified as ADHD (n=158), ADHD+ODD (n=74) and TD (n=140) with comorbid anxiety or depression and stimulant medication (discontinued for lab visits) permitted. We obtained questionnaire measures of ADHD symptoms (Conners), broad externalizing and internalizing psychopathology (BASC) and irritability (ARI) and children completed game time DD, mirror tracing persistence (MTPT), go/no-go (GNG), and spatial span tasks to assess hot and cold EF. General linear models were employed to test for effects of diagnostic group, sex, and their interaction on symptom and EF measures in childhood (ages 8-12) and linear mixed effects models were applied to examine age-related changes in clinical features from childhood through adolescence (ages 8-17 years) as a function of childhood diagnostic group.

Results: In childhood, ADHD+ODD females showed higher inattentive symptoms than ADHD females ($p=.043$) and ADHD males ($ps < 0.001$), while ADHD+ODD males showed higher hyperactive-impulsive symptoms than ADHD males ($p=.028$) with no significant difference for females ($p=.168$). Children with ADHD+ODD showed higher emotional lability symptoms than ADHD only, regardless of sex ($ps < .001$). ADHD groups showed higher internalizing symptoms than TD, regardless of sex or ODD comorbidity ($ps < .001$). Parent-rated irritability suggests that ADHD+ODD groups showed higher irritability than ADHD-only groups, regardless of sex ($ps < .004$), with child self-report revealing a similar pattern.

In childhood, ADHD+ODD females showed higher DD than TD females ($p=.013$) but no other groups differed. For the MTPT, children with ADHD ($p=.030$) and ADHD+ODD ($p=.015$) showed lower frustration tolerance than TD, with too few females to test for sex effects. On the spatial span task, ADHD males showed lower visual-spatial working memory than TD males ($p < .001$) and ADHD+ODD males ($p=.053$). On the GNG task, ADHD males (regardless of ODD) showed higher reaction time variability and made more inhibition errors than TD males ($ps < .05$), whereas ADHD females showed higher reaction time variability than TD ($ps < .05$) but no other groups differed.

Regarding developmental changes in symptoms, a group*sex*age interaction was observed for child-rated irritability, such that ADHD+ODD females showed a significant decrease in irritability whereas ADHD-only females showed a significant increase in irritability. Otherwise, group*age interactions were observed for ADHD symptom measures, with similar decreases in inattentive and hyperactive/impulsive symptoms in both ADHD groups. There was also a trend for a greater reduction in irritability and emotional lability in females with ADHD+ODD relative ADHD only.

Discussion: In conclusion, while symptom measures consistently differentiated ADHD from ADHD+ODD groups in childhood, hot and cool EF differences varied across measures and by sex

as did age effects for symptom measures. This study demonstrates the importance of considering hot and cool EF in relation to clinical presentation in youth with ADHD with and without comorbid ODD.

S54. ASSOCIATION BETWEEN APERIODIC ELECTROENCEPHALOGRAPHY ACTIVITY AND EXECUTIVE FUNCTIONS AMONG AUTISTIC CHILDREN AND CHILDREN WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

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Background: Periodic neural oscillations detected through electroencephalography (EEG) have been widely studied as key markers of brain activity in autism and ADHD. However, aperiodic EEG activity also provides insight into the neural mechanisms of these neurodevelopmental disorders. The aperiodic spectral slope quantifies the spontaneous neural oscillatory activity that is thought to play a role in regulating how the brain reacts to external stimuli, has links to excitation/inhibition balance, and has previously been associated with executive function (EF). Recent efforts have been focused on identifying biomarkers of ADHD and autism through resting state EEG. Previous research has shown that autism and ADHD are associated with developmental differences in the resting aperiodic slope (i.e., atypically flattened aperiodic slope). Additionally, both autism and ADHD are associated with executive function differences across the EF domains of inhibition, shifting, and working memory. Less is known about how diagnosed co-occurring autism and ADHD impacts resting state EEG activity and EF deficits. The current study examines the association between resting aperiodic slope and EF (inhibition, shifting, working memory) in children with autism and/or ADHD.

Methods: Participants were 132 children, 3-to-8 years of age (M=74.28, SD=14.30 months) from three diagnostic groups: autistic without ADHD (N=44), ADHD (N=47), and autistic+ADHD (N=41). EF difficulties were assessed using the parent-report Behavior Rating Inventory of Executive Function. Continuous EEG data were recorded while participants watched a video of floating bubbles to elicit resting state activity (rsEEG). Data were preprocessed using the HAPPE processing pipeline and aperiodic slope and offset were calculated using the FOOOF toolkit. Multivariate regression models were run in R Statistical Software to test if diagnostic group moderated the relationship between aperiodic slope and EF difficulties. Three models, one for each outcome, were run and included interactions of aperiodic slope and diagnostic group, along with covariates: sex, age, developmental quotient, and use of stimulant medication.

Results: Findings indicate that a lower gradient (i.e. flatter) aperiodic slope is associated with greater inhibition difficulties in children with ADHD ($B = -18.04$, $SE = 8.36$, $p < .05$) but not in autistic children ($B = -12.93$, $SE = 7.77$, $p = .098$) or autistic children with co-occurring ADHD. Aperiodic slope was not associated with either shifting or working memory in children with autism and/or ADHD.

Discussion: Parents of children with ADHD who had lower gradient aperiodic slope during resting state EEG reported that their child had more difficulty with inhibiting behavior, such as resisting

impulses and considering consequences before acting. The same relationship was not found for the other groups. Aperiodic activity is crucial for modulating various cognitive processes such as perception, attention, and stimulus processing and is linked to excitation/inhibition (E/I) balance in children. A flatter aperiodic slope, which indicates greater neural noise and desynchronization, suggests an altered E/I balance in children with ADHD, but this finding was not present in children with either autism or autism and co-occurring ADHD. Aperiodic slope in resting-state EEG may serve as a useful marker for understanding neural mechanisms related to inhibition in children with ADHD. Furthermore, the lack association for autistic children or those with co-occurring ADHD may imply that the neural mechanisms related to aperiodic activity and inhibition are different in these groups compared to children with ADHD alone. Results highlight the importance of considering the heterogeneity of neurodevelopmental conditions in understanding brain function.

S55. PHYSICAL ACTIVITY IS ASSOCIATED WITH WHITE MATTER FIBRE ORGANISATION IN CHILDREN WITH ADHD: NEW INSIGHTS FROM FIXEL-BASED ANALYSIS

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Background: Research in typically developing children suggests that physical activity (PA) is associated with individual differences in white matter fibre organisation. However, studies are yet to establish if this association is also present in children with attention deficit hyperactivity disorder (ADHD). To examine if individual differences in PA were associated with white matter fibre organisation in children with ADHD, this study estimated structural and morphological properties of four sensorimotor white matter pathways commonly implicated in ADHD and considered relevant to PA.

Methods: Participants were 29 children with ADHD (20 females, mean age = 8.76 years). High angular multi-shell diffusion data (b = 1500, 5000 with 25 and 64 directions respectively) and T1-weighted structural data were collected on a 3T MRI scanner. The cerebellar peduncles, the corpus callosum, the corticospinal tract, and the superior longitudinal fasciculus were reconstructed using TractSeg, a semi-automated tractography method. For each tract, we derived measures of fibre density (microstructure) and fibre bundle cross-section (morphology) using Fixel-Based Analysis (FBA), a novel and fibre specific analysis framework. Individual differences in PA were assessed using the Youth Physical Activity Questionnaire and quantified using Metabolic Equivalent of Task (MET) values. Non-parametric permutation testing, and partial correlations were used to examine the association between rates of PA and white matter fibre organisation.

Results: Non-parametric permutation testing, and partial correlations demonstrated that increased PA was associated with higher fibre density (microstructure) in the cerebellar peduncles and in the superior longitudinal fasciculus. Increased PA was also associated with higher fibre bundle cross-section (morphology) in the cerebellar peduncles, the corticospinal tract, the corpus callosum, and in the superior longitudinal fasciculus.

Discussion: Leveraging advanced white matter neuroimaging data and fibre specific analysis methods, this has been the first FBA study examining the association between PA and white matter

fibre organisation in children with ADHD. Our results suggest that increased PA is positively associated with white matter connectivity along sensorimotor pathways commonly implicated in ADHD. These findings advance our understanding of the neurobiological correlates of PA in children with ADHD and provide new insight into possible mechanisms through which PA may benefit children with ADHD.

S56. DIFFERENTIAL EFFECT OF VISUAL RHYTHMIC READING TRAINING WITH AND WITHOUT EXECUTIVE FUNCTIONS WARM-UP ON READING FLUENCY IN CHILDREN WITH READING DIFFICULTIES WITH AND WITHOUT ATTENTION DIFFICULTIES

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Background: Reading fluency, the ability to read accurately and quickly, has previously been shown to relate to intact audiovisual integration. Executive functions (EF) and attention abilities are top-down mechanisms thought to govern audiovisual integration and contribute to efficient reading. A previous study showed that visual rhythmic reading training (RRT) engaged audiovisual integration and EF in children with reading difficulties (RD). In this study, we aimed to determine the differential effect of visual RRT with and without an additional EF warm-up on word reading fluency in children with RD and those without clinically elevated attention difficulties.

Methods: English-speaking children aged 8-12 years with RD (n=93) and with RD+ attention-deficit/hyperactivity disorder (ADHD; n=78) participated in the study. The two groups were randomized into two training groups: 1) visual RRT (RD: n=64, RD+ADHD: n=44) and 2) EF warm-up combined with visual RRT (RD: n=29, RD+ADHD: n=34). Training lasted 8 weeks, 3 times per week, for 20-30 minutes per session. To test the effect of the two training types on word level reading abilities, a timed measure of fluent word reading (TOWRE-SWE) and an untimed measure of non-fluent word reading (letter-word, WJ) were examined before and after training, and delta measures (pre-post change in reading scores) were subjected to a 2 Word Level (fluent vs. non-fluent) x 2 Reading Group (RD vs. RD+ADHD) x 2 Training (RRT vs. EF+RRT) repeated measures analysis of variance.

Results: Results revealed a significant Word level x Reading Group x Training interaction [$F(1,170)=4.879$, $p=.03$, $\eta 2=.022$], such that the RD group showed the greatest improvement in reading fluency following the RRT, whereas the RD+ADHD group showed the greatest improvement in non-fluent word reading regardless of the type of Training. Results trending significance were also found for main effect of word level [$F(1,170)=2.285$, $P=.09$, $\eta 2=.016$] and Word level x Reading group interaction [$F(1,170)=2.811$, $P=.09$, $\eta 2=.016$], suggesting greater gains for fluent vs non-fluent reading and greater gains for non-fluent vs fluent reading in children with RD+ADHD, with no difference in gain among those with RD.

Discussion: Visual RRT in children with RD is related to improved reading fluency skills, which might be due to a more efficient audiovisual integration. Training EF in addition to RRT may enable children to allocate cognitive resources for semantic search and not only for automatic word recognition. Hence, non-fluent reading improves even more than reading fluency skills. For children with RD+ADHD, where EF is specifically impaired, the gain from both trainings might be limited to a deeper, slower process. Neuroimaging data focusing on audiovisual integration and

additional EF-related networks may reveal the mechanism underlying these changes in response to intervention among these two clinical groups.

S57. DIFFUSE STRESSORS: A LOOK AT NEUROIMMUNE AND SOCIOECONOMIC CONTRIBUTIONS TO MULTIMODAL BRAIN IMAGING SIGNATURES IN A COVID-19 DYAD COHORT

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Background: The effects of stress and poverty on health are diffuse and can come from various sources. Stressors have been shown to have deleterious effects on the neuroimmune system which in turn can amplify the risk for psychiatric disorders. Although extant literature points to interactive and even additive effects of stress on neuroimmune challenges, these interactions have yet to be explored in the recent COVID-19 epidemic. Herein we take a dyadic approach to uncover the neurobiological basis of stress and socioeconomic status in mothers and its implications for child outcomes.

Methods: Full sample of 114 mother-child dyads were enrolled in a multi-modal MRI study (COMBO). Analyses included usable diffusion (DTI) and resting state (rsfMRI) data from 35 moms. Preprocessing for rsfMRI was conducted using the ABCD-HCP pipeline and DGC for diffusion. Postprocessing for rsfMRI was conducted using the DCAN-BOLD pipeline and DSI-Studio for DTI. Whole brain analyses were conducted using Network Based Statistics Toolbox using connectivity matrices parcellated using the HCP atlas in shared MNI space for both modalities controlling for age and motion.

Results: Various regions were found to share anatomical specificity in terms of overlapping multimodal signatures. Beginning with stress (PSS) we found both rsfMRI (FC) and DTI (FA) had biomarkers in similar regions including: inferior frontal, anterior thalamic radiation, as well as frontal parietal and parahippocampal regions of the cingulate.

Discussion: These findings suggest that although stress has a diffuse impact on health, it may converge on certain regions important for cognition and goal oriented behavior. We intend to further explore the interactions of stress with SDH and ascertain what are the implications for neonatal development, child outcomes as well as dyadic relationships.

S58. NEIGHBORHOOD CHARACTERISTICS INFLUENCE ADOLESCENT BRAIN FUNCTIONAL CONNECTIVITY

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Background: Neighborhood characteristics including the built environment, socioeconomic status, and educational opportunities impact children's health and development. The measure of

these neighborhood level characteristics and their impact on health outcomes throughout the life course comprises an integrative framework known as the social exposome Our objective is to understand how the social exposome shapes brain development in children and adolescents, and to identify individual factors within the social exposome that most strongly drive these associations.

Methods: We used baseline data from the Adolescent Brain Cognitive Development (ABCD) Study (n= 6332; ages 9-11 years; 48.9% female) including demographics, residential address histories, and resting-state functional magnetic resonance imaging (rs-fMRI) scans. From a rs-fMRI scan performed on a 3T scanner, ABCD provided estimates of connectivity within the default mode network (DMN); a network of brain regions that are active during rest) using the Gordon parcellation atlas. We created an aggregated social exposome index (SEI) based on three neighborhood-levels (census tract) indices included in the ABCD dataset; the Child Opportunity Index (COI), Social Vulnerability Index (SVI) and Area Deprivation index (ADI). Redundant indicators across indices were excluded leaving a total of 40 individual continuous factors: COI (29), SVI (6), and ADI (5). Indicators were recoded such that a higher value indicates more positive attributes (i.e., access to parks/greenspace) and a lower value indicates less positive (i.e., limited access to parks/greenspace). We quantified associations between the SEI and DMN connectivity using weighted quantile sum (WQS) regression adjusting for sex, age, handedness, and site, including a penalization term for the estimate of the weights, and setting bootstrap samples and repeated holdout validation at 30 iterations (# of iterations will be increased in subsequent analysis). We constrained the WQS model in the positive direction to test whether a higher SEI would associate with greater DMN connectivity.

Results: The SEI was positively associated with DMN connectivity, i.e. More positive neighborhood characteristics associated with increased DMN connectivity. (b= 0.003; 95% CI [0.002, 0.004]). Heavily weighted neighborhood characteristics include fewer uncleaned Superfund sites in proximity (w: mean estimated weight = 0.16), a higher proportion of two-parent households (w= 0.06) and higher percentage of housing with complete plumbing (w= 0.05).

Discussion: Our exposomic approach leveraged WQS to examine the collective association of neighborhood level social factors on children's brain connectivity, while identifying individual factors that may be most impactful. These findings may inform resource allocation in children's health, reinforcing that actionable measures often depend more on resource distribution than on evidence gaps.

S59. CONTRIBUTIONS OF NEIGHBORHOOD VIOLENT CRIME AND PERCEIVED NEIGHBORHOOD SAFETY TO COGNITION AND MENTAL HEALTH IN THE ADOLESCENT BRAIN COGNITIVE DEVELOPMENT STUDY

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Background: Violent crime rates have been steadily decreasing in the United States since the 1990s. However, for the past 10 years anywhere from about 60-80% of the US population have indicated that they feel as if violent crime is getting worse annually. This perception of crime in the US may represent individual's lived experiences more than the reality of violent crime statistics. Following, subjective experience has been identified to be a more relevant factor to

psychopathology outcomes than objective measures alone. The measurable outcomes of perceived neighborhood safety (i.e., self-reported feeling of safety within a twenty-minute walk from one's home) in comparison to those of objective neighborhood violence (i.e., violent crime statistics for a census tract per population), suggests that the high perceived neighborhood safety can buffer against the negative psychosocial outcomes of violence. Perceived neighborhood safety is positively correlated with better overall mental health and inversely related to externalizing symptoms, emotional disorders, and general mental health disturbances. A positive association has also been demonstrated between perceived neighborhood safety and cognitive function, particularly working memory, executive function, and reading comprehension. Following, we aim to investigate the impacts of neighborhood violence on broad mental health and cognition outcomes, utilizing both subjective and objective measures of neighborhood safety/violence exposure. This approach will allow the comparison of individual experience to actual neighborhood violence and will allow us to examine if perceived safety moderates deleterious psychological effects of more objective indicators of neighborhood violence.

Methods: -To test hypothesis 1, we will examine factors that are associated with perceived safety above and beyond objective violence/neighborhood violence (NV) exposure.

Two linear mixed-effects one for baseline and one for year two will be conducted with perceived neighborhood safety as an outcome variable, and objective neighborhood violence, child level psychopathology, community cohesion, identity-based factors, familial and neighborhood poverty as predictor with the following covariates: sex, interview age, site, and family.

-To test hypothesis 2, we will examine the relations of NV and perceived neighborhood safety to cognition (NIH toolbox) and mental health outcomes (CBCL).

24 separate linear mixed effects model will be conducted one for each outcome variable. These models will examine each cognition and mental health outcome at baseline (13 models) and year two (11 models; See Table 1 above for breakdown of dependent variables analyzed as outcomes at baseline versus year 2) accounting for baseline familial and neighborhood poverty and with the following covariates assessed at baseline: sex, interview age, site, and familial status.

The 11 models for year two will account for baseline cognition and mental health abilities.

-To test hypothesis 3, we will use a linear mixed-effects model to determine if perceived neighborhood safety interacts with NV to moderate cognitive and mental health outcomes. Like with hypothesis 1 there will be separate models for baseline (13 models) and year two (11 models; See Table 1 above for breakdown of dependent variables analyzed at outcomes at baseline versus year 2).

24 separate linear mixed effects models will examine interactions of NV and perceived safety to the outcomes after accounting for all covariates assessed at baseline: sex, interview age, site, and familial status.

Neyman Johnson intervals will be used to elicit regions of moderation.

-All models will be conducted in R version 4.3.0, using the nlme, lme4, and interactR packages

Results: -

Discussion: -

S60. DOES SLEEP MODERATE NEIGHBORHOOD INFLUENCES ON DEPRESSION AND ADOLESCENT BRAIN DEVELOPMENT?

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Background: The features of a child's neighborhood environment–from green space to safety to air quality–have measurable effects on their life outcomes (Roux and Mair, 2010; Anglin et al., 2021). Likewise, sleep is closely linked to child outcomes, including mood and cognitive development. Sleep quality is also associated with neighborhood environment (Mayne et al., 2021), but the associations between neighborhood, sleep, and mood among adolescents have yet to be explored. Further, while we know that mood varies with the microstructure of white matter pathways, there is a great need to understand the degree to which neighborhood quality might alter neural mechanisms that have downstream effects on psychopathology (Bell et al., 2021).
Methods: Drawing on longitudinal data from the Transitions in Adolescent Girls study (N=174; ages 10-13 at time of recruitment; Barendse et al., 2020), we aimed to examine neighborhood influences on depression and whether sleep moderated these linkages. We operationalized the neighborhood by census tract as defined by the American Community Surveys (the participants in our sample reside in 66 different tracts), and quantified neighborhood quality by using the Child Opportunity Index 3.0 (COI). The COI determines a composite score of neighborhood features comprising 44 different indicators across education, health and environment, and social and economic domains that relate to child health and well-being.
Results: In our model, we looked at how COI at wave one relates to depressive symptoms across waves, but does so in ways that are moderated by sleep quality. In other words, for those who live in neighborhoods with a lower COI, the relationship with depressive symptoms is significantly moderated by sleep quality. Results presented at Flux will also include exploratory analyses examining neural differences in white matter development partially mediates the relationship between neighborhood environment and depressive symptoms. To assess WM microstructure, we quantify the mean fractional anisotropy (FA; a measure of WM integrity) of major tracts using a longitudinal probabilistic tractography pipeline trained on manually annotated tracts from the Human Connectome Project (Maffei et al, 2021).
Discussion: A guiding motivation of the present project was to establish how a modifiable health behavior like sleep can disrupt the known connection between neighborhood quality and mental health outcomes (Wood et al., 2023). We also aimed to isolate testable hypotheses that we can bring to larger data sets like the Adolescent Brain Cognitive Development study in order to assess generalizability.

S61. SEX DIFFERENCES IN RESPONSE TO VIOLENCE: POTENTIAL ROLE OF THE VENTRAL ATTENTION NETWORK

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Background: In the United States, 4.2% of adolescents have been physically abused, 4.4% have been sexually abused, and 8.4% have experienced family violence (McLaughlin et al., 2012). Further, witnessing and experiencing violence has been associated with increases in anxiety and depression symptoms among adolescents (Mrug and Windle, 2010). Interestingly, while females tend to experience violence less frequently than males (Buka et al., 2001), on average they have worse internalizing symptoms (Nolen-Hoeksema, 1990). Given that sex (Shanmugan et al., 2022),

violence (Corr et al., 2022), and internalizing symptoms (Chahal et al., 2020) have been shown to be associated with network connectivity, it is possible that network connectivity may explain any differential effects of violence exposure on the sexes. In the current study, we asked the following questions: Does it take fewer violence exposures for females to develop similar levels of internalizing symptoms to males? If so, is this effect explained by network connectivity in canonical networks such as the default mode, fronto-parietal, salience, or ventral attention networks?

Methods: 227 adolescents (ages 12-15) had clinical assessments and neuroimaging. Violence exposure was defined as the number of exposures in the past year to all of the following: family/friends violently hurt or killed, saw someone attacked with a knife/shot, attacked with a knife, personally being shot at, or shoved/kicked/punched. Recent anxiety and depression symptom severity was assessed using the Revised Child Anxiety and Depression Scale. The sum of the items was used as the outcome measure. Network connectivity was quantified as the average correlation of the time series in each network in the Seitzman atlas (Seitzman et al., 2020). A series of linear models were fit to estimate the coefficients to test mediation. P-values were adjusted for multiple comparisons using FDR correction. Networks that continued to have a significant relationship with the interaction between sex and number of violence exposures were tested for mediation.

Results: 54.2% of participants had been exposed to violence in their lifetime, and all of these individuals had been exposed to violence in the past year. On average, males were exposed to violence twice as many times as females in the past year (females = 2.07, males = 4.04 exposures). There was an interaction between sex and number of violence exposures in the past year such that each violence exposure appeared to have a larger impact on females' internalizing symptoms than males' (Beta = 0.343 scaled; 95% CI = [0.064, 0.621]). There was also an interaction between sex and number of violence exposures in the past year such that each violence exposure appeared to have a larger impact on females' ventral attention network connectivity than males' (Beta = 0.460 scaled; 95% CI = [0.178, 0.741]). This effect was not present for other networks after FDR correction. Ventral attention network connectivity did not mediate the association between the number of violence exposures in the past year and internalizing symptom severity among females, however (95% bootstrapped CI = [-0.006, 0.272]).

Discussion: Violence exposures may have a larger impact on females' internalizing psychopathology and ventral attention network connectivity than males. There is not evidence, however, that changes in ventral attention network connectivity as a function of violence exposures explains the association between the number of violence exposures in the past year and internalizing symptoms among females. Future research should examine the topography of functional networks, given that sex differences have previously been identified (Shanmugan et al., 2022), as a potential mechanism connecting violence exposure with internalizing symptoms among girls.

S62. SOCIAL AND STRUCTURAL DETERMINANTS OF YOUTH RISKY DECISION-MAKING

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Background: While neurocognitive developmental changes associated with normative pubertal change may contribute to developmental increases in risk-taking tendencies during adolescence, less research has investigated the social and structural determinants of differences in risky decision-making outcomes among youth. Greater risky decision making has been associated with increased risk for substance use during adolescence. The objective of this study was to investigate how the social and structural determinants of health influence risky decision-making among a diverse sample of youth in the Adolescent Brain Cognitive Development (ABCD) study.

Methods: 3 waves of data from the ABCD 5.1 data release were analyzed to investigate the associations between baseline (ages 9-10) social and structural determinants of health and risky decision making outcomes at the year 2 annual visit (n = 8336; 10-12 years) and at the year 4 annual visit study (n = 3612; 12-15 years; 50% of sample released). Family conflict, an interpersonal social determinant of health, was assessed with a 9-item scale. Two structural determinants of health at the community level were analyzed: educational opportunities and neighborhood economic opportunity. Educational opportunities were indexed using the Stanford Education Data Archive (SEDA) scores for school-level 3rd grade average of standardized test performance, which are thought to reflect broader school contextual influences such as teacher proficiency and school resources. Neighborhood economic opportunity was measured using the Childhood Opportunity Index sub-scale z-scores, comprised of 8 neighborhood economic indicators. Risky decision-making was measured using the Game of Dice task, where participants predict the outcome of a roll of a dice between high payoffs with low-probability (risky) and low payoffs with high-probability (safe). For each wave of data for Game of Dice, we conducted a linear mixed-effect model by entering our social and structural factors as predictors, controlling for age, sex, site, and family group.

Results: At the Year-2 follow-up visit (ages 10-12 years), lower risky decision making was predicted by lower family conflict (β = -0.06, CI [-0.08, -0.03], $p < 0.001$), higher educational opportunities (β = 0.13, CI [0.06, 0.19], $p < 0.001$), and more neighborhood economic opportunities (β = 0.31, CI [0.16, 0.46], $p < 0.001$). Similarly, at the Year-4 follow-up visit (ages 12-15 years), lower risky decision making was predicted by lower family conflict (β = -0.06, CI [-0.09, -0.03], $p < 0.001$), higher educational opportunities (β = 0.21, CI [0.12, 0.31], $p < 0.001$), and more neighborhood economic opportunities (β = 0.30, CI [0.07, 0.54], $p = 0.011$). Notably, the effect of the association for educational opportunities on risky decision making increased between ages 10-12 years and 12-15 years.

Discussion: These preliminary findings suggest a contribution of multi-level social and structural factors to developmental trends for risky decision making. The development of risky decision making has been shown to correspond to developmental changes in reward and decision-making brain structure. Future analyses will investigate the relationships between these social and structural determinants of health on underlying developmental changes in brain structure supporting decision-making.

S63. INTERACTIONS BETWEEN FAMILY SOCIOECONOMIC STATUS AND THE STRUCTURAL CONNECTIVITY PATTERNS OF THE OCCIPITAL-TEMPORAL CORTEX IN READING OUTCOMES AMONG SCHOOL-AGE CHILDREN

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Background: Reading is a fundamental skill crucial for both daily functioning and cognitive development, particularly during childhood. Past research suggests that reading is in part influenced by family socioeconomic status (SES). However, the precise mechanisms linking SES to reading abilities are still under investigation. Reading relies on coordinated cognitive processes orchestrated by various brain regions, notably by the occipital-temporal (OT) cortex. These regions are interconnected through structural white matter pathways, forming the neural circuitry essential for proficient reading. Recent advancements in diffusion MRI allow visualization of structural connections between the OT cortex and brain regions involved in linguistic and visual processing. Leveraging these advancements, we investigate whether differences in OT cortex connectivity are associated with variations in children's reading abilities across SES backgrounds.

Methods: Using diffusion MRI data from 174 school-age children participating in larger longitudinal studies on reading development, we examined SES associations with white matter indices. Study recruitment occurred after first grade, with families providing parental educational levels and occupation. One year later, after second grade, children underwent assessments for word reading skills and brain structure using standardized tasks and diffusion MRI, respectively. Diffusion MRI data preprocessing followed standard procedures using QSIPrep, followed by tractography analysis to characterize structural connectivity of regions within the OT cortex, focusing on the posterior-anterior gradient, and their connections with other brain regions. Connectivity matrices denoting the number of streamlines tracked between different cortical regions were computed. Moderation analysis was conducted to examine the interactions between family SES and OT connectivity patterns in predicting composite word reading scores, adjusting for covariates such as biological sex, age, handedness, and scanner.

Results: Our data analysis reveals significant interactions between family SES and structural connectivity of specific regions within the OT cortex, particularly the anterior portion, and the inferior temporal gyrus. Notably, lower SES levels were associated with stronger and more positive predictive relationships between anterior OT connectivity to other cortical regions and reading outcomes. These findings align with previous research indicating SES-related differences in neural systems supporting reading.

Discussion: Our study highlights the moderating role of family SES in the associations between OT cortex connectivity indices and reading proficiency in children, providing insights into the interplay between socioeconomic factors and neural pathways in reading acquisition. By deepening our understanding of these mechanisms, our study may contribute to informing targeted interventions aimed at supporting literacy development across diverse socioeconomic backgrounds.

S64. EXPLORING THE INTERPLAY BETWEEN FAMILY SOCIOECONOMIC STATUS, CHILDREN'S SUMMER ACTIVITIES, AND EXECUTIVE FUNCTIONS

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Background: Executive functions (EFs) are fundamental processes for succeeding in various tasks and behaviors, particularly during middle childhood. This developmental period is marked by significant growth in academic skills and active engagement in classroom activities, making EFs crucial for successful learning and social interaction. Research suggests that family socioeconomic status (SES) is associated with differences in children's EFs and their implications for academic performance and classroom behavior. The association between SES and EFs could become more apparent during the summer months where children may have limited access to structured classroom activities typically provided by the school systems. As summer provides unique non-classroom learning opportunities, understanding how children's activities during the summer period relate to their cognitive development is of particular interest. The current study investigates the interplay between family SES, children's summer activities, and EFs.
Methods: Drawing data from a larger study exploring the contextual, neurobiological, and cognitive factors contributing to learning differences during the summer months, our sample comprised 122 school-age children, with 63 and 59 completing 4th and 7th grades, respectively. Family SES was assessed at the beginning of the summer using household income-to-needs ratio and parental education levels. At the end of the summer, parents reported on their children's summer activities across multiple domains, including participation in academic, social, physical, leisure, and camp activities. Meanwhile, children underwent assessments measuring EFs using both paper- and computer-based tasks. Moderation analysis was conducted to examine the interaction between family SES and summer activities in predicting EFs, while controlling for biological sex and grade.
Results: For our SES metrics, family income-to-needs ratios ranged from 0.15 to 18.17 ($m = 1.81$, $sd = 2.21$), and parental education ranged from 12 to 22 years ($m = 18.44$, $sd = 1.93$). Children's participation in summer activities ranged from 12 to 61 ($m = 34.30$, $sd = 9.97$), reflecting a spectrum from limited to extensive participation and from infrequent to frequent engagement. Moderation analysis revealed a significant interaction between family SES and summer activities in predicting EFs ($b = -0.13$, $p < 0.05$), such that high engagement in summer activities was related to reduced SES-related differences in EFs. Notably, lower SES levels were associated with stronger and more positive predictive relationships between summer activities and EFs.
Discussion: Our study highlights the interplay between family SES, children's EFs, and summer activities. By examining these dynamics, it provides insights into how socioeconomic and experiential factors interact to influence EF development. Moreover, understanding these associations during the summer months contributes to a more comprehensive understanding of factors associated with children's learning outcomes beyond the school context.

S65. NEIGHBORHOOD OPPORTUNITY MODERATES THE IMPACT OF THREAT ON CHILDHOOD PSYCHOPATHOLOGY: AN ECOLOGICAL SYSTEMS PERSPECTIVE

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Background: This study investigates how neighborhood opportunity influences the relationship between threat and child psychopathology. Since neighborhood effects on mental health are not generalizable across all people, we further explore associations among neighborhood opportunity, threat, and psychopathology in differentially in children with and without minoritized racial and

ethnic identities. Understanding these dynamics can inform interventions tailored to diverse populations. Model 1: examines the moderating role of neighborhood-level opportunity on the threat and psychopathology association. Hypothesis 1: predicts that higher levels of opportunity will mitigate this association. Model 2: We aim to examine the moderating role of race, here serving as a proxy for experiences of racism not captured in the COI, on the association between threat, psychopathology, and neighborhood opportunity. Hypothesis 2: Consistent with literature suggesting that living in privileged neighborhoods may not confer the same benefits if youth are experiencing racism, we hypothesize that for Black children, higher levels of neighborhood-level opportunity will mitigate the association between threat and psychopathology, but the strength of this moderating effect will be comparatively weaker than that observed for White children.

Methods: The data analysis utilized participants from a longitudinal study involving 917 children aged 24–71 months (MAGE=45.55). After excluding 14 participants due to unavailable address information, our analytic sample comprised N=903 participants. Psychopathology was assessed using the Preschool Aged Psychopathology Assessment (PAPA), while neighborhood-level opportunity was measured using the Child Opportunity Index (COI). Threat was assessed using the Revised Conflict Tactics Scale, the Parent-Child Conflict Tactics Scales, and PAPA. In all analyses we will covary for income-to-needs, age, sex assigned at birth, and deprivation. The analysis utilizes multilevel modeling (MLM) approach to account for the structure of the data where children are nested within neighborhoods. Subsequently, a random effects ANOVA was conducted to decompose the variance at different levels.

Results: Model 1: Threat and psychopathology were included at Level 1. Neighborhood-level variables were added at Level 2. Cross level-interaction terms between threat and COI were included to assess moderation effects. Model fit for model 1 was acceptable (REML criterion = 2677.9, Random Intercept Variance = 0.01396, Adjusted ICC = 0.006). This model showed that threat ($\beta = 0.214$, SE = 0.081, $t(619) = 2.660$, $p = 0.008$), age ($\beta = 0.308$, SE = 0.059, $t(619) = 5.248$, $p < 0.001$), and family income ($\beta = -0.328$, SE = 0.075, $t(619) = -4.376$, $p < 0.001$) were associated with increased risk for psychopathology. No impact of COI or interactions between threat and COI were observed.

Model 2: Included a two-level MLM to examine a three-way interaction between neighborhood opportunity, racism as proxied by race, and threat as predictors of psychopathology. We observed that overall COI was more strongly related to psychopathology for White compared to Black participants ($\beta = 0.613$, SE = 0.239, $t(609) = 2.563$, $p = 0.011$), particularly for moderate levels of COI relative to very high or very low COI. Additionally, we observed that threat was more strongly related to Black compared to White participants ($\beta = -0.331$, SE = 0.109, $t(609) = -3.028$, $p = 0.003$). Overall Black participants reported slightly less psychopathology than their White peers. No significant three-way interactions (COI by threat by race) were observed.

Discussion: Understanding the interactions between COI and race is particularly useful for researchers studying brain development. This data indicates that COI levels affect participants differently based on their race. Interestingly, there was no observed interaction between threat and COI. Future analyses should also consider the impact of sex assigned at birth and brain development

S66. DO FEATURES OF BRAIN STRUCTURE PREDICT SENSITIVITY TO ENVIRONMENTAL INFLUENCE?: A WITHIN-PERSON ANALYSIS OF ADVERSITY, CAREGIVING QUALITY, AND MENTAL HEALTH IN THE ABCD STUDY

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Background: Developmental scientists have a long-standing interest in individual differences in sensitivity to the environment. Recent findings suggest that certain aspects of neuroanatomy may serve as indicators of whether individuals are more or less sensitive to the effects of negative and positive experiences. For example, prior studies have found evidence that structural features of the brain, such as subcortical volume and cortical thickness, may moderate the associations of life stress and caregiving quality with outcomes of interest. However, prior studies have been limited by relatively small samples, have typically considered the environment and an outcome at a single timepoint rather than repeated within-individuals, and have relied on univariate approaches. In this study, we employed a data-driven, multivariate approach to investigate whether structural features of the brain are predictive of within-person coupling of negative life events and caregiver warmth with fluctuations in mental health.

Methods: Data were drawn from the Adolescent Brain Cognitive Development (ABCD) study. The sample comprised at least 4500 adolescents with complete data on measures of interest (48% females; 75% White, 19% Black, 4% Native American, 7% Asian, 7% Other; 21% Hispanic/Latinx). Our analysis incorporated: (a) structural MRI features, including cortical and subcortical volume, cortical thickness, and surface area, from the baseline assessment of ABCD; (b) the Life Events Scale to assess exposure to negative life events at follow-up years 1 to 4; (c) the Children's Report of Parental Behavior Inventory (CRPBI) to assess primary caregiver warmth at follow-up years 1 to 4; and (d) the Child Behavior Checklist (CBCL) to assess adolescents' internalizing and externalizing symptoms at follow-up years 1 to 4. We standardized the repeated measures of life events, CRPBI, and CBCL scores within each participant, and conducted linear mixed effects models to consider individual differences in the within-person associations (i.e., slopes) of fluctuations in negative life events and caregiver warmth with fluctuations in internalizing and externalizing symptoms. The slopes were extracted from these models and treated as outcomes in ridge regression analyses, with the baseline structural data (i.e., volume, cortical thickness, and surface area measures) serving as predictive features. We evaluated model performance using the R-square of the association between the actual slope values and model-predicted slope values.

Results: Within-person fluctuations in negative life events were positively coupled with fluctuations in internalizing ($t = 4.55$) and externalizing ($t = 4.49$) symptoms. Conversely, fluctuations in caregiver warmth were negatively associated with fluctuations in internalizing ($t = -2.70$) and externalizing ($t = -4.19$) symptoms. We observed significant random effects (all $ps < .001$), suggesting that there were meaningful individual differences in the degree of coupling between environmental measures and symptoms. Cross-validated ridge regressions examined the predictive relationship between brain structure and the slopes extracted from these four different models. Structural brain features were not predictive of future sensitivity to the associations between environmental measures and symptoms; they accounted for < 1% of the variance in our within-person measures of environmental sensitivity.

Discussion: Our findings call into question whether brain structure measures are useful for understanding individual differences in environmental sensitivity in adolescents. In this context, it is possible that brain functioning measures are more useful, which may fit with the perspective that increased biological reactivity to stimuli is associated with increased environmental sensitivity. It is also possible that deeper phenotyping of adolescents' environments and their

broader adjustment is necessary to better capture individual differences in environmental sensitivity.

S67. ASSOCIATIONS BETWEEN DEPRIVATION AND NEURAL ACTIVATION DURING COGNITIVE CONTROL IN EARLY CHILDHOOD: A FMRI STUDY

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Background: Deprivation is a dimension of adverse childhood experience that involves limited access to expected social and cognitive input from caregivers, as is characteristic of exposure to neglect or low levels of cognitive stimulation. The Dimensional Model of Adversity and Psychopathology (DMAP) proposes that experiences of deprivation in early childhood impact the functional development of the frontoparietal control network which, in turn, alters the course of executive function development (Sheridan and McLaughlin, 2016). Despite a theoretical emphasis on the emergence of deprivation-related alterations to neurodevelopment underlying cognitive control in early childhood, previous research has primarily examined these associations in adolescence (Lambert et al., 2017; Mueller et al., 2010; Rosen et al., 2018; Sheridan et al., 2017). Furthermore, while behavioral studies of executive function in early childhood support a differential association of deprivation with cognitive control performance (Machlin et al., 2019), underlying deprivation-related alterations to neural activation have not been examined during this developmental period. In the present study, we examine associations between deprivation and neural activation supporting cognitive control in children aged 4 – 7 years. We predicted that deprivation would be associated with lower accuracy on a cognitive control task and altered activation in the frontoparietal control network when accounting for co-occurring adversity, namely threat exposure.

Methods: In the present study, 60 (53.3% female) children between 4 – 7 years (M = 6.36 years; SD = 0.88) were recruited from the community. The sample was enriched for exposure to structural inequality and, thus, had an increased likelihood of adversity exposure. Participants identified their racial and ethnic background as follows: 41.7%, African American/Black 6.7% Asian, 6.7% Multiracial, 43.3% White, 1.7% Other, 6.7% Latinx/Hispanic. Experiences of deprivation (e.g., neglect, low cognitive stimulation) and threat (e.g., physical abuse, witnessing violence) were assessed via caregiver and child report and through a home observation measure. Children underwent functional magnetic resonance imaging and completed a go/no-go paradigm designed to examine neural recruitment supporting cognitive control broadly. We examined whole brain activation related to deprivation for correct No-Go greater than correct Go trials controlling for age, sex, and lifetime threat exposure.

Results: Deprivation was negatively associated with activation in the left middle frontal gyrus, left inferior parietal cortex/intraparietal sulcus, and right middle temporal gyrus during correct No-Go compared to correct Go trials. However, contrary to our hypotheses, deprivation was not associated with the sensitivity index (d'), our measure of cognitive control performance (B = .13; p = .34).

Discussion: Taken together, these findings suggest that children who have greater deprivation exposure may recruit areas of the frontoparietal control network typically associated with executive function differently when successfully inhibiting a prepotent response. Furthermore, we

replicate and extend previous tests of the DMAP conducted in adolescence by showing predicted patterns of differential associations of deprivation with neural recruitment in the frontoparietal network supporting cognitive control in early childhood.

S68. RELATIVE CONTRIBUTIONS OF PARENTING BEHAVIORS AND NEONATAL BRAIN VOLUMES IN THE ASSOCIATIONS BETWEEN PRENATAL SOCIAL DISADVANTAGE AND SOCIOEMOTIONAL OUTCOMES AT AGE 2 YEARS.

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Background: Early social disadvantage is associated with increased externalizing and dysregulation symptoms in children. In older children, parenting behaviors mediate relations between disadvantage and socioemotional outcomes, and may also do so in early life. Additionally, prenatal social disadvantage (PSD) has been associated with volumetric brain reductions in cortical grey matter (GM), subcortical GM, white matter (WM), cerebellar, and total brain (BV) volumes- which, in older children, have been related to socioemotional dysfunction. We investigated whether (1) disadvantage-associated neonatal brain volumes relate to early socioemotional outcomes, and mediate relations of disadvantage and socioemotional dysfunction, (2) whether parenting behaviors mediate associations between early disadvantage and socioemotional outcomes, and if so, (3) what are the relative/distinct contributions of neonatal brain volumes and parenting behaviors in the association between early disadvantage and early socioemotional outcomes?

Methods: Women were recruited during pregnancy and followed longitudinally. In each trimester, information was collected about material and social resources, which was summarized as a latent variable, PSD. At birth, T2-weighted images were collected from sleeping, non-sedated neonates. At age 1 year, mother-child dyads (N=267) returned for a parent-child interaction observation. Supportive parenting encompassed maternal sensitivity and positive regard. Non-supportive parenting encompassed maternal intrusiveness, detachment, and negative regard. At age 2, parents completed the Infant-Toddler Social and Emotional Assessment (ITSEA). Mediation models tested whether (a) neonatal brain volumes or (b) parenting behaviors mediated associations between PSD and ITSEA outcomes. Parallel mediation models were used when a PSD-ITSEA outcome association was mediated by both parenting and neonatal brain volumes.

Results: PSD was positively associated with externalizing and dysregulation symptoms at age 2 years.

Smaller neonatal cortical and subcortical GM, WM, cerebellum, and total BV were associated with both greater externalizing and dysregulating symptoms at age 2. The association between PSD and externalizing symptoms was partially mediated by smaller cortical GM (95%CI: .005-.09), WM (95%CI: .003-.13), and total BV (95%CI: .011-.13). In contrast, the association between PSD and dysregulation symptoms was partially mediated only by smaller cortical GM (95%CI: .006-.13).

Supportive and non-supportive parenting behaviors were related both to externalizing and to dysregulation symptoms at age 2. Supportive (95% CI: .0003-.27) and non-supportive (95% CI:

.08-.32) parenting behaviors mediated PSD-externalizing symptom associations, however, neither parenting behavior mediated PSD-dysregulation associations.

Parallel mediation models examined simultaneous contributions of parenting behaviors versus neonatal brain volumes in the association between PSD and externalizing behaviors. When examining simultaneous contributions of non-supportive parenting with neonatal brain volumes, non-supportive parenting mediated the PSD-externalizing symptom association, while neonatal brain volumes (cortical GM, WM, total BV) did not. When examining simultaneous contributions of supportive parenting and neonatal brain volumes, neither supportive parenting nor neonatal brain volumes mediated the PSD-externalizing symptom association.

Discussion: Findings shed light on mechanisms through which PSD is associated with early socioemotional outcomes. Associations of PSD with these outcomes begin in utero, as evidenced by alterations in neonatal brain volumes that mediated associations between PSD and socioemotional outcomes. However, when compared to neonatal brain volumes, non-supportive parenting in early life may play a larger role in the development of socioemotional difficulties and may constitute effective targets for early interventions.

S69. CONTRIBUTIONS OF EXECUTIVE FUNCTIONING IN MENTAL ARITHMETIC DEVELOPMENT

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Background: Mathematics learning is fundamentally related to core aspects of cognitive development, collectively termed executive function (EF; Cragg and Gilmore, 2014), yet key aspects of this relationship remain elusive. Here we leverage insights from a smaller sample (n > 1,000) 2-year longitudinal study to propose and test a set of longitudinal hypotheses for the much larger ABCD study (n > 10,000) on the relationship of math and executive function development. Our 3rd to 8th-grade Bay Area study revealed a) our measures were sensitive to two-year growth in both EF and math, b) EF development appears to accelerate arithmetic progress over time, and c) younger children rely more on EFs, especially inhibitory control, for their arithmetic performance. Our study aims to test a specific set of empirically and theoretically informed hypotheses to better understand the developmental dynamics and association between mathematics learning and executive functioning, and how contextual factors (e.g. socioeconomic status) might influence this cognition-behavior relationship.

Methods: The proposed analysis will leverage data from the upcoming ABCD 6.0 data release, which includes longitudinal neurocognitive data. Our primary metrics of interest are the Stanford Mental Arithmetic Response Time Evaluation (SMARTE) and neurocognitive assessments from the NIH Toolbox. SMARTE is a tablet-based assessment probing various aspects of numerical and mathematical cognition, providing measures of fluency across various problem-level features including dot enumeration, single-digit arithmetic, and multi-digit arithmetic. SMARTE assessments were conducted in Year 3 and Year 5 of ABCD.

The NIH Toolbox is a comprehensive set of neurobehavioral measurements used to assess cognitive, sensory, motor, and emotional function (Weintraub et al., 2013). We will use the NIH Toolbox cognitive assessments including Flanker, Picture Sequence Memory, Pattern Comparison

Processing Speed, List Sorting, and Dimensional Change Card Sort, to assess critical measures of EFs. These assessments were conducted at baseline, 2-year, and 4-year follow-ups.

The ABCD data also include important environmental factors such as parental income, parental education, and educational context. These variables will be incorporated into our analyses to control for contextual influences and to examine how these factors may mediate cognitive and mathematical development.

Results: H 1: Robust growth in SMARTE and EFs. Younger children will experience more growth in both areas compared to older children.
We will fit a series of longitudinal growth models to understand the trajectories of growth in SMARTE fluency and various EF measures, while controlling for contextual factors. Age will be included as a continuous variable to examine differences in growth rates.

H 2: Growth in EF from baseline to Year 4 will be predictive of SMARTE growth from Year 3 to Year 5. Contextual factors will mediate this relationship.

We will build longitudinal growth models to examine the predictive relationship between EF growth and SMARTE growth. Mediation analysis will be conducted to assess the impact of contextual factors, such as SES, on this relationship.

H 3: As children develop, their SMARTE performance becomes less dependent on their EF profiles.

We will build linear growth models that include an interaction term between age and EF measures to test if the strength of the relationship between EF and math performance decreases with age.

Discussion: This research will first validate that students show robust development in both EF and math over time. It will address the unknowns of how EF development supports or decouples from math development as children age, and also extend our understanding of how contextual factors influence the relationship between EF and math performance. The findings will provide insights into these questions and have the potential to inform the design of cognitive training interventions and innovative classroom instruction.

S70. SCREEN TIME AND HOBBIES AND THEIR IMPACT ON NEUROCOGNITIVE DEVELOPMENT, A LONGITUDINAL STUDY USING THE ABCD STUDY

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Background: In the digital age, the past times of children and adolescents have shifted to include many more hours of screen time, especially after the COVID-19 pandemic. Children's hobbies, such as video games, social media, and other organized activities (e.g., sports), have been documented to influence their neurocognitive development. However, the literature has been mixed on whether these effects are harmful or beneficial, with some hobbies like video games being associated with improved as well as lower neurocognitive functioning (Bediou, 2023; Panjeti-Madan and Prakash Ranganathan, 2023). Importantly, existing studies examining relations between children's hobbies and neurocognitive development have failed to account for other types of hobbies that children concurrently participate in. For example, most studies on the effects of video games do not include screen time, hobbies, or organize activities. Moreover, most previous studies have only examined effects at one time point rather than taking a longitudinal approach.

Methods: The current study addresses these gaps examined data-driven profiles of different hobbies by utilizing the Adolescent Brain and Cognitive Development (ABCD) Study data collected at baseline (N= 11,173; 47% female). We used a Latent Profile Analysis (Collins and Lanza, 2009) to characterize profiles of children based on their video game play, social media use, TV/video watching, and involvement in social sports, non-social sports, and social non-physical hobbies (i.e., theater). Moreover, we tested differences between the profiles and their neurocognitive function by creating a composite of the Emotional n-Back, Stop Signal Task, and NIH toolbox tasks of executive function concurrently and two years later.
Results: Results revealed three distinct profiles based on fit statistics (i.e., AIC, BIC, entropy [0.95] and BLRT [p = 0.01]): a profile high in video game play and general screen time use, but low in sports and other group activities ("High-Screentime/Low-Sports Profile"; ~13% of the sample); a profile average-to-low in all activities ("Average Profile"; ~67% of the sample); and a profile moderate in video game play, low in social media and watch time, and high sports participation and social non-physical activities ("Low-Screentime/High-Sports Profile"; ~20% of the sample).

Concurrently, the three profiles differed significantly in scores of the neurocognitive composite ($p < 0.001$), with the Low-Screentime/High-Sports Profile having the highest mean scores, followed by the Average Profile, and the High-Screentime/Low-Sports Profile having the lowest. Two years later (time 2), while controlling for neurocognitive performance at the previous timepoint, results showed that the High-Screentime/Low-Sports Profile significantly increased more than the Average Profile, catching up to the same levels. There were no differences in neurocognitive changes in the Low-Screentime/High-Sports Profile, which remained the highest.

Discussion: These results illustrate the need to utilize approaches that consider multiple activities to provide a more comprehensive understanding of children's hobbies. Moreover, they highlight the importance of longitudinal investigations as some of the effects (e.g., high levels of screentime) may not be long lasting. Future analyses will examine fMRI data collected with the Emotional n-Back and SST to better understand the neural correlates of these differences. We hope that our work will contribute to the broader literature in understanding how children's past times can affect their neurocognitive development.

S71. AUTISTIC AND NEUROTYPICAL YOUNG ADULTS DEMONSTRATE REGIONAL DIFFERENCES IN BRAIN ACTIVATION DURING A COGNITIVE FLEXIBILITY TASK

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Background: Inflexible behaviors are a core feature of autism, but the neural bases of inflexible behaviors are less often investigated than social behaviors. Based on pre-clinical models, we have hypothesized that differences in cerebellar structure and function could contribute to inflexible behaviors in autism. To test this, we used functional MRI to investigate brain activation during a cognitive flexibility task using the Flexible Item Selection Task (FIST) in young adults with and without a diagnosis of autism. FIST has shown robust cerebellar activation during the cognitive flexibility trials in typically developing controls (Dajani et al., 2020). Additionally, prior studies

have shown that autistic individuals have poorer FIST performance on flexibility trials (Yerys et al., 2012, Campbell et al., 2017). We hypothesized that: 1) The autism group (AG) would perform worse on flexibility (Flex) trials compared to the neurotypical (NT) group; 2) the cerebellum will be more engaged during Flex trials compared to Control trials in the NT group; and 3) the AG will show differences in brain activation during Flex trials, specifically in the cerebellum.

Methods: Twenty-nine adults (AG=9, NT=20; 22±4 years; 14 Male, 15 Female) completed 2 runs of the FIST task during an MRI session. Task performance was modeled by multivariate linear models in R Studio. Neuroimaging data were preprocessed and denoised using the standard pipeline in the CONN toolbox and statistical modeling was performed using SPM12. Voxel- and cluster-level thresholds were set to $p < .005$ and $k > 25$, respectively.

Results: There were no significant differences in task performance between the groups on either the Control or Flex trials, with both groups performing well on the task (AG Flex accuracy=89%, NT Flex accuracy=77%). In the NT group, there was greater activation in the right posterior middle temporal gyrus and left angular gyrus during Flex vs Control trials. In the AG, there was greater activation in left middle temporal gyrus and posterior cingulate cortex during Flex vs Control trials. When we compared the group activation patterns during the Flex condition, the NT group showed greater activation than the AG in the anterior cingulate cortex, while the AG showed greater activation in the hippocampus and left frontal operculum compared with the NT group. Interestingly, there was greater cerebellar activation in the AG compared to NT during Control trials.

Discussion: These preliminary findings suggest that while AG and NT had similar performance on the cognitive flexibility task, the NT group relied more on brain areas associated with error monitoring while the AG elicited greater activation in regions associated with memory and planning. Contrary to our hypothesis, we did not see robust differences in cerebellar activation during cognitive flexibility in the autistic cohort, but we did see differential activation during Control trials. Future analyses will investigate the relationships between task performance and brain activation patterns in the AG.

S72. UNLOCKING THE NEURAL BASIS FOR READING FLUENCY IN NEURODEVELOPMENTAL DISORDERS: THE ROLE OF SENSORY INTEGRATION AND EXECUTIVE FUNCTIONS IN READING FLUENCY

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Background: Reading fluency (RF) is the ability to read quickly and accurately. Executive functions (EF) are critical for RF, but neglected in dyslexia models, some of which theorize a lack of synchronization between sensory (auditory-visual) networks. Recently, we demonstrated that lower RF is related to lower auditory-visual functional connectivity (FC) and, importantly, poorer EF, raising questions about the relationship between EF, sensory network engagement, and RF, and whether these relationships differ across clinical groups.

Methods: Participants included 8-12-year-old English-speaking children with dyslexia (n=83), ADHD (n=25), ASD (n=23), and typical readers (TR; n=95). Participants completed behavioral measures of RF (TOWRE-2 Sight Word Efficiency) and EF (WISC-V digit-span and coding). A subsample (dyslexia [n=18], ADHD [n=19], ASD [n=14], TR [n=33]) completed a brain scan. Sensory and EF network FC was compared across four groups using an analysis of variance (ANOVA). Relationships between EF and RF were also examined with correlations.
Results: Results suggest significantly lower RF ($F(3,222)=54.121$, $p < .001$, $\eta 2=.422$) and EF (digit-span: $F(3,211)=8.563$, $p < .001$, $\eta 2=.109$), coding: $F(3,215)=6.773$, $p < .001$, $\eta 2=.086$)) in the clinical groups compared to TR. Significant positive correlations were observed between RF and EF across groups (digit-span: $r=.37$, $p < .001$; coding: $r=.32$, $p < .001$). Clinical groups showed significantly reduced FC within the EF (CO: $F(3,80)=9.798$, $p < .001$, $\eta 2=.269$; FP: $F(3,80)=3.406$, $p < .05$, $\eta 2=.133$) and sensory networks (visual-auditory: $F(3,80)=5.591$, $p < .01$, $\eta 2=.173$) compared to TR.
Discussion: These results suggest that RF, EF, and sensory networks are affected in dyslexia, ADHD, and ASD. An important next question is whether and how EF differentially contributes to RF across clinical groups.

S73. CHILDHOOD SOCIOECONOMIC HARDSHIP, WORKING MEMORY, AND NEURAL CORRELATES PREDICTS DELAYED DISCOUNTING IN ADOLESCENCE

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Background: Delayed discounting (DD), or choosing larger but delayed rewards over smaller, proximal rewards uses both executive functioning (EF) and reward related processes. Previous studies show adults with more socioeconomic hardship is likely to have a preference for more immediate rewards, or less delayed discounting (Ludwig et al. 2019). Here, we investigate this relationship in adolescence, and assess whether such relationship may be based in executive functioning.
Methods: 119 adolescents (age 15-21 years) enriched for depressive and disruptive behaviors in early childhood participating the longitudinal Preschool Depression Study (PDS) (Luby et al., 2009). Delayed discounting was assessed via the area under the curve (AUC) calculated in a monetary discounting (MD) task, which provided participants with up to $60 based on their choices to receive money immediately, at two weeks or at six months. Higher AUC indicates greater preference for delayed rewards, while lower AUC indicated the participant values immediate rewards more. Socioeconomic hardship was measured via family income to needs ratios (INR) reported at the time of the MD task (T10, age 15-21 years) and in early childhood (T1, age 3-5 years). EF was evaluated via working memory (WM) as list sort scaled score from the NIH Toolbox. Neural correlates of EF were assessed via dlPFC volume as a proportion of whole brain volume (WBV) intercept and slope from structural MRI data in 112 participants who were scanned least twice between T5-10 (age 8-21 years), longitudinal processing as detailed in Barch et al., BP CNNI 2020. However, given the relationship between SES and whole WBV more generally (Rakesh et al., 2023), we also assessed intercept and slope of WBV. Linear regressions were used

to predict delayed discounting AUC from INR, WM, dlPFC and WBV, with mediation analyses to assess relationships.

Results: INR at T1 (r^2=0.103, t=3.38, p=0.001), but not at T10 (r^2=-0.007, t=-0.24, p=0.808), predicts lower AUC, or more discounting of delayed rewards, suggesting higher preference for immediate rewards in those with lower early childhood SES. Worse WM performance also predicts lower AUC (r^2= 0.066, t=2.83, p=0.006). WM partially mediates the relationship between INR and delayed discounting (indirect effect =0.011, 95% CI [0.000 - 0.025]). Smaller left dlPFC volume intercept (r^2= 0.037, t=2.06, p=0.042) but not slope (β=-0.17, t=-0.98, p=0.33) predicts lower AUC. However, smaller left dlPFC volume does not mediate the relationship between income to needs and delayed discounting. Smaller WBV intercept but not slope also predicts delayed discounting (β=0.0003, t=2.05, p=0.043; β= 0.021, t=1.52, p=0.132). WBV partially mediates the relationship between INR and delayed discounting (Est.=0.051, t=3.27, p=0.005).

Discussion: As greater socioeconomic hardship in early childhood, as indexed by INR, predicts greater delayed discounting, or higher preference for immediate rewards in late adolescence, but concurrent INR does not, we demonstrate early life experiences is likely the key contributor. As expected, WM, our index of EF, also affects delayed discounting and is a partial mediator of the effect of early childhood INR on DD. While dlPFC volume is related to DD as expected, given it is the major neural correlate of WM, surprisingly unlike our behavioral measures of WM, it does not mediate the relationship between INR and DD. Rather, WBV partially mediates the relationship between socioeconomic hardship and DD, indicating that a more global impact of the brain should be considered. Using longitudinal prospective data, the current study demonstrates socioeconomic disadvantages in early childhood has implication on individuals' evaluation and preference of immediate or delayed rewards that is partially mediated by working memory, though the neural effects appear more global. We provide a refinement in our understanding of the biological and neural mechanism of delayed discounting task in a high-risk population.

S74. NEURAL ADAPTATION TO WORDS AND PSEUDO-HOMOPHONES IN CHILDREN WITH VARYING READING SKILLS

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Background: Repeated stimulus presentation leads to reduced neural activity, also called neural adaptation (NA) effect, in brain regions involved in processing the presented information (Grill-Spector et al., 2006). In written word processing, this effect is expected to be specific to areas within the reading network, for example the ventral occipitotemporal cortex (vOTC) including the visual word form area, and its electrophysiological correlate, the occipitotemporal N1 event-related potential (ERP) (Price, 2012; Maurer et al., 2005). In a multimodal EEG-fMRI study, we aimed to replicate the neural adaptation effect for written words reported by Perrachione et al. (2016) in a group of children and secondly to investigate potential phonological and lexical adaptation effects to pseudo-homophone processing within the reading network.

Methods: A group of 85 fifth grade children with varying reading skills (11.4 ± .4 years) performed a visual adaptation paradigm during simultaneous high-density EEG-fMRI, consisting of block-wise presentation of stimuli. Nine blocks of words were visually presented for the

following three conditions each: repeated presentation of the same word (adapt: A), words without repetition (non-adapt: N), and pseudo-homophones of the same word (pseudo-adapt: P). Participants were instructed to respond to target items presented in blue. To derive adaptation effects (N vs A, N vs P), we performed one-sample t-tests on a whole-brain level for fMRI data. For EEG data, we computed the ERPs for each condition and extracted the mean amplitudes of the left visual occipitotemporal negativity N1 (170-230 ms) and the subsequent occipitotemporal positivity P2 (290-350 ms). These ERP amplitudes were then entered in linear mixed models (LMMs) with factors condition (A, N, P) and hemisphere (left, right).

Results: Our fMRI results reveal NA effects to words in bilateral vOTC and in the superior temporal cortex. Adaptation to pseudo-homophones (N > P) was dominated by a stronger deactivation of the default mode network during pseudo-homophone processing and stronger activation the superior temporal gyrus during non-repeated word processing. The finding of BOLD adaptation effects was strengthened by the ERP results over left occipitotemporal electrode clusters: In the N1 time window, the LMM with factors hemisphere and condition yielded significant main effects for condition with stronger amplitudes for the P than the A condition, and hemisphere with stronger amplitudes in the right than the left hemisphere, but no significant interaction. In the P2 time window, the LMM with factors hemisphere and condition yielded significant main effects for condition with stronger amplitudes for the N than the A and P conditions, and hemisphere with stronger amplitudes in the left than the right hemisphere, but no significant interaction.

Discussion: As expected, we found an NA effect for words in the BOLD response of the occipitotemporal cortex and other areas of the reading network, as in the P2 ERP. Additionally, adaptation for pseudo-homophones could be shown in the superior temporal gyrus, a brain area responsible for auditory processing of speech sounds (Price, 2012) and with a deactivation of key structures implicated in the default mode network during pseudo-homophone processing. The present study presents a neural adaptation effect for words and provides new insights into how unfamiliar word forms with familiar phonological information are processed in primary school-children.

S75. INVESTIGATING THE RELATIONSHIP BETWEEN INATTENTION, ANXIETY, AND READING COMPREHENSION IN BRAIN AND BEHAVIOR

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Background: Previous research has shown that inattentive behaviors and anxiety are significant negative predictors of children's reading comprehension (RC; McArthur, 2022). However, potential neural instantiations of these relationships, which could help explain these links, remain unexplored. This project aims to investigate relationships between inattention, anxiety, and RC behaviorally, and potential relationships between inattention and RC with white matter structure in the Arcuate Fasciculus (AF), Superior Longitudinal Fasciculus (SLF) and Inferior Longitudinal Fasciculus (ILF). The AF is a tract commonly implicated in language, reading, and attention. The SLF connects the parietal and frontal lobe and has been associated with visuo-spatial skills and reading. The ILF connects the occipital and temporal lobe and has been associated with reading and semantic processing.

Methods: Linear models were run using data (n = 1000) from the Healthy Brain Network biobank to test the following hypothesized relationships: inattention and anxiety will be significant negative predictors of RC behaviorally, and increased inattentive behaviors and/or decreased RC would predict reduced white matter integrity (reduced fractional anisotropy, increased mean diffusivity, neurite density and orientation). Given limited literature, we did not make directional predictions for anxiety in these tracts.
Results: Results revealed a significant relationship between inattention and RC and between anxiety and RC. Brain models revealed significant relationships between RC and tract integrity bilaterally in the AF, such that better readers had higher tract integrity. We also observed four significant or trending relationships between inattention and tract integrity in the AF such that more inattentive behaviors were associated with decreased tract integrity. In the SLF inattention and RC were not significant predictors, however, anxiety was a significant predictor of Left SLF tract integrity for all three white matter metrics. The ILF models revealed significant relationships between RC and tract integrity similar to that of the AF in addition to three significant or trending relationships between inattention and tract integrity.
Discussion: This project replicates previous findings relating RC to both anxiety and inattention and provides preliminary evidence that inattention and RC are linked to common white matter tracts. Anxiety was not associated with the same tracts as RC or inattention and thus likely impacts RC via a different pathway.

S76. SEMOTION BIASES ON EXPLORE-EXPLOIT DECISION-MAKING DIMINISH FROM ADOLESCENCE TO ADULTHOOD

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Background: Exploration and learning from reinforcement changes from adolescence to adulthood, potentially promoting future adaptive behaviors. To successfully navigate novel environments, individuals should adjust exploratory behavior based on feedback, typically learning to stay with a rewarded action (exploitative win-stay) and making adjustments after unrewarded actions (exploratory lose-shift). However, less is known about how appetitive and aversive emotional cues affect this adaptive win-stay/lose-shift (WS-LS) asymmetry across development. The current study tested two hypotheses based on previous findings that suggest cognitive and emotional development tends to prioritize exploitation over exploration as individuals transition from adolescence to adulthood: (1) task-irrelevant emotional cues will attenuate the WS-LS asymmetry and (2) there will be age-related increases in the WS-LS asymmetry that reflect a great reliance on win-stay behavior for maximizing rewards, particularly in response to emotional cues.
Methods: Seventy-three 13- to 30-year-old participants completed a reinforcement learning task in which they learned to stop a rotating clock hand to win points in the context of a task-irrelevant emotional face (happy, fear, and scrambled). Faster response times (RTs) yielded higher points (decreasing expected value [DEV] reward contingency) on three blocks of trials, whereas slower RTs yielded higher points on the other three blocks (increasing expected value [IEV]). Lose-shift behavior was indexed by larger shifts between previous and current trial RT following omissions,

whereas win-stay behavior was indexed by smaller shifts between previous and current trial RT following rewards.

Results: Linear mixed models of points earned in each run revealed that individuals who showed larger within-run behavioral shifts (greater exploration), particularly in the context of happy cues during DEV vs. IEV learning, earned fewer points on the run. Importantly, this effect weakened from adolescence to adulthood. RT shifts were not associated with run earnings in the context of fear or scrambled cues, regardless of reward contingency. Moreover, trial-level RT models revealed RT shifts tend to be larger after omission vs. rewarding outcomes, consistent with a WS-LS strategy. However, this effect was stronger in the context of happy and scrambled vs. fear cues and during DEV vs. IEV learning. During DEV learning, this WS-LS asymmetry in the context of happy cues became more pronounced with age, as evidenced by age-related increases in the magnitude between the win-stay slope and lose-shift slope. This asymmetry was driven by age differences in post-reward RT shifts, such that adults tend to make smaller behavioral adjustments after rewarding outcomes (win-stay) in the presence of happy cues compared to adolescents. There were no age differences in WS-LS asymmetry in the context of scrambled or fear cues.

Discussion: Our results suggest that appetitive emotion cues can trigger the expectation of rewards, which may motivate increased exploratory behavior during adolescence relative to adulthood. However, this tendency during adolescence may be suboptimal when behaviors that lead to positive outcomes should be repeated to maximize future rewards. These findings provide new insights into how age-related improvements in learning from positive reinforcement, particularly in appetitive emotion contexts, can inform explore-exploit decision-making from adolescence to adulthood.

S77. CHILD AUTISM SYMPTOM SEVERITY MODERATES THE RELATIONSHIP BETWEEN OBSERVED PARENT-CHILD BEHAVIORAL ATTUNEMENT AND SIMILARITY IN CHILD AND PARENT MULTISCALE ENTROPY DURING A DYADIC MATH FLASHCARDS TASK.

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Background: Social experiences are critical for learning. Autism spectrum disorder (ASD) is a developmental disorder characterized by socioemotional functioning deficits and repetitive and/or restrictive behaviors. ASD is being increasingly thought of as a spectrum of features as opposed to specific phenotypes, evident in the removal of individual diagnoses like Asperger's Syndrome. Students with ASD have been found to experience greater difficulties in the classroom, both socially and academically. Thus, the relationship between social functioning and learning is not only of particular interest within the context of ASD, but also when considering the natural variability of social behaviors across populations, irrespective of diagnosis.

Given the dynamic nature of neural systems, an increasing body of work suggests that variability in neural activity, or neural entropy, may be informative rather than being just "noise" that should be excluded from study. Multiscale entropy (MSE) is a measure of this neural variability across temporal scales and is commonly calculated from time series like EEG signals. EEG-measured MSE has been found to predict social perception, along with associations with age and functional

connectivity. Within the context of ASD, MSE has been found to be associated with symptom severity and diagnosis. Altogether, this highlights a potential role of MSE in cognition and social behaviors, which could be particularly interesting with regards to better understanding atypical social functioning.

Methods: 31 children aged 6-11 years old, with (n=8) and without ASD (n=23), orally answered arithmetic flashcards presented by their parents. Neural activity was recorded using EEG, and recorded task videos were coded for dyadic behavioral attunement. Parents completed the Autism Spectrum Quotient (AQ) to assess their child's ASD-associated symptom severity. Higher AQ scores indicate more ASD-aligned traits (e.g., more atypical social behaviors). AQ was used as a proxy for ASD symptom severity across all children to align with the conceptual understanding of ASD as a spectrum. MSE was calculated via the APPLESEED pipeline. The absolute value of correlations in MSE between dyad members was calculated. Given potential associations between neural entropy and functional connectivity, age, and ASD symptoms, higher correlated child and parent MSE may suggest more mature functional connectivity for the child and/or similarities in child and parent ASD symptoms.

Results: Observed behavioral attunement (b=0.18, p=0.03) and child AQ scores (b=0.02, p=0.03) were both found to be significantly positively associated with correlations in child-parent MSE, with child age as a covariate ($F(4,26)=2.77$, $R^2=0.3$, $p < 0.05$). Child age was not a significant covariate in this model. Child AQ was found to moderate the relationship between behavioral attunement and correlations in child and parent MSE. Specifically, children with higher-than-average AQ scores exhibited a more negative effect between observed behavioral attunement and child and parent MSE correlations (AQ=97.32, b=-0.21, p=0.02 vs. AQ=47, b=-0.01, p=0.87). Child AQ was found to be significantly negatively correlated with behavioral attunement (t=-2.42, p=0.02). No other variables were found to be correlated.

Discussion: This study suggests a potentially similar coordination of behavior and individual neural variability during child-parent interactions in an academic context, and the effects of individual variability in social functioning on this association. This analysis underscores the informative potential of MSE and further informs how neural variability and dyadic behavior may relate within academic settings. Overall, this highlights the importance of recognizing individualized needs of students and supporting different types of learning within the classroom, particularly children with ASD. In turn, this work can better inform how to facilitate academic growth and success for all children.

S78. FEARFUL-BONDS IN PARENTING: IMPACT OF ADVERSE EXPOSURES

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Background: Exposure to maternal and child adversity (environmental/emotional) may affect developmental processes within the dyad (mother and child). These experiences may increase stress, anxiety, and fear within the dyad. We hypothesize that mothers with history of adversity, who have been repeatedly exposed to environmental stressors perinatally (stressed during

pregnancy/postpartum), will demonstrate higher levels of stress, fear, and atypical bonding patterns that affect child neurodevelopment.

Methods: This cross-sectional study aims to develop a translational model of repetitive adversity on bonding and offspring development in a pilot sample of rodent mother-pup models and human mother-child dyads. Specific Aim 1: Test an animal-model of early-adversity and inhibitory avoidance (maternal fear that leads to offspring behavioral inhibition). Specific Aim 2: In a sample of 30 dyads characterized for adversity (early life and perinatal), assess if maternal fear responses relate to atypical maternal attachment and bonding, affecting child neurodevelopment. Specific Aim 3: Assess if behavioral assessments, in animal and human model, correlate with biomarkers of stress and inflammation. Statistical analysis will be performed for individual aims and a general interaction model to combine data from different aims using STATA or R- software.

Results: It is expected that the animal models will provide a foundation of areas that need to be furthered studied in dyads at risk of psychopathology. The assessment of fear, stress and neurodevelopment will provide preliminary data on the impact of repeated adversity on atypical mother-child bonding. Biomarkers of stress and inflammation will evidence the presence of altered physiological patterns when exposed to repeated adversity.

Discussion: Our findings aim to generate behavioral assessment paradigms to study long-term attachment security amid adversity and its impact on child neurodevelopment. This study will open doors for pinpointing causal relationships to identify risk factors for future psychopathologies and transference mechanisms (behavioral and physiological) in mother-child dyads.

S79. CORTISOL STRESS REACTIVITY AND STRUCTURAL NEURAL NETWORK ARCHITECTURE

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Background: The hypothalamic-pituitary-adrenal axis responds to acute stress and programs long-term patterns of responsivity through a set of physiological and neurobiological processes. Cortisol, the stress hormone, regulates neurobiological mechanisms involved in the development of gray matter structures, yet its impact on white matter connections is relatively unknown. Furthermore, few studies have examined how different dimensions of neuroendocrine functioning might contribute to white matter structural organization.

Methods: Therefore, we used growth curve modeling with landmark registration as applied to neuroendocrine data to examine the relationship between different phases of the cortisol response to stress (reactivity, peak, recovery) and graph analysis metrics of white matter connectivity (measures of efficiency, clustering, and segregation) in a sample of 222 adolescents recruited from a sample with a high representation of socioeconomically disadvantaged individuals.

Results: Greater cortisol reactivity was associated with more efficient ($\beta = .209$, $p = .006$) and less segregated networks ($\beta = -.111$, $p = .007$), but was not associated with network clustering ($\beta = 2.033$, $p = .143$). There were no associations between cortisol peak activation and recovery slope and network efficiency, clustering, or segregation (all p's > .119). There were no associations between cortisol peak activation or recovery slope and network metrics (all p's > .958). All these

associations remained after adjusting for covariates (family income, mother's marital status, city, medication, puberty, time from wakening, age, gender, and race/ethnicity).
Discussion: Findings suggest a link between cortisol reactivity and structural network organization. Greater reactivity was related to more integrated and less segregated structural networks. These findings suggest that neuroendocrine functioning may play a role in structural white matter development. Future analysis will examine the relationship between cortisol and specific white matter tracts that may underlie the development of structural connectivity.

S80. SNR INCREASES WITH EXCITATORY/INHIBITORY BALANCE THROUGH ADOLESCENCE INTO ADULTHOOD IN PFC

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Background: Adolescence is a time of unique neurocognitive development that is believed to be supported by specialization of PFC as excitatory/ inhibitory (E/I) function, reflective of plasticity, regains balance through adolescence into adulthood. Increasing E/I balance should result in a suppression of spontaneous activity shifting activity from spontaneous, asynchronous to evoked synchronous firing, increasing the signal-to-noise ratio (SNR). The auditory steady state response (ASSR) elicits oscillations driven by a train of auditory clicks, which has been shown to reflect developmental increases in evoked power with decreases in spontaneous activity as well as reflect balance. However, it is not known how changes in ASSR are related to increases in E/I balance. We hypothesized that increases in markers of E/I balance would be associated with increases in SNR supporting improvements in executive function.
Methods: EEG and magnetic resonance spectroscopic imaging (MRSI) data were collected on 164 participants (87 female at birth), 10-32yos with up to 3 visits at 18mo intervals (n=286 total sessions). EEG data was collected while performing the ASSR task where participants were presented with a 40 Hz click train. Participants also completed a memory guided saccade task and MRSI was collected using a 7T Siemens scanner as described in our previous work (Perica et al., 2022) to estimate levels of glutamate, GABA, and their balance. Total power was computed by averaging individual-trial EEG power spectra and evoked power by averaging the single trial epochs in the time domain and calculating the resulting power spectra, isolating the power that was phase-locked to the stimulus. Spontaneous power was defined as the difference between evoked and total power. SNR was calculated as evoked power divided by spontaneous power.
Results: Results showed spontaneous activity decreased through adolescence while cortical SNR increased. DLPFC glutamate was inversely proportional to spontaneous activity, while the balance of Glu-GABA levels was positively associated with cortical SNR. Importantly, increases in SNR and reductions in spontaneous activity were associated with improved accuracy and latency on a working memory task.
Discussion: Together, these results provide in vivo evidence suggesting that increases in markers of E/I balance results in enhanced SNR supporting cognitive development underlined by developmental decreases in spontaneous activity. This supports a model of adolescent development as a period of neural 'exploration' that may support the transition to stabilization of optimal neural function enhancing executive function.

S81. ANGRY FACES ALTER EMOTIONAL MEMORIES OF CHILDREN AND ADULTS IN DIFFERING TRAJECTORIES

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Background: Imagine a lady seeing an angry person holding a jacket. She stands with a child witnessing the same scene. What could the lady remember about the scene? And what about the child? A wide array of research studied the case of a lady remembering an angry person a jacket; also the association. On the other hand, current literature provides limited evidence on the way a child would form the memory representation of a person, a jacket and an association and how it compares with an adult's memory. In this research, we aim to answer those questions with a computer-assisted experimental paradigm. Negative emotions enhance item memory, it reduces the associations for the negative–neutral elements in adults (Madan, 2017; Bisby, 2018). Regarding the developmental aspects, current evidence shows that item memory and associative memory increases with age albeit with a different pace (Ghetti, 2010). But our knowledge on emotion related changes in item memory and associative memory in children and in adults is limited. Previous studies used multiple modalities of stimuli while studying item and associative memory, and faces remained as a special kind (Johnson, 2005). In particular, angry faces were shown to behave differently in influencing memory processes of clinical population and typically developing group (Lambert et al., 2019).

Methods: In this research, 30 children (16 girls) and 30 adults (15 females) learned the neutral face–neutral object associations. Children and adults were administered the same memory task. They completed item memory tasks for faces and objects with an old/new paradigm. Following item memory tasks, a cue-based associative memory task was administered. Associative memory was tested in two directions; i.e., face (cue) – object (test) and object (cue) – face (test).

Results: Results yielded evidence for an enhanced item memory for angry faces in children but no emotion-related changes in adults. Item memory for objects were not influenced by age group, emotion or interaction. Regarding associative memory, children's associative memory did not show any emotion-related changes, while the adults' associative memory for angry face -- object associations were reduced compared to neutral face – object associations. These results suggest that anger modulates the emotional memories of children and adults in differing manners and its effect in each age group depends on the memory modality (item versus associative memory). In addition, evidence revealed that emotion-related changes in associative memory cannot only be explained with attentional account as no memory difference was observed for item memory of objects in the presence of angry facial expressions and neutral facial expressions. These results were consistent in children and adults.

Discussion: Our research provided crucial insights into anger-related alterations in memory outcomes for items and associations, and how age is a critical factor in modulations. These findings have potential implications for clinical and educational settings, as well as eye-witness testimonies for evidence-based practices.

S82. CORTICAL ALPHA OSCILLATIONS UNDERLYING SPATIAL WORKING MEMORY PROCESSES SCALE WITH AGE AND BEHAVIORAL PERFORMANCE

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Background: Working memory is essential to everyday functioning and is highly predictive of academic and future career success. It is known to undergo a protracted developmental trajectory that begins in childhood. A sizable body of fMRI work has suggested that activation across right occipitoparietal and temporal regions is critical to spatial working memory processing. Further, magneto- and electroencephalography (M/EEG) studies have shown that working memory involves strong decreases in posterior alpha activity, thought to reflect the active loading of information into memory stores, as well as increases in alpha power reflecting inhibition of irrelevant incoming visual information. While recent studies have begun to map to the developmental trajectory of the neural dynamics serving verbal working memory, few have evaluated the oscillatory dynamics serving spatial working memory.

Methods: A cohort of 79 healthy youth ages 6 to 14 years old successfully completed a spatial working memory paradigm during high-density MEG. Participants were shown an array of four letters in a 5x5 grid and instructed to attend only to the locations of the letters. Raw MEG data was transformed into the time-frequency domain using complex demodulation, and significant sensor-level neural oscillatory responses were imaged using a beamformer. To identify developmental changes in neural oscillatory activity, whole-brain voxel-wise correlations were performed with chronological age per oscillatory response map. Behavioral performance was subsequently correlated with peak voxel activity at regions significantly associated with age at the whole-brain level.

Results: Behaviorally, accuracy and reaction time were significantly correlated with age, such that older participants were more accurate and faster to respond than younger participants. During the encoding phase, participants exhibited stronger alpha decreases (i.e., more negative relative to baseline) with increased age in the bilateral parietal cortices, right angular gyrus, right occipitotemporal area, right precuneus, and other regions ($p < .00005$). These oscillatory responses were associated with faster reaction times in each region and greater accuracy in parietal areas. This pattern of responses was largely sustained into the maintenance phase, as stronger alpha decreases (i.e., more negative relative to baseline) with increasing age were observed in bilateral parietal cortices, as well as occipital and temporal regions ($p < .00005$). As with the encoding phase, alpha oscillations in bilateral parietal, right temporal and bilateral middle occipital regions were significantly associated with faster reaction times, and activity in right inferior parietal and right temporal regions was associated with greater accuracy across the sample.

Discussion: Our results point to consistent developmental increases in alpha oscillatory activity serving both the encoding and maintenance of spatial information in working memory stores. Further, the stronger oscillatory activity with increasing age was also significantly associated with better task performance. Recruitment of association cortices is essential to spatial working memory, and these areas undergo significant refinement in childhood and adolescence. Our observation of consistent associations between stronger oscillatory activity across these bilateral regions and better task performance suggests that such neural responses may reflect increased

functional specialization in circuitry supporting spatial working memory with increasing age during this critical developmental window.

S83. INFLUENCE OF EMOTION AND EMOTION REGULATION ON THE SUBJECTIVE RECOLLECTIVE EXPERIENCE AND MEMORY FOR CONTEXT ACROSS DEVELOPMENT

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Background: Both emotion and age modulate the subjective recollective experience. Emotion intensifies the subjective vividness, the sense of reliving the event, and confidence in the accuracy of the memory for the emotional event (Neisser and Harsch, 1992; Neisser et al., 1996; Phelps and Sharot, 2008; Sharot et al., 2007; Talarico and Rubin, 2003), i.e. humans show a qualitatively distinct subjective recollective experience when remembering real-life emotional events compared to remembering neutral real-life events. Concerning age, studies show that the subjective recollective experience increases across development (Ghetti et al., 2011; Ofen et al., 2007). For emotional stimuli, it is currently unknown whether children, similar to adults, exhibit an enhanced subjective sense of recollection. In addition, it is unknown how the subjective sense of remembering emotional vs. neutral stimuli is associated with memory for contextual details across development from child- to adulthood. In addition, it is unclear how emotion regulation strategies may affect the subjective recollective experience across childhood.

Methods: In two experiments, we examine the impact of emotion on the subjective recollective experience recollection (SSR) and its relation to memory for contextual details. In Experiment 1, 7 to 8-year-old children (N = 27, 15 female), 10-year-old children (N = 30, 15 female), 14 year-old adolescents (N = 27, 16 female), and young adults (N = 27, 13 female) participated. With increasing age, the Subjective Recollective Experience was accompanied with a higher proportion of context memory.

In Experiment 2, we show that two emotion regulation strategies, re-appraisal and distraction decrease negative valence ratings in children of different ages (Group 1: 8-9 years, Group 2: 11-12 years, Group 3: young adults).

Results: In Experiment 1, negative compared to neutral stimuli were recalled with enhanced subjective recollective experience across all ages. Crucially, divergent to the boost in the subjective recollective experience, memory for context was lower for remembered negative vs. neutral stimuli in all age groups. In Experiment 2, we found that reappraisal and distraction show distinct effects on the subjective recollective experience of negative stimuli.

Discussion: These findings show that even at 7- 8 year old children, the enhanced subjective recollection experience for negative stimuli does not reliably indicate greater context memory, at least of the contextual detail tested, and thus may be driven by a different mechanism than the subjective recollective experience for neutral stimuli. In addition, our findings show that emotion regulation strategies decrease negative affect ratings in children and depending on the emotion regulation strategy modulate the subjective recollective experience differentially.

S84. ASSOCIATIONS BETWEEN PUBERTAL STATUS AND HIPPOCAMPAL SUBFIELD VOLUME IN PERIADOLSCENT CHILDREN

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Background: Puberty marks an inflection point in childhood in many ways, not least in terms of brain development: puberty has been associated with differences in brain structure and function. Endocrine factors drive many pubertal changes, for example, levels of testosterone and estradiol rise during pubertal development, though the magnitude of increase varies by sex. Bodily changes attributable to endocrine factors can be assessed using Tanner Staging also known as Sexual Maturity Rating (SMR). Tanner staging relies on detectable, large-scale puberty-related changes that can in turn be associated with more nuanced changes including those on brain structure. For example, the hippocampus is a hormone-sensitive structure, perhaps especially within the CA1 subfield which contains many estrogen-sensitive neurons. Previous studies have investigated these changes within the hippocampal subfields in association with sex and age. However, effects of pubertal status on hippocampal development remain underspecified. The current project utilized data from the NIA-funded Polygenic Risk of Alzheimer's Disease in Nebraska Kids (R01 AG064247) study, which investigates how brain and cognitive development is affected by polygenic risk of Alzheimer's disease (AD). Here, we report cross-sectional findings from the PRANK study with the goal of measuring potential effects of pubertal status on the hippocampal anatomy. We utilized the Tanner Stages to investigate the relationship between pubertal status and hippocampal subfield volumes for CA1, CA2/3, subiculum, dentate gyrus, as well as total hippocampal volume.

Methods: A sample of 129 healthy periadolescents age 8-13 years (65 females, 64 males), was drawn from the ongoing PRANK study. Participants completed a 3T MRI scan including a T2-weighted turbo spin echo ultra-high-resolution slab targeting the medial temporal lobe (MTL) and hippocampus. Hippocampal subfields were segmented from the MTL slab using the Automated Segmentation of Hippocampal Subfields (ASHS) toolbox. Meanwhile, the parental informant report of the ABCD Perceived Pubertal Development questionnaire was used to derive Tanner Staging for each participant using published methodology.

Results: On average females demonstrated greater Tanner Staging scores ($M = 2.84$, $SD = 0.93$) than males within our sample ($M = 1.68$, $SD = 0.90$), $t(126.75) = 7.26$, $p < .001$. We observed that right subiculum volume exhibited a statistically significant correlation with Tanner Staging scores across the whole sample ($r(128) = .254$, $p = .022$). Other subfield volumes were not found to be correlated with pubertal development.

Discussion: We observed a statistically significant correlation between pubertal status and the volume of a hippocampal subfield in a cross-sectional sample of periadolescent children. Specifically, volume of the right subiculum was significantly correlated with measures of pubertal development. Also, on average, females demonstrated higher Tanner Staging scores measuring pubertal maturation than males. Which is consist with former literature finding earlier average onset of pubertal development in females. Longitudinal data collection is currently underway and could provide more insight into how pubertal development might influence hippocampal subfield volumes. Future directions include longitudinal analysis of these variables and examining the effects of polygenetic risk scores of Alzheimer's diseases influencing brain and cognitive development.

S85. RELATIONS BETWEEN CORTICAL THICKNESS, GRAY MATTER VOLUME, AND EPISODIC MEMORY PERFORMANCE IN PRESCHOOLERS

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Background: Early childhood is a developmental period in which one's ability to remember details (episodic memory) proliferates with age (Bauer, 2015). During early childhood, the thickness of the gray matter across the cortex has been found to decrease as a function of age (Sowell et. al., 2004).

Decreases in prefrontal cortical thickness have been associated with working memory in preschool-aged children (Botdorf and Riggins, 2018). However, to our knowledge, no studies have investigated the link between regions in the cortex and episodic memory in young children. The present study investigated whether structural measures of memory-related cortical regions are associated with episodic memory accuracy in a preschool-aged sample.

Methods: Participants were 35 children between the ages of 3 and 6 years (M = 4.02, SD = 0.50; 20 Female). T1-weighted MRI images were acquired and pre-processed using FreeSurfer 6.0. Six cortical ROIs that have been associated with episodic memory in school-aged children were chosen: the caudal anterior cingulate, pars orbitalis, superior parietal, inferior parietal, lateral orbitofrontal, and medial orbitofrontal cortices (Ghetti and Bunge, 2012; Lei and Allard, March 2023; Østby et. al., 2012). Additionally, a whole-brain cluster analysis was performed for cortical thickness and volume using FreeSurfer 7.4, controlling for multiple comparisons using the Bonferroni method.

The task was a visuospatial episodic memory task (Kurdziel et. al., 2013). Specifically, participants were presented with the grid of cards face-up and trained to a criterion of 70% accuracy, then the cards were concealed, and the children were asked to recall the locations of the cards (immediate recall) and then again following a nap or equal time spent awake (delayed recall). Children were presented with a grid of 3x3 cards if younger than 48 months and a grid of 3x4 cards if older. Linear regressions were performed in R for the 6 bilateral cortical regions regressing the ROI thickness, immediate recall accuracy, and age on delayed recall accuracy for when the child took a nap and were corrected for multiple comparisons using the Bonferroni method. The analyses were repeated for when the child was kept awake.

Results: There was a significant relation between delayed recall accuracy following a nap and the right inferior parietal cortex when controlling for immediate recall accuracy and age, $t(31) = 2.14$, $p = 0.04$. The whole-brain cluster analysis revealed a significant relation between delayed recall accuracy following a nap and right lateral occipital cortical thickness, $p < 0.001$, right lateral occipital gray matter volume, $p = 0.007$, and right superior temporal gray matter volume, $p = 0.040$, when controlling for immediate recall and age. No significant relations were found when the children were kept awake.

Discussion: Thicker right inferior parietal and right lateral occipital cortices were associated with better delayed recall when children napped. Additionally, greater gray matter volume in the right lateral occipital and right superior temporal cortices was significantly related to better delayed episodic recall when children napped. Prior studies in older children have reported thinner cortices

are associated with better episodic memory performance (Østby, 2012). However, it is unclear whether the difference in findings is due to the age of the participants or the nature of the memory assessments. The differences in findings between the nap and awake delayed recall may indicate that memory recollection following a period of consolidation during sleep might rely on different cortical regions than recollection following a period of wakefulness. Future studies should test this implication by comparing the functional associations between cortical regions and memory performance on recall assessments between sleep and wakefulness.

S86. SLOW WAVE ACTIVITY AND DECLARATIVE MEMORY ACROSS THE TRANSITION FROM TRIPHASIC TO BIPHASIC SLEEP

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Background: Infants' daytime sleep patterns change significantly across early development. From 6 to 18 months, sleep patterns transition from triphasic (morning nap, afternoon nap, and overnight sleep) to biphasic (afternoon nap and overnight; Weissbluth, 1995). Prior studies found napping supports declarative memory during infancy, whereas staying awake leads to memory decay (Seehagen et al., 2015). However, these paradigms commonly include only 1 nap without regard to which nap and nap history (e.g., did they nap in the morning). Adding such experimental manipulations are critical because increased sleep pressure (e.g., due to skipping a morning nap) changes sleep architecture which may have downstream effects on the consolidation process. In one study, toddlers were kept awake for longer than usual during the day and they had more slow wave sleep (SWS) and higher power slow wave activity (SWA) when they eventually had their nap (Kurth et al., 2016). Alterations to sleep timing and SWS may impact memory consolidation. While SWS was negatively related to memory when infants took two naps, the association was negligible when they were kept awake during their morning nap (Mason et al., 2021).

This study focused on 12-month-olds' afternoon nap physiology and its relation to memory after skipping a morning nap. We had three research questions:

1. Does afternoon SWS change after morning nap deprivation?

2. Does afternoon memory performance change after morning nap deprivation?

3. Does the impact of afternoon SWS on memory consolidation change after morning nap deprivation?

Methods: Infants (N=7; M = 12.52 months; 1 female) participated in two within-subjects conditions, (nap-nap and wake-nap; order counterbalanced) separated by 1-2 weeks. In the nap-nap condition, infants took both their morning and afternoon nap. In the wake-nap condition, infants were kept awake during their usual morning nap time, then napped as usual in the afternoon. Infants wore a 32-channel Brainvision EasyCap, customized for polysomnography, during each nap. Infants learned a new deferred imitation memory task before the naps and were tested immediately and again after the nap.

Results: To test our first question, we ran a paired samples t-test and found a significantly higher percentage of SWS in the afternoon nap in the wake-nap condition ($t=2.860$, $p=0.029$). Regarding our second question, we did not find a significant difference in afternoon memory performance based on whether the morning nap was skipped ($t=-0.956$, $p=0.376$). Finally, to address our third

question, we ran Bayesian correlations on percent SWS in the afternoon nap and afternoon memory performance. When deprived of the morning nap, SWS in the afternoon nap was negatively correlated with memory performance (r=-0.249 BF10=3.166). However, when infants took the morning nap, SWS in the afternoon nap was positively correlated with memory performance (r=0.311 BF10=2.888).

Discussion: We found that when infants skipped their morning nap, they had more SWS in their afternoon nap. Skipping the morning nap did not adversely affect their performance in the afternoon; however, it did change the role of SWS. We found that SWS was negatively correlated with memory performance on the deferred imitation task after a morning awake, but was positively correlated when both naps were taken. This suggests that nap deprivation and increased sleep pressure may alter the functional role of sleep features. Additional data have been obtained from 8 infants and data collection is ongoing. In future analyses, we will investigate how SWA in SWS is related to morning nap deprivation and memory consolidation.

S87. REACTIVATION OF EXISTING MEMORIES DURING NEW LEARNING MEDIATES HIPPOCAMPAL MEMORY ORGANIZATION IN DEVELOPMENT

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Background: The ability to represent the commonalities among related events is critical to higher-order cognition, enabling individuals to extend beyond direct experience to support flexible behaviors such as reasoning. Explicating how integrated memory representation emerges across development not only has important implications for flexible reasoning behaviors, but also academic success. Yet surprisingly we know little about the neural mechanisms that underlie integrative memory representation—or lack thereof—in children and adolescents. In the present study, we address this gap. We build on a growing body of empirical work with adults showing that several brain regions, including hippocampus, support an integrative encoding process whereby existing memories (i.e., AB) are reactivated and considered during overlapping event (i.e., BC) encoding. Findings in adults further show that such learning-related memory reactivation changes the underlying neural representation of indirectly related event elements (i.e., A and C) within hippocampus, resulting in neural codes that are more similar following learning as compared to prior to learning. Moreover, this index of neural integration—which is thought to reflect organization of related events within memory—supports adults' ability to infer the connections among related events as assessed via behavioral reasoning tasks. Because the hippocampus undergoes continued development through adolescence, we predict that children and adolescents may reactivate related memories due to emerging hippocampal maturity; however, functional immaturity will limit updating mechanisms that promote integration.

Methods: To measure the development of these processes, here children (7-12; N=14), adolescents (13-17; N=14), and adults (18-23; N=14) completed a paired associative inference task, wherein they learned an initial set of associations (AB) followed by overlapping (BC) pairs during functional magnetic resonance imaging (fMRI) scanning. To address our primary question regarding the role of memory reactivation on hippocampal memory representation, we used representational similarity analysis (RSA) to measure reactivation of A items during BC learning,

relating this reactivation measure to changes in the degree to which hippocampal patterns for the A and C elements became more or less similar to one another from pre- to post-learning.

Results: As expected based on prior behavioral work, we found that AC inference performance increased from childhood to adulthood ($r(41)=.38$, $p=.01$), even when controlling for direct pair memory. In line with such evidence of age-related increases in flexible memory behavior, our neural data further hints at developmental differences in neural integration, such that in adults, indirectly related items (A and C) were numerically more similar following learning ($p = .12$); a trend that was not observed in children or adolescents. Interestingly, however, when we interrogated hippocampal AC representation as a function of the degree to which participants reactivated related AB memories during BC learning, we found that on trials where children strongly reactivated prior memories, they showed a greater degree of separation between the related AC items in hippocampus ($p = .02$), reflecting active separation in the face of memory competition.

Discussion: Taken together, these findings suggest that reasoning in development may rely on a more effortful strategy, wherein memories are represented separately from one another and then recombined during inference, leading to poorer behavioral performance in children.

S88. DIFFERENTIAL EFFECTS OF SLEEP AND WAKE ON DECLARATIVE MEMORY ACROSS TODDLERHOOD

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Background: Sleep benefits declarative memory in infants (9-15 mos) and preschool-aged children (33-60 mos). However, research has neglected toddlerhood (16-30 mos), despite this age range being significant in terms of neurodevelopmental changes, particularly in regions of the hippocampus relevant to memory (Gomez and Edgin, 2016). Furthermore, research in early childhood has exclusively used a nap paradigm. Overnight sleep allows for multiple sleep cycles and REM sleep (which is minimal in naps), both of which have been suggested to benefit some aspects of memory (Sonni and Spencer, 2015; Spanò et al., 2018). We aimed to assess to what extent sleep supports declarative learning in toddlers and if their ability to maintain memories across wake improves with age. Given that the hippocampus, critical to memory consolidation, is posited to be developing prior to 18-24 months, memory consolidation should be greater in those older than this compared to younger ages. An alternative is that REM sleep benefits memory prior to 28 months (Cao et al., 2020) and nREM sleep serves this function in older children. We sought to test these hypotheses by assessing memory consolidation and sleep physiology in children from 16-31 months.

Methods: Data are from an ongoing longitudinal study in which children were enrolled at either 16 or 21 months ($N = 38$) and were tested again 5 and 10 months later. At each session, toddlers were presented with an associative learning task (based on Mooney et al., 2020) where they learned different character-location pairings and were later asked to recreate the correct pairings. Toddlers completed one version of pairings in the morning, followed by an immediate recall phase, and then completed a delayed recall phase in the early evening (wake condition). Toddlers then encoded a new set of character-location pairings in the evening, followed by immediate recall prior to sleep, and delayed recall the following morning (sleep condition). Polysomnography was used to record

physiology of overnight sleep bouts. Conditions and character-location presentations were counterbalanced across all participants.

Results: Of interest was the change in memory over the sleep interval compared to the wake interval. A change score was calculated as delayed recall accuracy minus immediate recall accuracy. Differences in task performance between conditions and age groups were compared with a 2 (Condition: Sleep vs. Wake) x 4 (Age: 16, 21, 26, 31 mos) ANOVA. There was a main effect of condition, such that toddlers across all age groups generally performed better following sleep compared to wake ($F(1,141) = 6.10$, $p = .003$). There was no main effect of age on accuracy (with conditions collapsed), though there was a trending interaction between condition and age on memory accuracy ($F(3,141) = 2.09$, $p = .104$). Pairwise comparisons showed that while change scores did not differ between age groups for the sleep condition, the wake condition did have significant differences. Toddlers performed significantly worse in the wake condition at 16 months compared to 26 ($p=.019$) and 31 months ($p = .025$).

Lastly, Pearson's correlations were used to assess relations between overnight memory change scores and time in REM and nREM sleep. When separated by group, we found a marginal association between minutes of REM sleep and change in memory performance for toddlers at 16 months ($r(9) = -.660$, $p = .107$), but this did not reach significance. No other associations were found to be significant.

Discussion: Overall, we found that overnight sleep benefitted associative learning for toddlers across age groups. There is some evidence to suggest that wake-dependent memory emerges across this age range which emphasizes the importance of sleep in preserving memory. Further data is being collected to better explore what sleep stages or microstructures (e.g., spindles, slow waves) support sleep-dependent memory consolidation in toddlers.

S89. LEVERAGING LATENT MODELING TO ASSESS SPECIFICITY IN THE RELATION BETWEEN INDIVIDUAL DIFFERENCES IN HIPPOCAMPAL SUBFIELDS AND MEMORY

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Background: The ability to recall details from memory varies between individuals and improves across development. Structural differences in hippocampal subfields likely contribute to this variability.

Methods: Using latent modeling, we simultaneously tested individual differences in item and associative memory and hippocampal subfield volumes in 105 7–20-year-olds. We assessed latent item and associative memory using nine memory measures, thus accounting for differences due to task features. We assessed cornu ammonis (CA)1, CA3/dentate gyrus (DG), and subiculum (Sub) using volumes segmented by a validated automatic atlas, corrected using a validated protocol, and adjusted for head size.

Results: Better item and associative memory related to older age. Larger CA3/DG and Sub volumes related to older age. Independent of age, larger CA1 and CA3/DG volumes related to better item and associative memory.

Discussion: Results demonstrate specificity in the relation between memory and subfield volumes in development.

S90. DEVELOPING EYE-TRACKING BASED MACHINE LEARNING TOOLS TO CLASSIFY WAKEFULNESS IN FUNCTIONAL MRI DATA

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Background: Functional neuroimaging could revolutionize psychiatric practice by identifying underlying network pathology and treatment targets. Wakefulness and sleep state are known to substantially impact functional MRI analyses, but are not typically taken into account during measurement or in post-processing. Our study aims to develop tools to classify wakefulness frame-by-frame during MRI imaging without needing EEG.

Methods: Eleven subjects were monitored concomitantly with EEG and eye-tracking in a mock-MRI scanner, for up to 2 hours/participant, producing 14 hours of recordings. EEG and eye-tracking data were divided into 30 second, non-overlapping epochs. The EEG data were graded by qualified sleep technologists into awake, stage-one (S1), or stage-two (S2) sleep. A previously validated and open-source AI protocol extracted pupil, lid, and blink metrics from the corresponding eye-tracking video and were reviewed manually for accuracy. Alignment of the EEG and eye-tracking was used for K-nearest neighbors supervised machine learning classification with 3-fold cross-validation.

Results: Drowsiness was highly prevalent in the data, with 9 subjects falling asleep (time asleep from 5.5-59 minutes by EEG sleep stage). Initial machine learning models show 85.38% classification accuracy at identifying sleep stage overall. The model most precisely identified wakefulness (86.2%) and stage-two sleep (71.4%), but identified all stage-one sleep as awake. Blink speed (0.589), Interblink interval (0.568), number of blinks (0.2715), and average interblink eyelid tone (0.1472) were the most impactful classifiers.

Discussion: While more data is needed, this proof-of-principle study demonstrates the feasibility of sleep identification using eye-tracking and may help segregate data by wakefulness during analysis, thus leading to more accurate MRI functional data.

S91. PRECISION FUNCTIONAL MAPPING IN CHILDREN WITH TOURETTE SYNDROME: A FEASIBILITY STUDY

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Background: Precision functional mapping (PFM) is a promising tool for studying functional brain organization in individuals. PFM relies on collecting hours of fMRI data over multiple scan sessions, which can prove challenging for child and clinical populations. Nonetheless, PFM holds promise for revealing individual differences underlying developmental disorders with unique clinical profiles. One such disorder that would benefit from a personalized approach is Tourette Syndrome (TS). TS is characterized by motor and/or vocal tics, which are brief, repetitive, unwanted movements or noises that can severely impinge upon quality of life. Given the

considerable heterogeneity in the clinical profile of TS, PFM provides a unique opportunity to characterize brain function at the individual level. However, inherent challenges exist when attempting to repeatedly scan children with TS. Children tend to move more in the scanner than adults, and children with tics may have even more movement, affecting data quality. Further, families often have busy schedules, including school and extracurricular activities, which could make repeated visits burdensome. This study aimed to test the feasibility of PFM (i.e., obtaining large quantities of low-motion data via repeated scanning) in children with TS, including refining strategies for participant comfort and retention, and examining the ability to retain large amounts of low motion data.

Methods: We enrolled 7 children with a diagnosis of TS, ages 8-15 (M=11.4, 4 female, 3 male) to participate in multiple fMRI sessions. Comorbidities included attention deficit hyperactivity disorder (n=3), autism spectrum disorder (n=1), obsessive-compulsive disorder (n=1), and generalized anxiety disorder (n=2). Participants were recruited from the community and movement disorders clinics. Tics exhibited among participants during clinical evaluations included hard blinking, uttering words, and head jerking, among others. Only one child (12 yo male) was withdrawn from the study early due to excessive motion during scans.

Results: Across all seven children, there was an average of 7 scan sessions each (range 4-10 sessions) over an average of 14.36 weeks (range 7-28 weeks). An average total of 168.43 minutes (range 59 - 232 mins) of resting state fMRI data were collected from each child. After motion censoring using strict framewise displacement (FD) criteria, an average of 107.61 minutes (range 8.25-187 mins) of resting-state fMRI data per child was retained. In addition to the high amounts of data retained over the course of the study, we found that the proportion of good data per session did not decrease throughout scan sessions.

Discussion: Using strategies such as conducting a mock scan, allowing for breaks, encouraging low motion through the use of rewards, and forming comfortable relationships with participants and their families, we were able to consistently collect large amounts of high quality data from children with TS. Overall, we show that PFM is feasible in child clinical populations and is a viable method for capturing the unique profiles of children with neuropsychiatric disorders.

S92. AN ENGAGING VIDEOGAME TO ASSESS PROPRIOCEPTIVE VS. VISUAL BIAS IN CHILDREN WITH AUTISM

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Background: Combined visual and proprioceptive input is crucial to learning a range of actions, including social gestures, tool use, and other motor skills. Therefore, the relative weighting of visual vs. proprioceptive input may be fundamental to understanding patterns of child development. Behavioral, computational, and imaging findings reveal that children with autism show excessive reliance on proprioceptive input and associated difficulty with visual-motor integration (VMI). For example, infants at risk for autism show less anticipatory action to balls rolled to them; further, children with autism, but not those with ADHD, show difficulties with ball catching, tracking dynamic stimuli, and motor imitation. Earlier approaches for assessing sensory-motor bias were cumbersome with low potential for clinical use. Addressing this, we developed a

highly engaging videogame ("HaptiKart") interfaced with an off-the-shelf force-feedback wheel to examine proprioceptive vs. visual bias in 8 to 12-year-old children with ASD and neurotypical children (NTC).

Methods: Forty children (23 NTC and 17 ASD) that did not differ in age (p=0.92) or sex (NTC: 65% male, ASD: 70% male; p=0.72) participated in this study. The HaptiKart task involves the child using a force-feedback steering wheel to keep a car moving at a constant speed on the centerline of the track. During gameplay, participants could see their driving errors visually on the monitor but also feel them proprioceptively via the force-feedback steering wheel. Following a familiarization period, participants completed two separate conditions (~2- min each) in counterbalanced order: (1) non-delayed visual with 300-ms delayed proprioceptive feedback (V+DP) and (2) 250-ms delayed visual with non-delayed proprioceptive feedback (DV+P). Both conditions were separated by a ~1 -min washout block on a separate track, receiving non-delayed visual and proprioceptive feedback. The difference in driving errors between the two conditions provided a bias score (bias score = V+DP – V+DP), with positive scores showing proprioceptive bias and negative scores showing visual bias.

Results: Children with ASD showed significantly higher proprioceptive vs. visual bias relative to NTC (non-parametric t-test p=0.007), such that ~50% (8/17) of children with ASD showed proprioceptive vs. visual bias whereas nearly all (22/23) of NTC showed visual vs. proprioceptive bias. Within the ASD group, proprioceptive vs. visual bias correlated significantly with elevated clinically-rated autism features (ADOS-2 comparison score: r=0.59, p=0.02) and lower IQ (general ability index; r=-0.69, p=0.002). At the whole group level, proprioceptive vs. visual bias correlated significantly with more severe parent-rated autism features (SRS-2 total score: r=0.52, p=0.002) and worse motor skills (MABC-2 total score: r=-0.36, p=0.03).

Discussion: Our findings show a pattern of proprioceptive vs. visual bias in children with ASD and visual vs. proprioceptive bias in NTC (while ~50% of the children with ASD showed proprioceptive bias, nearly all NTC showed visual bias). Further, proprioceptive vs. visual bias was significantly associated with core diagnostic features of ASD, as well as IQ. Planned future studies include examining brain-behavioral patterns underlying proprioceptive vs. visual bias in ASD, including in contrast with other developmental disorders, with the goal of advancing targeted diagnosis and intervention.

S93. SEX DIFFERENCES IN THE SIZE OF FUNCTIONAL BRAIN NETWORKS IN ADOLESCENCE

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Background: Adolescence marks a period of change and increased susceptibility, characterized by significant brain development and the onset of diverse neuropsychiatric disorders. Many of such disorders have substantial sex differences in prevalence, suggesting that differences in brain development may underlie differential risk for psychopathology between males and females. Recent advances in neuro imaging provide unique insights into individual functional brain network architecture, revealing idiosyncratic functional network size (i.e., how much cortical surface area

"real estate" is taken by each network). Such variation has been linked to individual differences in adaptive (e.g., cognition, motor skills) as well as non adaptive behaviors (e.g., depression), and has even been shown to govern treatment responses (e.g., rTMS in depression).
Methods: By leveraging the ABCD Reproducible Matched Samples (ARMS) with a discovery sample (N = 2747; 1447 female) and a replication sample (N = 3012;1527 female) from the Adolescent Brain and Cognitive Development (ABCD) study, we delineated person-specific functional networks using a template matching procedure. Then, we calculated the proportion of surface area for 15 networks: DMN, VIS, FP, DAN, VAN, SAL, CO, SMD, SML, AUD, Tpole, MTL, PMN, PON, SCAN. T-tests were used to examine mean differences between the network size in males and females. We repeated the analysis in the replication sample.
Results: We found significant differences in proportional surface area for Default Mode Network (DMN), Fronto-Parietal (FP), Cingulo-Opercular (CO), and Dorsal Attention Network (DAN) between males and females ($pBonf < 0.05$). FP and DAN occupied larger cortical "real-estate" in males compared to females, whereas DMN and CO took larger cortical "real-estate" in females compared to males. These differences were replicated across both arms.
Discussion: Our findings suggest that males and females differ in terms of functional network size, mostly in the association networks. Future work will determine if these findings replicate in lifespan samples. We will also examine how such sex-specific differences in the brain relate to differential risks and treatments for psychopathology.

S94. NETWORK INTEGRATION IN DEVELOPMENT: RELIABLE PATTERNS OF SOMATOMOTOR AND VISUAL NETWORK INTEGRATION REVEALED THROUGH COMBINED PRECISION FMRI AND LARGE GROUP DATASETS

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Background: A prominent theory of neurodevelopment suggests that the functional organization of the human brain shifts from local to distributed with age. The empirical evidence for this theory has been mixed, with different studies finding inconsistent effects. Precision functional mapping (PFM), or the collection of large amounts of data in individual participants, may help us better characterize network integration in development.
Methods: In this study, we utilize two PFM datasets (child PFM: n = 10 children, Midnight Scan Club: n = 9 adults, densely sampled individuals) and two high quality group average datasets (ABCD: n = 185 children, WUSTL: n = 120 adults) to investigate reliable changes in network integration occurring over middle/late childhood to early adulthood. Using the PFM data, individual-specific brain networks were defined in both age cohorts using InfoMap community detection across multiple density thresholds (1, 2, 3, 4, 5%). For each pair of brain networks, we calculated the mean between-network connectivity in order to quantify age-group specific relationships between networks.
Results: The adult group was found to have significantly larger connectivity between visual and ventral attention networks, and between somatomotor with dorsal attention and cingulo-opercular networks compared to the child group (FDR corrected $p < .05$). Further, we calculated the participation coefficient, a measure of a node's integration with networks outside of its own, for

each cortical parcel in child and adult PFM participants. We found that somatomotor parcels have significantly larger participation coefficients in the adult cohort compared to the child cohort. Using independent child and adult group data (ABCD, WUSTL), we created connectivity maps from seed regions of interest located in the center of somatomotor and visual networks. In line with the previous results, the adult group was found to have more diffuse patterns of somatomotor and visual connectivity, with greater integration to both the dorsal and ventral attention networks. **Discussion:** Our results, combining two PFM and two large group datasets, reveal consistent patterns of somatomotor and visual integration that characterize healthy neurodevelopment.

S95. GENETIC RISK FOR ALCOHOL DEPENDENCY IS ASSOCIATED WITH ALTERED NEURAL NETWORK TOPOGRAPHY IN YOUTH

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Background: Alcohol Dependency is associated with a host of adverse medical, psychiatric and social consequences and has been previously shown to have a high heritability. However, it is unclear if genetic risk factors shape early functional connectivity even before any symptom onset. Recent advances in neuroimaging have allowed us to reveal an individual's functional network topography enabling researchers to address causal links between neurobiology and genetic risk factors. The adolescent brain cognitive development (ABCD) study is a prospective study with the aim to examine the social, cognitive, neurological, and environmental factors that influence risk for mental health and substance abuse.

Methods: Utilizing data from the ABCD study, 5382 9-10 year old participants with at least 10 minutes of low-motion resting state fMRI timeseries data were processed using the ABCD Human Connectome Project (HCP) pipeline. Using dense whole brain correlation matrices (91282 x 91282 grayordinates), a supervised network detection algorithm, known as template matching, was implemented to delineate 14 canonical neural networks for all participants. Concurrently, genetic data were collected, and polygenic risk scores (PGRS) for alcohol dependency were computed using a genome-wide association study meta-analysis from the Psychiatric Genomic Consortium as the reference data set. Using each participant's own MNI mid-thickness surface model, we calculated the proportion of the cortical network surface area for each participant. Combining the cortical network surface area and PGRS, a partial least squares regression (PLSR) model was constructed to predict polygenic risk scores from network surface area, revealing a discernible pattern of topography associated with heightened genetic risk.

Results: Controlling for sex, age, and framewise displacement, the PLSR model demonstrated significant predictive capacity for polygenic risk scores across distinct ABCD study groups. Evaluation of reproducibility using the ABCD Study® Reproducible Matched Samples (ARMS) indicates consistent beta weights regardless of sample group (ARMS 1 n=2652, ARMS2 n=2730). We found that the PGRS could be significantly predicted (ARMS 1 to ARMS 2 $r=0.19$ $p < 0.01$, ARMS 2 to ARM1 2 $r=0.19$ $p < 0.01$,) from the network surface area. Results indicate that the surface area of neural networks exhibits both increases and decreases systematically corresponding to escalating genetic risk for alcohol use disorder. Notably, participants with higher PGRS had a

relatively larger somatomotor network, and medial temporal networks, and relatively smaller cingulo-opercular network, dorsal attention network, and fronto-parietal networks.
Discussion: These results suggest that genetic liability for alcohol dependency contributes to subtle alterations in functional topography, underscoring the intricate interplay between genetic predisposition and neural network architecture.

S96. IMPROVING READING FLUENCY VIA THE UTILIZATION OF EXECUTIVE FUNCTIONS NETWORKS IN CHILDREN WITH ADHD AND DYSLEXIA: AN FMRI STUDY

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Background: Reading involves the ability to transpose written language into spoken language. This process requires phonological processing skills to recognize and pronounce the sounds of each letter while simultaneously comprehending the content. Reading relies on brain networks governing executive functions (EF) such as the cingulo-opercular, fronto-parietal, ventral attention, and dorsal attention networks. Reading difficulties (RD) involve primary deficits in phonological processing and reading fluency, as well as executive function (EF) impairments similar to those associated with attention-deficit/hyperactivity disorder (ADHD). While ADHD and RD are discrete conditions in the DSM, 40% of individuals with ADHD experience reading difficulties or are diagnosed with dyslexia. Shared deficits in EF among individuals with ADHD and RD may contribute to their increased co-occurrence. Individuals who have RD without ADHD (RD-only) may show less or different executive dysfunction from those with RD and comorbid ADHD.
Methods: The current study seeks to examine the role of EF in reading difficulties and remediation among children with RD-only and RD+ADHD. Participants include 8-12 year-old English-speaking children classified as RD+ADHD (n=19), RD-only (n=18), and typical readers (TR; n=18), matched for age and nonverbal IQ, who completed a reading fluency intervention (visual Rhythmic Reading Training (visual RRT) that also targets EF skills. Participants completed behavioral testing and a functional magnetic resonance imaging (fMRI) resting-state scan before and after the 8-week intervention to determine effects on behavioral measures of reading and EF as well as EF-related brain networks, including the fronto-parietal (FP) and dorsal attention networks (DAN). A 3 Group x 2 Time (pre vs. post) repeated measures analysis of variance was conducted to test for differential effects of the intervention on behavioral and brain measures across groups. Regression analyses examined whether baseline functional connectivity of EF networks predicted gains in reading performance and whether this differed across groups.
Results: Behavioral results revealed that children with RD+ADHD showed greater gains in reading and EF than those with RD-only Test*Group[$F(2,52)=1.34$, $P=0.271$, $\eta2=0.049$]. Results revealed a main effect of group between the FP and DAN networks with the RD+ADHD group showing the greatest change when compared to RD-only and TR. The RD+ADHD group also displayed a significant decrease in functional connectivity in FP and DAN compared to the RD-only and TR groups Group[$F(2,52)=3.01$, $P=0.054$, $\eta2=0.106$]. Regression analyses revealed that

baseline functional connectivity within DAN predicted gains in reading fluency, (R2=.112, p=.13) and comprehension (R2=.071, p=.049) as did baseline functional connectivity between the FP and DAN networks (Fluency: R2=.104, p=.016; Comprehension: R2=.005, p=.099).

Discussion: These results provide further evidence for the role of EF in reading in support of a precision approach to reading remediation targeting EF skills. These findings provide evidence for mechanisms of change in reading remediation between clinical groups with reading and EF difficulties. More critically, it highlights the possible role of EF in reading fluency in children suffering from different levels of EF and RD difficulties. The results also open up mechanistic questions regarding the interactions between EF and audio-visual integration previously related to reading fluency skills which should be further researched.

S97. SOCIAL IDENTITY WITH PEERS DURING ADOLESCENCE MODERATES NEURAL SIMILARITY BETWEEN SELF AND PEERS IN RISK-RELATED CONTEXTS

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Background: Adolescence is critical for social identity formation and development (Marcia, 1987). Peers become a central part of adolescents' social lives and are more integrated into adolescents' sense of self. To achieve a favorable sense of belonging within a socially valued group, forming a social identity with peers is key during adolescence (Kroger, 2000). Social identity with peers generates the internal structure and content of the belief systems that represent the relationships between adolescents and their peers in a social context, driving teens to adjust their social behaviors to match group norms via social reward (Telzer et al., 2018; Kwon and Telzer, 2023). In other words, the psychological process of subjectively perceiving oneself as a peer group member organizes adolescents' social behaviors, which ultimately manifest in a self-peer overlap (i.e., homophily). This may be particularly true in risk-taking contexts, one of the most ubiquitous behaviors during adolescence, in which peer groups often play a direct and proximal influence (Steinberg, 2008). Here, we investigated whether social identity with peers moderates the longitudinal integration of self and peers (i.e., self-peer overlap) in risk-related decision-making contexts across adolescence.

Methods: A diverse sample of adolescents completed a decision-making task during scanning annually across three waves (Wave 1, N = 136; Wave 2, N = 137; Wave 3, N = 126). Adolescents made risk-related decisions for themselves and their best friend. We also collected adolescents' self-reported peer identity at wave 1 (Harway and Fuligni, 2006). Representational similarity analysis was conducted to examine the neural similarity between making risk-related decision making for themselves and their best friend (i.e., self-peer overlap) in the nucleus accumbens (NACC). We conducted unconditional and conditional growth curve modeling to examine 1). the developmental trajectory of neural similarity between self and peers in risky decision-making contexts over time; and 2). the moderating effect of peer identity in the development of neural similarity.

Results: Multilevel models examined the linear trajectory of self-peer overlap. Across the sample, there was no significant linear slope in self-peer overlap in the NACC. There were significant random slope variabilities (left NACC, 95% CI = [0.003, 0,02]; right NACC, 95% CI = [0, 012]),

suggesting individual difference in representing self and peers in adolescents over time. Our conditional growth curve model added peer identity as a cross-level interaction term. We found a significant interaction between peer identity and linear changes in neural similarity between self and peers in the NACC. Johnson-Neyman analysis revealed that for those teens whose peer identity was low (i.e., < 0.78 SD below the mean), the linear slope of neural similarity was significant (γ_Grade = -0.01, $p < 0.05$), but for youth with high peer identity, the linear slope of neural similarity did not change. This result suggests that youths with lower initial peer identity show longitudinal declines in neural similarity between self and peers over time.

Discussion: Our previous study found that teens who exhibit a larger self-peer overlap in the NACC while making risky decisions are more likely to take risk and are more susceptible to peer influences (Dai et al., 2023). In this study, we found an enormous individual variation in the development of self-peer overlap in the NACC over time. Importantly, social identity with peers contributes to this individual variation during development, such that adolescents with lower social identity tend to exhibit a decreases in neural similarity between self and peers over time. This finding suggests that subjective perception of social identity with peers organizes the neural representations of the self and peers in social contexts during adolescence.

S98. TEMPERAMENT COMMUNITIES LINKED TO COGNITION IDENTIFIED WITH THE FUNCTIONAL RANDOM FOREST APPROACH IN INDIVIDUALS WITH ADHD: INSIGHTS FROM THE ABCD STUDY

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Background: Distinct cognitive and emotional profiles exist among individuals with an Attention-Deficit/Hyperactivity Disorder (ADHD) diagnosis. Using such profiles to define heterogeneity, for example the distinction between ADHD with and without emotional dysregulation, has been shown to be clinically meaningful. Temperament traits (e.g. behavioral inhibition and sensation-seeking) are implicated in theories of ADHD etiology and provide a related, but distinct, framework for identifying ADHD population subgroups, allowing for transdiagnostic insights spanning normative to clinical ranges. This research aims to identify communities defined by associations between temperament (behavioral inhibition, sensation-seeking) and cognition (working memory, fluid intelligence) in the context of ADHD using data from the Adolescent Brain Cognitive Development (ABCD) study.

Methods: The Functional Random Forest (FRF) approach was used to define communities at the participant level based on the relationship of temperament to working memory (WM) and fluid intelligence (FI). To establish replicability, we applied the FRF method independently to each ABCD Reproducible Matched Sample (ARMS). The BIS/BAS9 and UPPS-P scales were used as temperament input features, the NIH Toolbox List Sorting Working Memory Test was the dependent variable for WM, and the NIH Toolbox Fluid Composite score was the dependent variable for FI. The FRF model accuracy was evaluated using mean absolute error (MAE). The MAE was calculated for both the model predictions and the permuted predictions. Communities

were then matched based on high and low proportions of ADHD diagnoses to examine similarities across the ARMS in cognitive and temperament profiles. ADHD diagnosis thresholds were published previously, with different thresholds based on assessment method and number of informants used. Temperament profiles were then constructed, and cognitive profiles were constructed using the untested NIH Toolbox metrics.

Results: The analysis revealed distinct temperament communities linked to WM and FI. Within each ARMS for both WM and FI, lower MAE values were obtained for the model's predictions compared to the permuted counterparts across all domains (WM/ARMS1=11.6, ARMS2=11.5; FI/ARMS1=13.5, ARMS2=13.3; p=0.001), indicating that the FRF models outperformed random guessing and successfully learned the underlying relationships in the data. For both WM and FI, 9 communities for ARMS1 and 7 communities for ARMS2, all with > 100 participants, were identified. Chi-squared tests ($\chi 2$=1.064) identified 3 statistically significant homologous community comparisons when evaluating the ADHD diagnosis proportions across the ARMS, for both WM and FI. Communities with higher and lower rates of ADHD diagnosis displayed similar cognitive and temperament profiles across each ARMS, particularly in the WM-defined communities, where the higher proportion groups had a MAE of 0.98 for the cognitive profiles and 1.34 for the temperament profiles, and the lower proportion groups had an MAE of 0.95 for the cognitive profiles and 0.26 for the temperament profiles.

Discussion: Leveraging the population-level ABCD study to investigate person-level heterogeneity with advanced analytical techniques, we identified novel communities defined by the relationship of temperament dimensions to specific cognitive domains. We validated communities first through replication in held-out datasets, and then externally validated them by comparing rates of ADHD diagnosis, and temperament and cognitive profiles. The identified communities advance understanding of the heterogeneity of ADHD and may lead to targeted interventions. Future research will explore neurobiological profiles and longitudinal trajectories of the identified communities.

S99. MATURATION OF REWARD-RELATED BRAIN PROCESSES SUPPORT INCREASES IN HABITUAL BEHAVIOR THROUGH ADOLESCENCE

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Background: Behavior can be classified as either goal-directed or habitual. Goal-directed behavior is highly sensitive to changes in outcome value, compared to habitual behavior that is insensitive to changes in outcome value. The process of habitual formation is supported by dopaminergic processes that facilitate the transition from prefrontal and ventral striatum function to dorsolateral striatal function, which animal studies show continues to mature into adulthood. However, the developmental trajectories of goal-directed and habitual control and the brain systems underlying it, have not been characterized.

Methods: The current study examined the neural correlates of decision making during a validated task that differentiates goal-directed and habitual behaviors. Using an accelerated longitudinal cohort design (346 scans nested in 222 participants), we characterized developmental changes from 10 to 33 years of age in goal-directed and habitual functional connectivity at rest. Behaviorally, participants also completed a two-stage sequential decision-making task that has

been used to differentiate goal-directed and habitual control. We used reinforcement learning models to derive measures of goal-directed and habitual control, and used those measures to examine associations among age and functional connectivity. Further, we examined the contribution of dopaminergic processes to changes in habitual circuitry and reinforcement learning using assessments of striatal tissue iron, a MR-based measure that has been shown to correlate with dopaminergic neurobiology.

Results: In line with previous work, we found that tissue iron concentrations increased in the dorsolateral striatum with age ($F = 42.15$, $p < 0.001$), and that habitual responding during the two-stage sequential decision-making task increased with age ($F = 35.21$, $p < 0.001$). Importantly, habitual responding was associated with tissue iron concentrations in the dorsolateral striatum ($F = 9.77$, $p < 0.001$), such that increases in habitual responding were supported by increases in dorsolateral tissue iron concentration.

Discussion: Together, these results provide evidence in humans that habitual behavior continues to mature into adulthood and may be supported by increased specialization of reward and cognitive systems.

S100. NEURAL PROCESSING OF VICARIOUS REWARDS IN ADOLESCENTS WITH AND WITHOUT ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

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Background: Adolescence is a transitional life phase characterized by a strong motivation to pursue rewarding outcomes for oneself and others (Braams et al., 2014). Previous research found heightened activation in the adolescent brain in response to both vicarious and self-benefiting rewards. However, we still know little about how neurodevelopmental disorders manifest differences in vicarious reward sensitivity across age. Adolescents with ADHD generally have fewer friends, and poorer friendship quality and stability, factors associated with a diminished understanding of the mental states and feelings of others (Gardner and Gerdes, 2015). In this study, our objective is to investigate how ADHD symptoms across adolescence relate to age-related differences in vicarious outcome processing (https://osf.io/jqmvb). In addition, we examine the association between potential age differences in the quality of adolescents' friendships and their sensitivity to vicarious rewards.

Methods: The sample consisted of adolescent boys with and without ADHD (total N = 98, ages 13-22; N = 42 with ADHD; N = 56 without ADHD). Participants completed a newly developed fMRI Reward Gambling Task. In this task, a cue was presented indicating the possible outcomes, i.e. reward or loss. During reward trials, a correct guess would results in a reward and an incorrect guess would result in no-reward, while in the loss trials an incorrect guess results in a loss and a correct guess would result in no-loss. Moreover, each trial indicated whether the participant played for themselves or for their best friend.

Results: Both adolescents with ADHD and without showed increased activation for reward vs. no-reward and no-loss vs. loss at receipt. We found no effect of group or recipient. However, when taking a continuous approach, we observed that adolescents with more inattention symptoms had

higher activation in the vmPFC while they received losses for themselves compared to losses for their best friend. Currently, we are analyzing the data using a mixed model with age and group as between-subject predictors and recipient as within-subject variable separately for the loss and reward trials and BOLD signal as outcome. Based on prior models, age-related differences in adolescents with and without ADHD may be similar in shape, but those with ADHD could exhibit a blunted social reward sensitivity, potentially tied to symptoms of inattention and hyperactivity.
Discussion: We anticipate that our findings will offer valuable insights into vicarious reward processing in a vulnerable population of adolescents with ADHD.

S101. EFFECT OF MATERNAL DEPRESSION AND MALNUTRITION ON THE COGNITIVE DEVELOPMENT OF CHILDREN IN KISUMU, KENYA

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Background: This study investigates the impact of maternal depression and malnutrition on the cognitive development of children in Kisumu, Kenya. Malnutrition is prevalent in Kenya, with significant numbers of children in Kisumu County underweight. Maternal depression, although underrepresented in regional research, is closely associated with childhood malnutrition, exacerbating the cognitive deficits in children. Malnutrition during early childhood disrupts brain development and function, impacting cognitive, motor, and socio-emotional outcomes through mechanisms such as nutrient deficiencies and increased susceptibility to infections. Maternal depression similarly impacts cognitive development through altered maternal engagement and increased cortisol levels, affecting brain regions crucial for cognitive and emotional processing.
Methods: Conducted at the Jaramogi Oginga Odinga Teaching and Referral Hospital, this research involved a cohort of 299 children aged 18 to 36 months, assessing their cognitive functions using the Bayley Scales of Infant Development III. The study uniquely decorrelated the effects of maternal depression and malnutrition to examine their independent influences on child cognition. The study site was selected for its high patient volume and representation of both urban and rural populations. This study provides new insights into how these factors independently and interactively influence child cognition, using tools such as the Patient Health Questionnaire-9 (PHQ-9) to measure maternal depression and the Bayley Scales of Infant and Toddler Development for cognitive assessment.
Results: Our study found that malnutrition and maternal depression are superadditive in their effects on cognitive development, with the combined impact being more severe than their individual contributions. These findings underscore the importance of early interventions and support for families facing these challenges.
Discussion: By addressing both maternal mental health and childhood nutrition simultaneously, there is potential to improve developmental outcomes and resilience in children. The implications of this research are significant for public health policies and programs, advocating for a comprehensive approach to child development that integrates nutritional support and mental health care.

S102. EXPLORATION IS ASSOCIATED WITH SOCIOECONOMIC DISPARITIES IN LEARNING AND ACADEMIC ACHIEVEMENT IN ADOLESCENTS

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Background: Why do children from lower socioeconomic (SES) backgrounds display reduced academic learning and achievement relative to their wealthier peers? Existing research has linked these disparities to unequal access to educational and financial resources that influence what children learn and achieve academically. However, it has been hypothesized that lower SES might also influence how children learn by reducing their willingness to engage in exploration–a behavior that is critical for learning and heightened in childhood and adolescence. Despite the theoretical and practical significance of this possibility, empirical research has yet to examine the link between SES, exploration, and learning. Here, we asked whether lower SES in adolescence is related to less exploration, and in turn, how this influences task-based performance and real-world academic skills.

Methods: Children and adolescents (n=124; 12-14 years old) from diverse SES backgrounds (household income range: $2,000 to $1.1 million dollars annually) completed the Balloon Emotional Learning Task (BELT). On each trial, they had to decide how much to explore and exploit. Choosing to explore led to greater information that could be leveraged to optimize future decisions. However, exploration also led to uncertain rewards, with the potential for significant losses. By contrast, choosing to exploit secured rewards, but limited information gain. We computed individual differences in exploration, task performance (points earned), and learning (the optimization of decisions across time) on the BELT. We also collected grades and measured academic skills. We then examined whether SES was related to in-task exploration, and in turn, how exploratory behavior was related to task performance, and academic learning and achievement.

Results: We found that lower SES was linked greater exploitation: a preference to explore less and secure rewards earlier. Computational modelling revealed that this effect was driven by a higher aversion to losses rather than beliefs that exploration would not yield positive outcomes. We also observed that reduced exploratory tendencies led to fewer losses, but also fewer gains across the task, leading to reduced task-performance (points earned) overall. Furthermore, reduced exploration mediated the relationship between lower SES and reduced school grades and academic achievement. We also observed that exploratory tendencies shifted across the task in response to rewarding experiences, such that higher rewards boosted exploration, suggesting a possible means of increasing exploration among lower SES adolescents.

Discussion: By linking exploratory tendencies to grades and academic skills, these findings suggest that disparities in learning and achievement might be driven by disparities in decision strategies that shape learning opportunities through exploration. This research therefore adds novel theoretical and practical insight into the academic opportunity gap, as well as a promising avenue for future interventions: by boosting rewarding experiences, one might be able to increase exploration, and in turn, academic learning, and achievement.

S103. USING NORMATIVE DEVELOPMENT OF SLEEP MACRO- AND MICROARCHITECTURE AS A FOUNDATION FOR UNDERSTANDING ATYPICAL NEURODEVELOPMENT

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Background: Adolescence is a period of growth associated with distinct neuro-maturational changes. Sleep physiology, particularly slow wave sleep, offers a sensitive indicator of brain development. Similar to pediatric growth charts, which are used for early identification of atypical development in metrics such as height or weight, normative sleep physiology models may help us understand how inter-individual variations can detect youth at greatest risk for suboptimal outcomes. We created sleep physiology "growth charts" to establish normative reference models of brain development during sleep. We take a novel approach to understanding neurodevelopment by 1) creating normative reference models of sleep physiology and 2) demonstrating sleep physiology can be assessed in scalable and affordable ways.

Methods: The current analyses harmonized archival sleep physiology data sets from polysomnography in typically developing youth (N=569, 6-26 years old). General linear models were used to examine age associated trajectories of measures of sleep macro-architecture (e.g., amount of time spent in slow wave sleep and other sleep stages) and microarchitecture (e.g., sleep spindles (11-16 Hz); spectral power). We then recapitulated age-associated analyses using an at-home wearable sleep EEG device (i.e., Dreem3; N=60, 9-26 years old).

Results: The results from the archival PSG data set found a decrease in the amount of time spent in slow wave sleep with increasing age ($b=-0.47$, $p < 2.2e-16$). Corresponding EEG delta power showed a similar pattern ($b=-0.49$, $p < 2.2e-16$). Like the archival data, sleep micro- and macro-architecture variables from the at-home wearable sleep EEG device (Dreem3) showed decreases in slow wave sleep with increasing age ($b=-0.53$, $p=0.004$), as well as decreases in EEG delta power in slow wave sleep ($b=-0.53$, $p=0.009$).

Discussion: In summary, we provide a comprehensive understanding of normative sleep physiology over adolescent development. Further, we offer an accessible way to measure this development and establish a template for understanding how deviations from these normative trajectories may put young people at risk for adverse outcomes.

S104. SOCIAL AND NEURAL PREDICTORS OF LONELINESS IN ADOLESCENCE

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Background: As an inherently social species, humans' well-being suffers when experiencing loneliness or social isolation. Loneliness, the subjective feeling of dissatisfaction with one's level or quality of social relationships, and social isolation, which consists of low levels of friendships, social interactions, or support, are considerable risks for a wide array of worse health outcomes. Moreover, loneliness is particularly prevalent among adolescents and can have long-term effects into adulthood. While loneliness and social isolation are conceptually similar, adolescents can feel lonely even when they have multiple friendships or are well-liked by their peers. Such discrepancies may be related to differences in neurobiological characteristics associated with loneliness, including altered sensitivities to social threats and rewards.

Methods: The current study investigated neural predictors of adolescents' subjective loneliness amid varying levels of observable social isolation and peer rejection. Using an accelerated

longitudinal design, over 900 adolescents from three schools and two grade cohorts participated. Subjective loneliness, friendship nominations, friendship quality, and popularity were longitudinally assessed. A subset (n = 117, 65 female, ages 11.9-14.5, Mean age = 13.15, SD = .42) underwent fMRI sessions, completing the Social Incentive Delay task measuring neural sensitivity to social threats and rewards. Through a series of hierarchical regressions, we evaluated the impact of various indices of friendships and social isolation, including reciprocated and unreciprocated friendships, friendship quality, and popularity on increased loneliness between 7th and 8th grade. Additionally, neural sensitivity to social threats and rewards in regions of interest such as the amygdala, ventral striatum, and ventromedial prefrontal cortex were introduced as potential moderators.

Results: After controlling for sex and social group membership, individuals' number of unreciprocated friendships (i.e. instances wherein an individual nominates a peer as a friend but that peer does not nominate them back) significantly predicted increased loneliness from 7th to 8th grade (B = 0.036, p = .007). Additionally, while popularity alone was not predictive of changes in loneliness, there was a significant interaction between popularity and neural sensitivity to social threats in the amygdala (B = -0.49, p = .019), such that unpopular adolescents experienced increased loneliness over the course of one year when they exhibited heightened amygdala sensitivity to threats. No significant findings were found for other friendship measures or for neural sensitivity to social rewards in any of the selected regions of interest.

Discussion: The present study aimed to evaluate the impact of numerous social and neurobiological factors on increased loneliness amongst early adolescents. Given the importance of reciprocity in adolescent relationships, our findings suggest that lower social support and consideration from peers that are considered friends can give rise to social dissatisfaction and feelings of loneliness. Moreover, low popularity was associated with heightened loneliness, but only amongst those with higher neural threat sensitivity in the amygdala. These individuals may be more vigilant toward cues related to rejection and victimization in their social environments, leading to greater feelings of loneliness. Overall, these findings underscore the complex interplay between social relationships and neurobiological factors in shaping adolescent loneliness, highlighting the need for further research that probes underlying mechanisms and informs strategies to support adolescent well-being.

S105. SPECIFICITY OF THE NEURAL PROCESSING OF SOCIAL TACTILE INFORMATION

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Background: Social touch, defined as non-sexual, pleasant, and affective touch, is critical for creating physiological homeostasis, facilitating parent-infant bonding, and communicating in early infancy. However, little is understood about how the infant brain differentiates between the social intent of incoming tactile information. This research aims to assess whether infants neurologically discriminate between the intentionality of incoming tactile information (e.g., between social and non-social touch) and if this is modulated by the infant's varying tactile environment (e.g., touch related to moving a baby from one place to another versus the frequency of social touch).

Methods: We hypothesized that infants would show greater neural activation to social touch compared to non-social touch in brain regions associated with emotion and reward processing (e.g., amygdala and insular cortex) and that it would be positively associated with the frequency of gentle, loving touch during everyday interactions with their caregiver. To assess infants' neurological differentiation between social and non-social information, we recruited nine infants between zero- and four-months of age (Mage=93.78 days old, SDAge= 38.32 days) to participate in a functional magnetic resonance imaging (fMRI) study. During the fMRI, infants underwent a 2x2 block design in which they experienced social and non-social tactile and auditory stimuli. For the social tactile stimulus, infants were gently stroked with a paintbrush on their left shin at a rate of 3 cm/sec, a rate shown to optimally encode the emotionally rewarding properties of touch. Prior research has found that placing a plastic barrier between the skin's surface and the paintbrush inhibits the mechanoreceptors responsible for encoding the emotionally rewarding properties of touch from firing, thereby simulating non-social touch. Thus, for the non-social tactile stimuli, a piece of medical grade plastic was placed between the shin and the paintbrush and stroking continued at the same rate. Additionally, parents and infants underwent a video-taped feeding paradigm, in which the parent was told to feed their infant as they would at home. The first five-minutes of the recording were later behaviorally coded by a research assistant blind to the hypothesis using the Maternal Infant Synchrony Scale (MISS), which assesses the frequency and type of tactile engagement between the infant and parent during feeding. A general linear model was used to assess the relationship between the infants' preferential neural response to social- compared to non-social touch and the frequency of different tactile experiences during feeding.
Results: We found that gentle touch, defined as soft, caresses, kisses, wiping or cleaning an infant's face with easy strokes, implying tenderness, or an attempt to support or sooth infant, positively predicted infants' preferential neurological response to social touch compared to non-social touch in the brainstem, lingual gyrus, and putamen (FDR corrected at $q < 0.05$, $k \geq 10$ voxels, and with a Z-score threshold > 3.1), regions thought to be associated with discriminating tactile information and for the spatial representation of incoming tactile information. However, task-related touch, defined as lacking tenderness, having a functional component, and neutral, did not predict infants' preferential neural activation to either social or non-social touch (FDR corrected at $q < 0.05$, $k \geq 10$ voxels, and with a Z-score threshold > 3.1).
Discussion: These results suggest that infants can neurologically differentiate between incoming tactile stimuli and social touch may modulate neural development necessary for the social encoding of tactile information. Future research should investigate the longitudinal development of these pathways and how other forms of touch (e.g., rough touch) may influence neural trajectories.

S106. INFLUENCE OF MUSICAL ACTIVITIES IN A NATURAL SETTING ON MOTHER–INFANT/CHILD PHYSIOLOGICAL SYNCHRONY AND MATERNAL AFFECT

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Background: The increasing prevalence of mental health problems in parents and children, such as parenting stress and child depression, necessitates the development of effective intervention methods. Musical activities that are easily integrated into daily life and can be implemented at home are a promising avenue. However, the effects of such activities on the psychophysiological states of parents and their infants/children and individual variations in these effects remain largely unexplored. This study examined whether and how interaction through musical activities in a natural setting affects the psychophysiological states of mothers and their infants/children, focusing on their physiological synchrony.

Methods: Twenty-three infants (ages 6–12 months; mean = 289.95 days, standard deviation [SD] = 60.12 days) and their mothers and 25 children (ages 3–4 years; mean = 3 years 165 days, SD = 129.05 days) and their mothers participated in this study. Music play sessions, including listening to music, singing songs, and singing songs with gestures 20 to 30 min long, were held at Kyoto University with the assistance of two music teachers. Classes were divided into mother–infant and mother–child pairs; in both cases, there was always a maximum of three parent–child pairs per class.

Participants' heart rate (myBeat WHS-1, RRI-Analyzer 2, UNION TOOL, Japan), respiration (79 GHz MIMO Radar Module Evaluation Kit, S-Takayama Electronics Industry, Japan), and body movements (Kinect Azure, Microsoft, USA) were measured simultaneously. In addition to physiological and behavioral measurements, mothers completed the Positive and Negative Affect Schedule (PANAS) before and after the musical activity.

Results: Four behavioral scores corresponding to positive and negative dimensions of PANAS were calculated, each taken before and after the musical activity. A three-factor mixed-design analysis of variance with time (2: pre, post) and affective dimension (2: positive, negative) as within-participant factors and age group (2: infants, children) as the between-participant factor showed a significant interaction between time and affective dimension ($F(1,48) = 16.95$, $\eta p2 = .26$, $p < .001$). Mothers' positive affect increased after the musical activity than before (M pre = 2.87, SD pre = 0.63, M post = 3.36, SD post = 0.79, $t = -7.79$, $p < .001$, $d = 5.67$). The negative affect did not change before or after the musical activity. The age group of children was not associated with the PANAS score.

The heart rate synchrony of mother–infant/child pairs was examined during the musical experiences and its relationship to changes in mothers' PANAS scores (post–pre). The R–R interval (RRI) was calculated using a 10 s time window with 50% overlap during the musical activity. After baseline correction, the mean cross-correlation (maximum delay = 1) of the RRI was calculated for each mother–infant/child pair. Spearman's rank correlation indicated a marginally significant positive relationship between RRI synchrony and the enhancement of mothers' positive affect ($\rho = .30$, $p = .056$) and a significant negative correlation with mothers' negative affect ($\rho = -.35$, $p = .034$).

Discussion: This study has two important findings: musical activities with infants/children positively affect mothers' subjective emotions, and mother–infant/child physiological synchrony is associated with changes in these emotions. By identifying factors related to the effects of music on mother–infant/child pairs and their diversity, we can propose new "individualized" parenting support methods that lead to stable caregiver-infant interaction and facilitate parenting self-efficacy.

S107. EXPLORING ADOLESCENTS' PERCEIVED LONELINESS AND SELF-PEER AND SELF-PARENT NEURAL SIMILARITY – A THREE-WAVE LONGITUDINAL STUDY

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Background: Adolescence is a critical period for developing self-concept within social contexts, driven by significant brain development (Blakemore and Mills, 2014). Forming attitudes that integrate others' perspectives becomes increasingly important during these years (Crone and Fuligni, 2020). According to social identity theory, adolescents incorporate the values and thoughts of salient others, such as peers and parents, into their own self-concept (Tajfel and Turner, 1986). This integration is dynamic and context-dependent (Hackel et al., 2017; Van der Cruijsen et al., 2019, 2023).

Feelings of loneliness may influence this process, such that adolescents feeling distant from their close others may exhibit lower integration of others into their self-concept. Conversely, closer social connections may result in higher levels of integration. Cross-sectional research has found this relationship in adults (Courtney and Meyer, 2020), but little is known about how this relationship unfolds longitudinally during adolescence. This study examines how self-peer and self-parent neural similarity covaries with adolescents' sense of loneliness over 3 years.

Methods: A sample of rural U.S. adolescents (N = 164; Age in Wave1: M = 12.8, SD = 0.5, from 11.9 to 14.5 years; 52% female and 48% male) completed an fMRI Ratings task annually across 3 waves, starting in 6th and 7th grade. In each wave, adolescents reported their perceived loneliness over the past year (e.g., "I felt alone"; αs = .91 - .93).

During an fMRI task, adolescents rated negative risk-taking behaviors on how good or bad (1) they think the behaviors are, and their perceptions of how (2) their peers and (3) their parent think the behaviors are. We used representation similarity analysis (RSA) to quantify the self-other neural similarity between the task conditions (self-peer and self-parent). Based on Neurosynth meta-analytical findings on "mentalizing" (Yarkoni et al., 2011; downloaded October 2023), we identified key regions of interest (ROIs) critical for social cognition and self-referential thinking: the ventromedial PFC (vmPFC), dorsomedial PFC (dmPFC), and precuneus.

Results: We used a 2-level multilevel model to examine if perceived loneliness covaries with neural similarity between self and others across years. Our analysis revealed a significant within-person effect of loneliness on self-peer neural similarity in the vmPFC ($b = -0.01$, $p = .03$) and precuneus ($b = -0.02$, $p = .01$), suggesting that on years when an adolescent experienced higher loneliness than their average, they showed decreased self-peer neural similarity. No significant between-person effects of loneliness on neural similarity were observed. Additionally, loneliness did not significantly predict self-peer neural similarity in other ROIs or self-parent neural similarity in any ROIs.

Discussion: This study is the first to longitudinally examine how perceived loneliness is linked with neural similarity in self-peer and self-parent evaluations during adolescence. Our study finds that on years when teens experience increased feelings of loneliness, they exhibit decreased neural similarity between self and peers when evaluating risk-taking behaviors. In other words, when adolescents are lonelier, they integrate their peers into their sense of self less, suggesting perceived loneliness may contribute to the within-person changes in neural processes underlying social

perceptions. Further, the lack of significant effects in self-parent neural similarity suggests that the influence of loneliness on neural responses may be more pronounced in peer-related contexts. This underscores the unique role of peer relationships in adolescent social and neural development. Future research should explore the causal mechanisms behind these effects over a longer adolescent timeframe. This could offer deeper insights into how social experiences shape the developing brain across adolescence.

S108. LINKS BETWEEN NEGATIVE EMOTION DIFFERENTIATION AND NEURAL ACTIVATION DURING EMOTION REGULATION IN ADOLESCENTS

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Background: Negative emotion differentiation (NED) characterizes a trait-like ability to draw distinctions between discrete negative emotional states with high specificity. Greater NED is linked to improved emotion regulation and buffers against numerous mental health problems (Barrett et al., 2001; Kashdan et al., 2015). Compared to childhood and adulthood, adolescence is a developmental period marked by increases in emotional intensity and negative affect (Bailen et al., 2019), relatively low NED (Nook et al., 2018), and heightened risk for the development of psychopathology (McLaughlin et al., 2011). Adolescence is also a time when brain development and new experiences can contribute to increasingly sophisticated emotion understanding (Grosse and Streubel, 2024) and emotion regulation (Ahmed et al., 2015), making it an interesting developmental stage for examining the relationship between NED and emotion regulation. The present study is the first to examine how individual differences in adolescents' NED predict neural activity during emotion regulation.
Methods: The sample consisted of 61 adolescents (Mage = 16.91, SD = 0.54 years; 50.82% female; 45.90% White; 34.43% Black; 32.79% Hispanic/Latinx) from a rural southeastern region of the United States. Participants completed a 14-day ecological momentary assessment (EMA) paradigm where they were asked to rate how much they felt 9 negative emotions (e.g., sad, stressed) on a scale from 1 ("very little or not at all") to 5 ("very strongly") three times a day. To derive an NED index for each participant, we computed Fisher r-to-z transformed intraclass correlations across all emotion ratings, and multiplied values by -1 for ease of interpretation (higher values indicate higher NED; M = 0.60, SD = 0.34). Person-level mean trait negative affect was calculated by averaging intensities of negative emotion ratings across the EMA period for each participant (M = 1.45, SD = 0.41). Following the EMA, participants underwent an fMRI scan during which they completed a cognitive reappraisal task. Participants viewed negative images and were instructed to either "look" at the image (i.e., passively view) or "make it better" (i.e., regulate or cognitively reappraise their negative emotion).
Results: We conducted regions of interest (ROI) analyses in 4 ROIs selected a priori based on prior evidence for their involvement in facets of emotion regulation – the amygdala (salience detection), anterior insula (integration of bodily signals with exteroceptive information), ventrolateral prefrontal cortex (vlPFC; cognitive control and semantic retrieval), and ventromedial PFC (vmPFC; emotion representation). Parameter estimates of signal intensity were extracted from the ROIs from the contrast of interest, Regulate > View. We conducted regression analyses to test how NED predicts neural activation when regulating emotion. Adolescents with greater

NED showed lower activation in the anterior insula (β = -0.284, p = .039) and right vlPFC (β = -0.279, p = .041) during emotion regulation (compared to passive viewing), controlling for age, sex, and trait mean negative affect. Higher trait mean negative affect was also associated with lower activation in the right vlPFC (β = -0.300, p = .031). NED was not significantly associated with activation in the bilateral amygdala, left vlPFC, or vmPFC.

Discussion: These findings indicate that adolescents' NED is associated with differential engagement of brain regions associated with the representation of internal states and cognitive control during emotion regulation. Results are in line with theory suggesting that experiencing emotions as more discrete and specific in daily life may facilitate self-regulation (Lindquist et al., 2015). They also offer initial interpretations of how NED may impact emotion regulation via both the down-regulation of internal visceral states and eased access to alternate semantic representations, though longitudinal replication is needed.

S109. INTERRELATIONSHIPS AMONG CHILDREN'S AUTISTIC SYMPTOMS, GAMMA BAND EEG MULTISCALE ENTROPY, AND CHILD-PARENT SOCIAL BEHAVIOR DURING A JOINT MATH TASK.

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Background: Social processing is integral to learning. Autism spectrum disorder (ASD), a condition linked to atypical neural social and sensory processing, is also linked to academic and interpersonal difficulties in the classroom. ASD refers to a spectrum of phenotypes with symptoms (e.g., atypical communicative behaviors) emerging in varied combinations and levels of intensity. Importantly, the same social cognitions may also produce markedly different behaviors among neurotypical individuals based on situational context (e.g., in a new or familiar space) or developmental Background: (e.g., cultural differences in response patterns). There is thus a need for metrics to supplement observational measures of social processing, particularly for work among individuals with ASD given their hallmark divergence in social behavior.

Multiscale entropy (MSE) analysis quantifies the complexity (i.e., variability) of a time series across a range of sampling scales. MSE of EEG data is shown to predict social behavior and more flexible representations of the changing social environment. Neural MSE may thus be a viable biometric for evaluating variability in social capacity in the absence of predictable behavioral manifestations, particularly when measured in the context of social interactions. Gamma band neural MSE may be especially informative in the context of ASD, as power and complexity in gamma band EEG activity are shown to be inversely related to social responsiveness among autistic children.

Methods: This study assessed relationships among child MSE in the EEG gamma band, child ASD symptom intensity, and child-parent social behavior. Participants included 34 dyads of parents and their biological children with ASD (N = 9) and without, aged 6-11 years old. Each dyad performed a 5-minute math task in which parents presented children flashcards with single- and double-digit addition/subtraction and single-digit multiplication problems of increasing difficulty. Parents were permitted to provide any assistance besides stating the answer to allow for social interactivity. Child-parent behavioral attunement was coded post hoc using a manual based

on factors like shared gaze, mutual responsiveness. EEG activity during this task was recorded using 20-channel mobile headsets. MSE was calculated using the APPLESEED pipeline, and area under the curve was calculated across scales within the gamma frequency (30-60 Hz). Autism Spectrum Quotients (AQ) based on parent surveys served as a continuous measure of ASD symptom intensity across participants.

Results: Results showed that child AQ (B = 0.03, p = 0.01) and child-parent behavioral attunement (B = 0.28, p = 0.01) positively predicted children's gamma band MSE (F(4,29) = 2.45, R^2 = 0.25, p = .07). At higher levels of behavioral attunement (BA), the relationship between child AQ and child gamma band MSE was significantly less positive (BA = 4.3: B = 0.001, p = 0.58 vs. BA = 6.4: B = -0.01, p = 0.01). Child AQ was negatively correlated with behavioral attunement (t =-2.42, p = .02). All relationships persisted when controlling for child age.

Discussion: These findings support relationships between child AQ and child MSE in gamma band EEG. They also suggest interactions between child-parent social dynamics and a potential neural correlate of ASD, which could have significant implications for our understanding of the condition. Ultimately, this study underscores the value of metrics in addition to observation, such as neural MSE, for identifying or characterizing variability in social processing, particularly for individuals with ASD. Adding another level of analysis to the study of human social behavior could enable a more complete understanding of its manifestations and implications for learning and other crucial outcomes among neurodiverse individuals.

S110. PROSOCIAL BEHAVIOR MODERATES THE RELATIONSHIP BETWEEN PSYCHOTIC-LIKE EXPERIENCES AND ELEVATED SUBSTANCE USE IN THE ADOLESCENT BRAIN AND COGNITIVE DEVELOPMENT STUDY

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Background: Patients with psychotic disorders misuse substances at elevated rates, and cannabis use has been implicated in the onset of psychosis. The social environment may contribute to heightened risk for hazardous substance use in youth at high risk for psychosis. We aimed to test associations between prosocial behavior, psychotic-like experiences, and substance use in youth.

Methods: We analyzed self-report and clinical interview data from the Adolescent Brain and Cognitive Development (ABCD study). A total of 7,842 youth (Mage at last timepoint=12.96±.63) completed a three-wave substance use assessment. Youth were interviewed about their use of illicit substances in the past 30 days. For these analyses, alcohol, nicotine, and cannabis use were cumulatively scored by use frequency. Longitudinal associations between substance use, psychotic-like experiences (PLEs) and self-reported prosocial behavior (ABCD Prosocial Behavior Profile) were tested using linear mixed effects models. Site, family unit, age, sex, socioeconomic status, and other substance use were included as covariates.

Results: PLEs were associated with increased tobacco (b = .437), cannabis (b =.494), and alcohol use (b =1.79) longitudinally across three waves of data (p's < .001). Prosocial behavior moderated the relationship between PLEs and tobacco (b=-.605, p < .001), cannabis (b =-1.37, p < .001), and alcohol (b =1.18, p=.007).

Discussion: Prosocial behavior moderates the relationship between PLEs and elevated rates of substance use in youth. People at clinical high risk for psychosis (CHR-P) report social engagement as a primary reason for substance use1–3 and higher levels of social functioning are associated with elevated substance use in CHR-P.4 Social skills and behaviors may affect attainment and use of illicit substances in youth at high risk for psychosis, particularly given legal barriers to youths' access.

S111. BEYOND INDIVIDUAL BRAINS: EXPLORING ADOLESCENT NEURAL SIMILARITY IN SOCIAL REJECTION AND DEPRESSION

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Background: Adolescence is characterized by heightened sensitivity to social evaluation and an increased reliance on peer relationships (Somerville, 2013). Feelings of rejection and dissimilarity from peers during this sensitive developmental period contribute to the elevated depression risk (Niu et. al., 2022). Further, depressed adolescents show an increased neural response to social rejection in salience and social threat regions of the brain (insula, amygdala, and anterior cingulate cortex (ACC); Pagliaccio et al., 2022), suggesting depressed adolescents may respond similarly when observing social rejection. Despite work connecting social experiences of rejection as well as similarity with peers to depression, research has not yet examined how similarity across both behavioral and neural levels relate to one another as well as to depression in adolescents. Thus, our research aims to examine (1) how neural similarity to social rejection predicts adolescent levels of depressive symptoms and (2) whether perceived dissimilarity moderates the relation between neural similarity to rejection and depressive symptoms.

Methods: In this study, a sample of autistic and non-autistic adolescents (n = 88, aged 11-14), participated in an fMRI during which they watched a series of naturalistic videos. For these analyses, we focused on peer rejection videos only (i.e., a video in which an adolescent was rejected and bullied by her peers and a video in which a man is bullied and shunned by his co-workers due to a facial deformity). To get a measure of neural similarity for each participant to the group, pairwise correlations were calculated between time series from each ROI and averaged within ROIs. We used 4 regions of interest (ACC, amygdala, right insula, left insula). To assess for depressive symptoms participants completed the Children's Depression Inventory, 2nd edition (Kovacs, 1992), a 28-item questionnaire in which the participants were instructed to self-report thoughts of depression and suicidal ideation for the past two weeks. To measure perceived dissimilarity to their peers, participants completed the Perceived Dissimilarity questionnaire, a novel 27-item questionnaire in which participants rated how similar they felt to their peers and close friends; constructs include "I have little in common with other kids". We focused on peers in general to reflect that neural similarity was measured against peers, not close friends.

Multiple linear regressions were run in R to examine associations between neural similarity, perceived dissimilarity, and depression, controlling for diagnostic group and age for each ROI. We next examined whether perceived dissimilarity moderated the relation between neural similarity and depression. Analyses were corrected for multiple comparisons using FDR correction.

Results: We found that there was a significant relation between neural similarity and depression in the right insula when participants viewed the adolescent social rejection video ($\beta = 15.23$, $t = 2.8$, $p < 0.026$). We did not find significant relations between neural similarity and depression in the other ROIs or in the other video. Perceived similarity did not moderate the relation between neural similarity and depression.

Discussion: We found that for the social rejection video involving adolescents, neural similarity was significantly related to depressive symptoms in the right insula. We did not find significant results between neural similarity and depression when moderated by perceived dissimilarity for the other video or ROIs. This suggests that adolescents whose insula responds more similarly to content portraying peer rejection are more likely to be high in depressive symptoms. This may be due to the role of the insula in detecting social threat and social pain, which may be particularly salient for adolescents who experience greater social rejection.

S112. EXAMINING CHILDHOOD PREDICTORS OF SOCIAL COMPETENCE AND SOCIAL ERROR SENSITIVITY

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Background: Skills in several domains, including language, socioemotional functioning, and executive functioning, underlie a child's ability to competently engage in social interaction. However, individual differences in social competence exist, raising questions about which factors may drive this inter-child variation. Social self-monitoring (i.e., monitoring one's own behavior while in a social context) is related to social competence and may also relate to social anxiety risk. The goal of the present study was to examine longitudinal links between risk factors assessed during early childhood and children's socially oriented skills later in childhood.

Previous work has linked behavioral inhibition (BI) to poorer social outcomes (e.g., social anxiety) among children. In addition, maternal neuroticism has been linked to adverse parenting behaviors (e.g. lower warmth, less autonomy support). In line with these findings, we hypothesized that children with higher BI and higher maternal neuroticism would demonstrate lower social competence and greater social self-monitoring. Further, based on existing findings that children's executive functioning (EF) may influence the development of social skills, we hypothesized that children's EF skills may moderate the associations between early risk factors and later social skills.

Methods: To test our hypotheses, we used data from a longitudinal study ($N = 291$) investigating associations between early temperament and the later emergence of anxiety. Participants were recruited at age 4 months and were followed to age 18 years. BI was assessed at ages 24 and 36 months via coded laboratory assessment. Maternal neuroticism was assessed at age 48 months via the NEO-Five Factor Inventory. Inhibitory control and task switching EF skills were assessed at 36 months via laboratory tasks. Social competence was assessed via behavioral coding during a dyadic interaction with an unfamiliar peer at age 9 years. Social self-monitoring was measured via EEG as the social effect of the error-related negativity (social ERN) – the difference between the amplitude of the ERN when a person commits an error alone vs. when they commit an error while they believe they are being observed by another person – during a social flanker task at age 12

years. Path analysis was used to test relations between four predictor variables (BI, maternal neuroticism, inhibitory control, task switching) and two outcome variables (social competence and social ERN), along with hypothesized 2-way interactions between EF scores and early childhood risk factors.

Results: Path analysis revealed two statistically significant main effects: greater inhibitory control at age 3 predicted greater social competence at age 9 ($p = 0.007$) and a larger social ERN at age 12 ($p < 0.001$). In addition, there were three statistically significant interactions. Both task switching skills and inhibitory control skills moderated the association between maternal neuroticism and the social ERN, such that maternal neuroticism was associated with a smaller social ERN only among children with lower task switching skills ($p = .048$) or with greater inhibitory control skills ($p = .014$). Lastly, task switching also moderated the association between BI and the social ERN, such that greater BI was associated with a larger social ERN only among children with greater task switching skills ($p = 0.030$).

Discussion: Contrary to our hypotheses, maternal neuroticism and BI did not directly predict social competence or the social ERN. Instead, their effects were moderated by children's EF skills. However, greater inhibitory control at age 3 predicted both greater social competence at age 9 and a larger social ERN at age 12. These results suggest that although greater inhibitory control may support competent social interaction, it is also linked to increased sensitivity to committing social errors, which has been shown to be a characteristic of social anxiety.

S113. THREAT-SENSITIVE BRAIN FUNCTION PREDICTS REJECTION-ELICITED AGGRESSION IN ADOLESCENTS

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Background: During adolescence peer relationships are highly salient. Peer rejection is a social threat which increases risk of aggressive behavior. However, not all instances of peer rejection elicit aggression. Little is known about the temporal unfolding of threat-related neural response to rejecting peer feedback. Therefore, we sought to determine whether engagement of brain regions implicated in threat-related processing was predictive of later aggression in adolescents.

Methods: Adolescents (N= 34, 41% F) 10-15 years old (12.38 ± 1.78 years) completed the Virtual School and Aggression (VSA) task, while undergoing fMRI. In the VSA, participants are "new students" in an online school and create a personal profile and avatar that they believe will be sent to three other purported students with reputations for being Mean, Nice, and Unpredictable. Each trial consisted of 3 temporal epochs: Anticipation, when a 'student' who is about to provide feedback is highlighted; Feedback, when they deliver reputation-consistent feedback (e.g. mean: "I can't believe you're so dumb."); Response, when the participant can respond with a noise blast from five categories: No Volume, Low Volume, Mid Volume, High Volume, and Max Volume (e.g. 0-5). Mean peers give 100% rejecting feedback, Nice peers give 100% non-rejecting, and Unpredictable peers give 50% of each. Given our interest in rejection-elicited aggression, all analyses focus on mean (rejecting) and nice (non-rejecting) peers. A repeated-measures ANOVA was performed to confirm that greater aggression was elicited by rejecting than non-rejecting feedback. To model brain activity predictive of aggression, trial-by-trial aggression scores were used as a parametric modulator of the hemodynamic response function on BOLD signal. For each

epoch, we extracted BOLD signal predictive of aggression from an a priori network of brain regions implicated in threat processing (bilateral amygdala, insula, and dorsal anterior cingulate cortex). To probe whether threat-related brain function was predictive of aggression elicited by rejecting compared to non-rejecting feedback, paired sample t-tests were performed for each temporal epoch.

Results: Behavioral analysis confirmed that rejecting feedback (3.33 ± 1.04) elicited greater aggression than non-rejecting feedback (2.03 ± 0.67; $t(33) = 4.84$, $p < 0.001$). Greater threat-related brain function was predictive of aggression elicited by rejecting compared to non-rejecting feedback specifically during the Feedback epoch, $t(33)= 2.44$, $p < 0.05$, not during Anticipation ($t(33)= -1.15$, $p= 0.26$) or Response epochs ($t(33)= 0.69$, $p= 0.50$).

Discussion: Using a novel fMRI paradigm that successfully induces rejection-elicited aggression, we show that threat-sensitive neural activity is predictive of later aggression only while adolescents are receiving, rather than anticipating or responding to, rejecting feedback. This is the first time that peer-based aggression could be probed with such temporal specificity. Future analyses will explore the extent to which functional connectivity with brain regions implicated in cognitive control modulate threat reactivity predictive of aggression. Moreover, the VSA is well-suited to investigate the neural substrates of aggression in the context of accepting peer feedback (e.g. proactive aggression). Because peer feedback demands complex neural function and informs behavior it is vital to map these constructs, particularly as they apply to adolescents, to address peer-based aggression and its widespread harmful impact.

S114. NEURAL CORRELATES OF WELLBEING IN YOUNG ADULTHOOD

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Background: There is a longstanding interest in understanding what makes us feel well, happy, and satisfied about ourselves and our lives (Bautista et al., 2023; Diener, 1984; Rice and Steele, 2004). Wellbeing is an overarching construct with multiple facets, including life satisfaction, happiness, quality of life, and mental health (Diener et al., 2009; Dodge et al., 2012; Ryan and Deci, 2001). Most studies examine single aspects of wellbeing (e.g., happiness), instead of its full multidimensionality (Bautista et al., 2023). The goal of this research was to examine subjective experiences of wellbeing in a controlled setting, encompassing its multi-faceted nature.

Methods: Using a self-evaluation fMRI-task we examined five domains of wellbeing: 1) having impact, purpose, and meaning; 2) dealing with stress; 3) family relationships; 4) self-confidence; and 5) feeling loved, appreciated, and respected. Participants first rated their wellbeing on each trial on a scale from 1-4, and then evaluated whether they would like to see future changes on this item. The items were previously validated and co-created together with adolescents and young adults (Green et al., 2023). We tested the neural substrates of domain specificity in young adults (age range = 20 – 25 years; n=34) that were part of the longitudinal Braintime study. Prior research demonstrated that early life experiences predict later wellbeing (Maciejewski et al., 2015; O'Connor et al., 2021), therefore we focused on young adulthood as an important time to examine neural activation patterns related to wellbeing.

Results: Behavioural ratings showed that young adults were least positive about dealing with stress compared to other domains of wellbeing. They reported the highest degree of preferred change for the dealing with stress condition. Higher rating for impact, confidence, and loved were associated with less depressive and burnout symptoms. In contrast, higher desire for future changes in the same three domains was associated with more depressive and burnout symptoms. Neuroimaging results that examined separable effects of domain in a whole-brain ANOVA showed engagement of the precuneus for the family domain and in the (dorso)lateral prefrontal activity for the dealing with stress domain.
Discussion: As part of the DMN and the social brain network, the precuneus has previously been linked to episodic and autobiographical memory (Dörfel et al., 2009). In the current task participants were asked to reflect upon their wellbeing over the past month. Thus, it is plausible that evaluating wellbeing also involves the engagement of memory retrieval, and more so for family relations as these are individuals with whom you have a life-long history. Extensive work on the function of the dlPFC has shown its involvement in emotion regulation and reappraisal in both healthy (Dobbelaar et al., 2023; Golkar et al., 2012; Kerestes et al., 2014) and clinical samples (Dolcos et al., 2011; Nejati et al., 2022). Possibly, the dlPFC is related to the evaluation of hedonic aspects of wellbeing (which comprises affect, mood, happiness, etc.), which may have stronger relations with emotion regulation, compared to the judgment of eudemonic wellbeing (i.e., having purpose and meaning in life). Together, these findings highlight the importance of assessing various components of wellbeing as aspects do overlap, but also show distinct behavioural and neural patterns. Future research will focus on the early developmental predictors of wellbeing later in adulthood.

S115. UNRAVELING AUDITORY ATTENTION: THE ROLE OF INTERNAL STATISTICAL MODELS AND TOP-DOWN MODULATION IN AUDITORY PROCESSING

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Background: Understanding the neural mechanisms that govern attention to natural language is a central focus in auditory perception research. A new line of studies has emerged in the last decade, suggesting that speech processing can be modified by an individual's ability to learn statistical modularity. These studies propose that speech processing operates using internal models on linguistic features probability that can be activated at different levels of linguistic hierarchy to help predict complex sentences in real-time. However, it is still unclear how this mechanism is modulated by attention and goal-directed listening, and whether it is stable in different developmental stages.
Methods: We manipulated the probability of an auditory successive syllable stream while maintaining a cohesive oscillatory structure at 3 Hz. Specifically, we paired different syllables together at different probability rates (50%, 25%, and 10%); this pairing induced a 1.5 Hz sub-harmonic alternation frequency that was unrelated to the physical features of the stream. To further investigate the connection between individual ability to understand the internal structure and their current situation-dependent attention, participants were instructed either to attend to the

manipulated auditory stream or to ignore it and focus on a visual stream consisting of letters displayed at a rate of 1.25 Hz on a screen in front of them.

By adopting steady-state evoked potential design (SSVEP) and examining neural entrainment, this unique audio-visual methodology enables us to separate the neural responses based on the carrier frequency of each unimodal input (e.g., 3 Hz and 1.25 Hz and their harmonics). Moreover, this design allows us to examine the relationship between the bottom-up sensory input from the physical features of the stimulus and the internal top-down modulation, imposed by the task, that occurs simultaneously. Thirty-nine students, aged 12-14, participated in the study, which consisted of two sessions conducted within their school environment. In each session, participants were tasked with identifying target stimuli signaled by specific sequences (the syllable 'Ba' followed by 'Bo' in the auditory-attend condition, or the letter 'M' followed by 'X' in the visual-attend condition) using button presses. The study was part of a research-practice partnership between Stanford University and Synapse K-8 school in California and was developed with feedback from middle-school students.

Results: Our results revealed a significant effect at 1.5 Hz, showing stronger amplitude in this frequency in the auditory-attend condition compared to the visual-attend condition. This observed difference aligns with the time domain characteristics of the auditory stimuli, which were paired, suggesting that individuals tend to group the auditory syllables into couples more when their attention is toward the auditory stream. This effect was correlated with participant behavior and accuracy rates, showing that individuals whose EEG reflected the internal structure of the auditory stream made fewer false alarm mistakes during the task.

No significant difference was detected between conditions in the carrier frequency of the auditory stream (e.g., 3 Hz) and its harmonics, suggesting that the comprehension of the 1.5 Hz structure might be processed differently compared to the sensory auditory inputs, which were not affected by attention alone.

Discussion: Our findings present strong evidence for a top-down mechanism for the segmentation of an ongoing auditory stimulus based on inferring breakpoints in transition probabilities. These results can serve as a potential method for assessing individual attentional strategies at the neural and behavioral levels during speech processing. Moreover, this promising line of research can promote individual-based teaching and intervention methods to enhance comprehension and engagement, ultimately improving learning outcomes.

S116. DEVELOPMENTAL CHANGES IN LOCAL PREFRONTAL CIRCUITRY SUPPORTS MATURATION OF WORKING MEMORY

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Background: Adolescence is a period of significant maturation of cognitive control, supported by the refinement of prefrontal circuitry through synaptic pruning and changes in excitatory-inhibitory balance. However, the effect of these changes on functional signaling properties, including local circuit dynamics, remains only partially characterized.

Methods: Here, we used data from a longitudinal, adolescent cohort (n=162 individuals ages 10-30, scanned up to three times each at 18mo intervals, n=244 total sessions) with MRI and fMRI

data acquired at 7 Tesla. We used resting state fMRI data to compute regional homogeneity (ReHo), a measure of the local functional connectivity, i.e., between a voxel and its immediate neighbors, across the brain.
Results: We identified widespread decreases in ReHo with age (p=0.008), including in prefrontal cortex and subcortical regions including the caudate nucleus. These data suggest increasing heterogeneity of functional properties, consistent with increased specialization of functional circuits through adolescence. Whole-brain ReHo values were significantly associated with developmental improvements in accuracy on a spatial working memory task after controlling for age (p=0.028). Voxel-wise analyses identified this association was driven by regions of inferior prefrontal cortex, insula, and prominently, caudate nucleus, which consistently showed correlations with working memory performance, such that improved accuracy was associated with reduced ReHo.
Discussion: These results suggest remodeling of prefrontal circuitry through adolescence in which increased functional specialization of local circuits supports the maturation of adult-like executive functioning.

S117. INFANT WHITE MATTER MICROSTRUCTURE PREDICTING INFANT EMOTIONALITY DEVELOPMENT

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Background: Negative and positive forms of emotionality undergo critical development during infancy, which can be assessed to predict future emotional behavioral outcomes. Negative emotionality (NE) tends to exhibit relative consistency, with a trend to increase over time, whereas positive emotionality (PE) develops rapidly during this period. Therefore, identifying objective markers of emotionality development can enhance the understanding of the etiology of early psychopathology. White matter (WM) tracts also undergo significant development during the first year of life, paralleling the development of emotionality. Among major WM tracts, the forceps minor (FM), cingulum bundle (CG), and uncinate fasciculus (UF) interconnect cortical and/or subcortical regions in emotion generation, identification, response, and regulation, undergirding largescale neural networks critically related to emotional regulation. Therefore, microstructural characteristics of these tracts derived from neuroimaging in infants are potential markers for predicting the development of infant emotionality.
Methods: Three-month-old infants (n = 39) underwent multishell diffusion MRI scans to calculate the intracellular-specific neurite density index (NDI) and orientation dispersion index (ODI) through the NODDI Matlab toolbox. A tract-based approach was applied to extract these indices by WM tracts in DSI Studio. Infant NE and PE were evaluated twice from the negative and positive composites of the caregiver-reported Infant Behavior Questionnaire-Revise Short Form when infants were 3 and 9 months old. To account for other factors which WM microstructure is also sensitive to, sociodemographic and clinical variables of the infant-caregiver dyads including infant age at 3- and 9-month evaluations, biological sex, 3-month corresponding baseline emotionality, and 3- and 9-month intracranial volume, caregiver age, socioeconomic status, 3- and 9-month

parental depression, 3- and 9-month caregiver affective instability, and 3- and 9-month caregiver anxiety were controlled for in partial correlations between infant tract microstructural features and emotionality development.

Results: We found that 3-month FM NDI ($\rho = 0.630$, $p = 0.004$), FM ODI ($\rho = 0.507$, $p = 0.027$), right UF NDI ($\rho = 0.485$, $p = 0.035$), and right CG NDI ($\rho = 0.457$, $p = 0.049$) were all positively correlated with the 3-to-9-month development of NE. No tract microstructure was associated with PE development.

Discussion: Greater 3-month neurite density of FM, right UF, and right CG were significantly associated with larger NE increase, suggesting that higher anatomical connections widely among emotion-related brain regions at 3 months may lead to larger number of negative stimuli received and processed, leaving a long-term impact on NE development. Greater 3-month neurite dispersion of FM was also significantly associated with larger NE increase, further suggesting that more complex information transferred across hemispheres at 3-month may also have persistent impact on NE development. Interestingly, although PE significantly develops in infancy, the 3-month WM microstructure level is not predictive for the PE development when controlling for other factors. These findings suggest that the microstructural features of WM tracts interconnecting emotion-related brain regions are potential markers for predicting infant negative emotionality development, thus acting as potential indicators of future emotional behavioral disorders.

S118. PARSING MECHANISMS UNDERLYING SLEEP-IRRITABILITY DYNAMICS IN YOUNG ADULTS: THE POTENTIAL ROLE OF REGULATORY AND INHIBITORY STRATEGIES

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Background: Irritability is a common and impairing transdiagnostic symptom with limited behavioral treatment targets, particularly in young adults. Adverse sleep behaviors (e.g., insufficient duration) and poor sleep quality are linked to increased irritability. Given the importance of studying irritability and sleep within young adulthood, additional research is needed to further explore mechanisms underlying the relationship between these constructs during this developmental stage. Poor sleep decreases frontal-amygdala connectivity, impacting regulatory processes, manifesting in issues with emotion regulation and inhibitory control (IC), or the ability to control automatic responses. However, it remains unknown whether impacts of sleep on emotion regulatory processes or inhibitory control more broadly explain associations between poor sleep and increased irritability during young adulthood. The current study investigated the following aims: 1) emotion regulation and IC as mediators for the association between retrospective assessment of sleep quality and irritability 2) associations between irritability with changes in IC and affect following experimentally restricted sleep duration.

Methods: 97 (M[SD]age=19.26[1.97] years; 67% female; 85% non-Latino/Hispanic; 74% White) young adults completed the study. A subset of participants (n=75) completed a sleep protocol that consisted of both a sleep restriction (5 hours) and non-sleep restriction condition (8 hours). IC was assessed at baseline and again the morning following each sleep condition via a novel mobile

application version of the AXCPT task. IC was operationalized using Dprime, the percent incorrect BX trials subtracted from the percent correct AX trials. At baseline, emotion dysregulation was measured using the Difficulties in Emotion Regulation Scale (DERS) total score and irritability was measured using the Brief Irritability Test (BITe) total score. Effects of sleep restriction on mood was assessed using the Positive and Negative Affect Schedule (PANAS) the morning following each sleep condition. Structural equation modeling was conducted to explore Aim 1 and repeated measures ANCOVA (rmANCOVA) was used to assess Aim 2.

Results: Aim 1: Results of two separate mediation models revealed that emotion regulation, but not IC, mediated the association between sleep and irritability ($\beta = .06$, $z = 3.00$, $p = .003$). Aim 2: Results of the rmANCOVA model predicting affect ratings revealed a main effect of affect valence, $F(1, 61) = 37.64$, $p < .001$, such that across all sleep conditions, participants reported significantly higher positive affect compared to negative affect. However, there was also an interaction for sleep quality, such that as sleep quality worsened participants reported more negative affect and less positive affect $F(1, 61) = 9.72$, $p = .003$. Although trending, this same pattern was observed for those with increased irritability $F(1, 61) = 3.25$, $p = .077$. No significant interactions with sleep conditions were observed ($ps \geq .089$). Results of the rmANCOVA model predicting IC performance revealed a main effect of irritability, $F(1, 34) = 4.76$, $p = .036$, such that irritability was associated with increased IC across all sleep conditions. However, this main effect did not remain after removing outliers. No other significant main effects or interactions emerged.

Discussion: Overall, emotion regulation emerged as a mediator for the association between sleep and irritability in a young adult sample. While there were no significant main effects or interactions with sleep restriction on IC or affect, participants with worse sleep quality reported significantly more negative than positive affect. These findings indicate that sleep quality and irritability are relevant in young adults specifically. Furthermore, emotion regulation and affect are particularly important to consider when investigating sleep-irritability dynamics during this developmental period.

S119. THE HURST EXPONENT AS MARKER OF INHIBITION IN THE DEVELOPING BRAIN

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Background: Understanding the spatial and temporal progression of developmental plasticity is crucial for identifying periods of vulnerability and opportunity in human brain development. Plasticity is partly regulated by the maturation of inhibitory neurons, particularly parvalbumin positive (PV+) cells, constituting about 40% of cortical inhibitory neurons. Postmortem studies across species have shown PV+ cell maturation continuing throughout development, reaching maturity in late childhood to adolescence (Fung et al., 2010; Grateron et al., 2003). However, these studies focus on specific brain regions, leaving the whole-brain developmental trajectory of inhibitory circuits unknown. In addition, acquiring human postmortem samples, especially from pediatric cases, is challenging, limiting our understanding of inhibitory circuitry development. Another approach to studying inhibition is magnetic resonance spectroscopy (Perica et al., 2022), but this method is also limited because it is highly sensitive to motion and can only be used to

collect data from one brain region at a time. It is critical to develop methods than can be used to efficiently characterize inhibition in the entire brain.

Previous computational modeling suggests inhibition reduces high frequency noise in electrophysiological and BOLD signals (Gao et al., 2017; Trakoshis et al., 2020). When these signals are Fourier transformed, the slope of the decay in power as frequency increases can be characterized by the Hurst exponent. Higher Hurst exponents from fMRI data in adults are linked to more rigid structural-functional coupling (Fotiadis et al., 2023). The Hurst exponent differs in individuals with autism, with lower values indicating lower inhibition in males with autism (Trakoshis et al., 2020). However, the Hurst exponent's validity as an inhibitory marker is mainly based on simulated data, with sparse empirical evidence. Moreover, no studies have characterized changes in the Hurst exponent during childhood, a period when significant changes in plasticity are believed to occur.

Methods: In this study, we used a cross-species, multi-modal approach to investigate early inhibitory circuit development.

Results: Analyzing the relationship between the Hurst exponent from resting-state fMRI data and inhibitory marker RNA expression in both children and adults, we found significant correlations across the cortex in both age groups (children, $n = 128$: $R2 = 0.345$, $P = 0.034$, adults, $n = 46$: $R2 = 0.426$, $P = 0.018$). We confirmed the Hurst exponent's validity as a translational inhibitory marker by demonstrating a strong correlation between the Hurst exponent and PV cell density across the cortex in mice ($n = 24$, $R2 = 0.598$, $P < 0.001$). Additionally, we identified a plateau in the Hurst exponent during late childhood, aligning with a plateau in PV RNA expression (partial $R2 = 0.012$, $PFDR < 0.001$).

fMRI measures of inhibition are crucial not only for tracking inhibitory circuitry development but also for exploring its role in functional network maturation. During development, functional networks tend to become more specialized and segregated. The participation coefficient quantifies this segregation and specialization, indicating the diversity of connections of a node across systems. Using the Hurst exponent as an inhibitory marker, we found a negative correlation between the Hurst exponent and the participation coefficient across cortical parcellations ($r(df) = -0.377$, $Pspin < 0.001$) and across children ($r(df) = -0.056$, $Pspin < 0.001$), suggesting inhibition might play a role in cortical specialization.

Discussion: In summary, our findings support using the Hurst exponent as a non-invasive tool for studying inhibition and plasticity in developing human brains. The consistency of the Hurst exponent's validity across mice and humans further supports its translational potential, facilitating exploration of underlying mechanisms in inhibitory development.

S120. CHANGES IN COMPUTATIONALLY DERIVED COMPONENTS OF REWARD LEARNING ACROSS ADOLESCENCE IN YOUTH AT LOW- AND HIGH- RISK FOR DEPRESSION

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Background: Multiple lines of evidence show that the reward system undergoes dramatic change across adolescent development, with concomitant increases in reward responsivity frequently observed in adolescents. However, reward responsivity is not a unitary construct, and the

application of a computational model to a reward learning task can break reward-related choices into component parts, revealing mechanisms that drive reward response. To-date, relatively little is known about how these computationally derived components of reward response change across development. Additionally, evidence suggests that disruptions to reward system development during adolescence are associated with depression. For example, youth at high-risk for depression show reduced reward learning across different experimental paradigms. However, relatively little is known about the mechanisms driving altered reward learning in youth at high-risk for depression.

Methods: In the current project, youth aged 9-17 completed the Play-or-Pass Iowa Gambling Task (PoP-IGT) across five timepoints. In the PoP-IGT, a single deck of cards is presented, one at a time, and participants decide whether to play or pass on each deck, learning through trial-and-error to approach good decks that deliver net wins and avoid bad decks that deliver net losses. We used traditional scoring for this task, which yields performance metrics that represent approaching rewards (good deck proportion play), avoiding punishments (bad deck proportion play), and overall good decision making (net proportion play). Additionally, we applied a reinforcement learning model, which yields performance metrics that represent updating in response to better-than-expected outcomes (reward learning rate), updating in response to worse-than-expected outcomes (punishment learning rate), updating in response to the frequency of rewards while ignoring reward magnitude (win frequency sensitivity), and a general tendency to play (rather than pass) on stimuli (go-bias). Using multilevel models, we examined developmental trajectories for each of the performance metrics to examine how traditional reward learning metrics and computationally derived metrics of reward learning change across adolescent development. Further, we examined whether a maternal history of depression—a strong risk factor for depression in offspring—was associated with differences in PoP-IGT performance metric trajectories across adolescence.

Results: Both good deck proportion play and net proportion play increased significantly across age (ps $< .05$), whereas bad deck proportion play did not show significant age-related change. All of the computational parameters showed significant age-related changes, with punishment learning rate, win frequency effect, and go-bias showing significant increases across age (ps $< .05$), and reward learning rate showing an age-related decrease ($p < .001$). There was also a significant fixed effect of lower reward learning rate among youth with a maternal history of depression ($p = .02$).

Discussion: Given that better net game play was positively associated with punishment learning rate, win frequency effect, and go-bias, but was negatively associated with reward learning rate, the observed parameter changes across age suggest that, across development, youth are tuning their learning parameters in ways that support better decision making on the PoP-IGT. This interpretation is also consistent with the developmental patterns observed in the traditional performance metrics. The only computational parameter to show an effect of maternal history of depression was reward learning rate, with high-risk youth showing lower reward learning rates at baseline (~9 years old). This finding suggests that maternal history of depression may have a unique effect on reward learning rate and that alterations to reward learning rate may be one mechanism by which a maternal history of depression confers risk for depression in offspring.

S121. EXAMINING THE FUNCTIONAL ORGANIZATION, SPECIFICITY, AND LATERALITY OF LANGUAGE AND THEORY OF MIND

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Background: Language and theory of mind (ToM) are vital skills for effective communication in a social world. These skills both activate the superior temporal lobe (STL). Prior work in adults shows that distinct, functionally specialized regions of STL are separately recruited for language and ToM processing; however given the intertwined nature of these skills during development, we may expect the same parts of the brain, or some overlapping regions, to be similarly recruited for both tasks. Do more complex cognitive functions like language and ToM emerge from an initially common neural substrate for social communication? In this project, we test this question by first replicating previous findings in adults showing primarily distinct regions of activation for language and ToM, and extend these findings by also examining the functional organization, functional specialization, and laterality of the STL during development.

Methods: We completed functional and structural MRI scanning in 36 adults and 38 children (ages 3-9 years). Each participant completed a T1 structural scan and two fMRI tasks: 1) watched a non-verbal short movie to localize ToM (Jacoby, 2016), 2) listened to an auditory language localizer (Fedorenko, 2010). We created subject-specific functional regions of interest (fROIs) to examine within individual selectivity (language: Sentences > Nonsense speech; ToM: Mentalizing > Pain) of canonical regions within the STL for language and ToM by selecting the top 10% most responsive voxels per contrast of interest within search spaces from previous literature (Jacoby, 2016; Fedorenko, 2010; Julian, 2012) and examining selectivity from independent runs of all tasks. We examined overlap of maximally sensitive regions by selecting the top 5, 10, 20, and 30% of responding voxels to each contrast of interest in a mask of the entire STL (rather than subregions; created using Destrieux FreeSurfer parcellations (Destrieux, 2010)) and calculating the Dice coefficient of overlap across regions sensitive to language and ToM. Finally, we generated group level GLMs (separately for adults and kids) to examine the laterality of the language and ToM responses, and compared the resulting maps, to see if the two tasks show opposing laterality in the same regions of the STL. We also compared the overlap in the laterality of the hotspots of activation within an individual.

Results: Both children and adults showed similar patterns of selectivity. All left hemisphere language fROIs were significantly selective to the language and more selective to language than mentalizing, whereas the right anterior temporal region responded to both language and ToM. In adults, both ToM fROIs (the superior temporal sulcus (STS) and temporal parietal junction (TPJ)), were significantly selective to ToM and not language. In children, the bilateral TPJ was significantly selective to ToM and not language, whereas we did not see a reliably responsive, specific ToM region in the STS. However, the maximally responsive regions to language and ToM across the entire STL were non-overlapping, in both children and adults (mean Dice coefficient for all %s were below 0.3 for both groups). Finally, while we observed opposing laterality (i.e. language lateralized to the left and ToM lateralized to the right) in both groups, the most lateralized regions were not homologues of one another: for both kids and adults, the strongest language lateralization was seen in the middle STL, extending anteriorly, whereas ToM showed the strongest laterality in the posterior STL.

Discussion: These results oppose the idea that language and ToM are intertwined in the developing brain, and instead suggest that young children show a similar pattern of functional selectivity, specificity, and laterality as adults. In particular, left language regions are selective and distinct from ToM regions at young ages, and these functions do not overlap nor share neural resources early in development.

S122. FUNCTIONAL CONNECTIVITY DURING ACADEMIC, EF AND REST STATES IN YOUTH

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Background: Challenging tasks for youth, such as math and reading tasks, require many domain-general and domain-specific brain networks to complete successfully. How effectively and efficiently the whole brain communicates and organizes during academic tasks is likely important for skill performance. Graph metrics are one way we can measure how connected different brain networks or systems are to one another during both task and rest states. Global efficiency and modularity are graph metrics that measure network integration and segregation, respectively. Whole-brain global efficiency has been found to increase during cognitively demanding tasks, and higher functional network integration during these cognitively demanding tasks has been linked to better performance. However, task functional connectivity studies in youth have been limited and have not examined measures of network integration and segregation during academic tasks, or compared network organization during academic tasks to other cognitively demanding tasks. The current study examined differences in global efficiency and modularity in a sample of 4th and 7th graders during cognitively demanding (math, reading, cognitive flexibility), and less-demanding (resting state) tasks in order to better understand how the brain dynamically organizes during different types of tasks.

Methods: The current study (n=53, 21 4th graders and 32 7th graders, 32 F) utilized graph metrics to test the functional integration and segregation of brain systems during different task states. Participants completed at least one run of each of the following MRI tasks: a subtraction and addition confirming task, a task with rhyming and semantic judgments, a cognitive flexibility/cued-switching shape task, and a resting state task. Participants were required to have 3 minutes of usable data after removing all frames with a framewise displacement (FD) > 0.3mm and requiring at least five contiguous frames for data to be included (mean time read= 4 min 47 sec; mean time math= 4 min 40 sec; mean time cognitive flexibility= 7 min 54 sec; mean time rest= 8 min 54 sec). Global efficiency and modularity were calculated using the Brain Connectivity Toolbox and graphs were density thresholded at 15%. Multi-level models controlling for grade and sex were used to test for differences in global efficiency and modularity, separately, across the four tasks.

Results: We found significant differences in global efficiency and modularity across the four states. Global efficiency was higher for both the math and reading tasks compared to either the cognitive flexibility or resting state task (all p-values < .001). Global efficiency during the cognitive flexibility task was not significantly different from the resting state task. Read and math did not differ in global efficiency. Modularity was lowest during the reading task and modularity during the reading task was significantly lower than modularity during the cognitive flexibility task, math task, and resting-state task (all p-values < .01), but modularity during the cognitive flexibility, math, and resting state tasks did not differ from each other.

Discussion: We found that integration across the brain was highest during the two academic tasks and segregation was lowest during the reading task, indicating that academic tasks elicit strong functional coupling among distinct brain networks, particularly for reading. However, there was

also substantial variability in global efficiency and modularity across individuals. Future directions include examining factors associated with individual measures of integration and segregation, including developmental (grade) and task performance differences (academic achievement).

S123. TRACKING THE DEVELOPMENT OF THE SOCIAL BRAIN FROM CHILDHOOD TO ADOLESCENCE

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Background: Childhood represents a period of considerable change to various aspects of social cognition, which represent the ability of an individual to make sense of social environments by understanding and interpreting the intentions, goals, and desires of others. Social cognitive abilities, such as theory of mind, form the basis of the expansion and prioritization of children's social lives, and are central to the way children think, interact, and live in social contexts. It is during this time that children's social networks begin to grow, and their interactions with others become more structured and complex. Not coincidentally, the social brain, which is comprised of an integrated network of brain regions that include the temproparietal junction and prefrontal cortex, also undergoes considerable changes as children mature into adolescents.
However, the developmental trajectory of the functional connectivity profile of different networks of the social brain remains poorly understood

Methods: Children and adolescents (n=656) between the ages of 5 and 17 underwent functional MRI scans to acquire brain activity while they watched an 10-minute clip of the movie 'Despicable Me.' Functional connectivity of the fMRI data was computed within and between three networks of the social brain networks: 1) cognitive mentalizing, 2) affective mentalizing and 3) the empathy networks. We used generalized additive models (GAMs) to investigate the developmental trajectory of each of the three networks. We also compared (t-contrasts) connectivity profiles within and across the three networks in three equally matched age bins from early childhood to adolescence.

Results: We found that the functional connectivity profile within the three networks forming the social brain undergo distinct developmental trajectories. That is, development of the cognitive mentalizing network follows an asymptotic trend (edf = 2.401, F = 9.64, $p < 0.001$), the affective mentalizing network develops along a linear trend (edf = 1.001, F = 13.24, $p < 0.001$), whereas the empathy network appears to develop along an inverted quadratic pattern (edf = 2.069, F = 9.53, $p < 0.001$). In addition to finding an increasing number of positive connections within networks, we also found an increasing number of negative correlations between networks, with the most and strongest negative correlations in adolescence.

Discussion: We found evidence that the three networks that together form the basis of the social brain follow distinct developmental trajectories, and the increase in number and strength of negative correlations between networks suggest a developmental segregation of the networks that may subserve different aspects of social cognition.

S125. MOTOR LEARNING IN MILD COGNITIVE IMPAIRMENT: A SYSTEMATIC REVIEW AND PRELIMINARY FINDINGS

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Background: Research investigating the influence of early-stage, age-related cognitive decline on acquisition, retention, and transfer of motor skills upon rehearsal has yet to be systematically synthesized. Therefore, we conducted a systematic review of the current evidence on motor learning in mild cognitive impairment (MCI). Subsequently, we initiated an original research study informed by the results of this review, examining motor learning in MCI. Preliminary findings of that research will be presented alongside systematic review findings.

Methods: The review was registered with PROSPERO international prospective register of systematic reviews (registration ID CRD42023417329). Articles were identified from five databases as of January 29, 2024. Records included in this review were required to be full-text, peer-reviewed original research articles published in English. Studies that had at least one behavioral outcome related to motor learning, a study population with a mean minimum age of 60 years, and an MCI sample characterized in accordance with established diagnostic criteria were considered by two independent reviewers for inclusion in this review.

Results: The search returned a total of 6,058 references, 11 of which met criteria for inclusion in this review. Upon quality assessment, nine studies were graded fair quality, and two studies were graded high quality. A significant difference in motor learning outcomes was reported in 42% of studies comparing MCI and age-matched non-cognitively impaired (NCI) samples. Results are presented by category of motor task (i.e., key press sequence, rapid aiming and reaching, and visuomotor rotation tasks) and by stage of learning (i.e., acquisition, retention, and transfer).

Discussion: The existing evidence on motor learning in MCI was notably variable with an overall moderate risk of bias. Possible sources of heterogeneity among collective findings include variability in motor tasks, outcome measurement, and research design. Further research is needed to support a comprehensive understanding of motor learning in the early stages of age-related cognitive decline. Future investigations aiming to improve motor learning in MCI populations should emphasize functional motor tasks and clinically relevant learning outcomes while controlling for potentially confounding factors such as motivation and sleep performance. Preliminary findings of an original research study being conducted to fill the identified gaps in existing MCI motor learning literature will be discussed.

S126. STABILITY OF PERSONALIZED BRAIN FUNCTIONAL NETWORKS IN INFANTS

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Background: The importance of functional networks in the brain has been extensively studied. While there has been significant emphasis on the understanding of functional networks in adults, there has been less focus on the functional networks present in infants. Resting state functional

MRI (rsfMRI) has been used to study brain organization and its network organizations. As this research progresses, there has been a shift to focusing on the individualized functional networks. In this study, we aim to examine the stability in those personalized functional networks that are present in infants through precision confidence mapping (PCM).

Methods: To examine this, we used precision imaging data from a group of infants (n=10, post-menstrual age 44.86-50.57 weeks). 3T fMRI data acquired using a four-echo ME sequence (14ms, 39ms, 64ms, 88ms, TR=1.761s, 2mm isotropic). The anatomical images for T1w and T2w were acquired in accordance with the protocol used for the HBCD study (T2w: TR = 42.3s, TE = 323ms, resolution = 0.8 x 0.8 x 0.8 mm, flip angle = 120°; T1w: TR = 2.4s, TE = 2.2ms, resolution = 0.8 x 0.8 x 0.8 mm, flip angle = 8°). All data acquisition was performed during natural sleep.

The data was denoised before pre-processing using NORDIC. Segmentations of the anatomical data were created using BIBSnet. Multi-echo preprocessing was done using Nibabies and functional connectivity processing was done using XCP-D. For further analysis, functional connectivity matrices were calculated using only low motion data (framewise displacement = 0.3mm).

PCM was used to identify the functional networks present and create a confidence map for those network assignments to emphasize the stability of the individualized functional networks. PCM extends our recently published Template Matching method (Hermosillo et al., 2024) by bootstrapping segments of the functional time series and applying the community detection across permutations. PCM was used to examine the personalized networks of participants across 68-143 minutes of low motion data. The network confidence maps were constructed based on the 14 functional networks of the Gordon Parcellation, with the addition of the recently discovered somato-cognitive action network (SCAN). The stability of each network was determined using split-half analysis with 30-65 minutes of data in each half.

Results: Two out of ten subjects failed to attain network assignments for all networks across permutations. For the other eight participants, the highest stability was observed in the SCAN network (M=0.630, SD=0.080). This was followed by the auditory network (M=0.617, SD=0.066) and the salience network (M=0.608, SD=0.034).

The lowest stability across the eight participants was observed in the default mode network (M=0.326, SD=0.082), followed by the fronto-parietal network (M=0.336, SD=0.053) and the parietal occipital network (M=0.390, SD=0.072).

Discussion: Based on prior knowledge, we expected the stability of sensory networks to be highest in infants (Sydnor et al. 2022). However, previous studies did not include the SCAN network in their analyses. Our findings included the SCAN network which could take awayfrom the stability of sensorimotor networks.

Although the data is shuffled through PCM, a higher stability in the auditory network could have resulted from the oddball auditory task that was performed in this study.

Future steps will include investigating why two subjects failed to attain the network assignments for all networks across the permutations and determine the impact of the variability in amounts of data between subjects.

S127. EFFECTS OF NEW YORK CITY AIR POLLUTION ON CHILD PSYCHOPATHOLOGY AND FUNCTIONAL CONNECTIVITY IN THE BRAIN

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Background: The effects of air pollution have been studied for decades, and scientists have found a clear link between air pollution and various health conditions, such as respiratory and cardiovascular disease (Kim et al., 2013; Fiordelisi et al., 2017). However, more recently, researchers have shifted their focus to explore the effects of air pollution on the central nervous system and, more specifically, how it may negatively impact mental health (Buoli et al., 2018). Animal studies show air pollution causes inflammation in certain brain areas and prolonged exposure impairs neuron function (Fonken et al., 2011; Yao et al., 2015). In humans, exposure to black carbon (BC), particulate matter (PM), and nitrogen dioxide (NO2) is positively associated with higher rates of depression, with BC exposure also being related to higher rates of generalized anxiety disorder (Hautekiet et al., 2022; Manczak et al., 2022; Pelgrims et al., 2021; Sakhvidi et al., 2022). The effects of these exposures may be particularly harmful to children, as their brains are continuing to develop and mature. The present study aimed to test hypotheses that children with greater exposure to air pollution will exhibit poorer emotional and behavioral regulation and cognitive function, as well as differential functional connectivity of hippocampal and amygdala regions.
Methods: The study was conducted using data from an NIMH-funded study of neural correlates of impairing emotional outbursts, where 5-9 year old children were recruited across three groups: (1) children in the typically developing control (TDC) group who did not have any current or past psychiatric diagnoses except for specific phobia and/or enuresis; (2) children in the ADHD group who were diagnosed with ADHD and were not exhibiting impairing emotional outbursts (IEO); and (3) children in the IEO group who exhibited at least three outbursts per week for the past six months that were more severe than would be expected given the situation and developmental level of the child. Using air pollution data from the New York City Community Air Survey (NYCCAS), parent-reported Behavior Assessment System for Children (BASC-2) scores, and resting-state fMRI scans, we examined the effects of several pollutants (BC, PM, NO, and NO2) on participants' psychological wellbeing and functional connectivity in the brain.
Results: Positive associations were observed between pollutant levels and problems with depression, anger, inattention, and executive functioning, but only in the most impaired, IEO group. Across all participants, NO2 exposure was associated with functional connectivity of the right hippocampus with the occipital lobe, and the left hippocampus with the precuneus. In the ADHD and IEO groups, NO2 exposure was associated with connectivity of the left hippocampus and amygdala with regions of the occipital lobe.
Discussion: Together, these findings suggest that air pollution is harmful to the psychological wellbeing of children, and exposure worsens symptoms for those who already experience psychopathological vulnerabilities. Exposure to air pollution also impairs functional connectivity in the child brain, which could contribute to negative psychopathological outcomes.

S128. DREAMIES T-M: A NOVEL EAR PROTECTION METHOD IN INFANT NEUROIMAGING RESEARCH

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Background: Effective ear protection is crucial for infant neuroimaging to ensure safety and data quality. Typical infant ear protection is a combination of putty earplugs, adhesive foam earmuffs (i.e., MiniMuffs or Neonatal Noise Guards) stabilized with adhesive tape, and headphones playing white noise. Soft foam padding is frequently added to stabilize the infant's head. This method is time-consuming and may disturb the infant especially if ear protection becomes dislodged due to infant sweat.

DREAMIES T-M (NEATCap Medical, LLC, Bethlehem, PA), offers a new solution using soft foam, sealing ear cups and a soft, adjustable neoprene-nylon headband to ensure a snug seal providing a 27 dB overall sound attenuation. It's quicker and less invasive than traditional methods, reducing infant disruption. DREAMIES T-M is unaffected by moisture, and stays secure throughout MRI acquisition. Successful, motion-free MR scanning up to 55 minutes for neonates to 4-month-old infants wearing DREAMIES T-M has been reported (Beluk et al., 2022).

Our lab piloted DREAMIES T-M during infant scans as part of an ongoing study using a Siemens 3T scanner (MAGNETOM PRISMA Fit) with a 32-channel coil, and included T1, T2, fMRI, DWI, QALAS, and Spectroscopy sequences. During the trial phase, we tried DREAMIES T-M with and without headphones, sometimes playing white/rain noise, and foam padding. As pronounced motion artifacts were noticed when DREAMIES T-M were used with headphones playing white noise, we ultimately discontinued use of headphones and white noise. The use of DREAMIES T-M has yielded an overall success rate of 76% among infants up to 15 months (n=29, ages 3-15 months). Note achieving a successful scan is depends on more than good hearing protection, e.g. the infant's ability to fall asleep, etc.

The present study aimed to evaluate sound attenuation of DREAMIES T-M compared to other ear protection methods to find optimal hearing protection for infant neuroimaging.

Methods: Sound attenuation testing used a 3d-printed 31cm circumference model head with two microphones to accommodate various hearing protectors, placed inside a foam-lined enclosure containing 2 Bluetooth speakers playing recorded MR T1, T2 and DWI sounds and pink noise. White/rain noise was played through headphones positioned next to the test head. DREAMIES T-M, silicone ear putty, MiniMuffs, headphones (MR Confon Starter f MKII+), and soft paddings (NoMoCo Pillow pads) were applied in various combinations onto the test head. Overall sound attenuation was calculated using standard methods.

Results: Sound attenuation results were as follows. Overall attenuation of white/rain noise with DREAMIES T-M was 33-34 dB, whereas with MiniMuffs it was 1 dB. Overall attenuation of T2 and DWI noise with DREAMIES T-M alone was 25-26 dB. Overall attenuation of pink noise with headphones and foam padding alone was 12-15 dB compared to DREAMIES T-M alone which was 28 dB, and compared to combinations of a) DREAMIES T-M plus headphones, b) DREAMIES T-M plus foam padding, and c) DREAMIES T-M plus headphones and foam padding, which were 33-34 dB (although sound blocking in low-frequency bands decreased using headphones).

Discussion: DREAMIES T-M combined with foam padding provided low-frequency blocking plus high overall attenuation of relevant infant MRI noise, without headphones, MiniMuffs, silicone earplugs or tape. Further testing of a variety of configurations simulating MRI sound exposure will be conducted to provide comprehensive understanding to optimize the use of DREAMIES T-M in research settings. DREAMIES T-M is a promising new device to provide effective sound attenuation for infants undergoing MRI.

S129. EXPLORING THE IMPACT OF VICTIMIZATION ON NEURAL MECHANISMS OF AGGRESSION IN ADOLESCENTS

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Background: Victimization impacts adolescents to a greater extent than adults and children due to heightened sensitivity to social feedback, necessitating research that explores the effects of peer victimization.

Aggressive victimized teens are prone to mental health disparities. Alarmingly, there is a distinct lack of research exploring how victimization explains distinct forms of aggression. It can be divided into two subtypes, reactive (retaliatory behavior in response to threat) and proactive (goal-oriented behavior motivated by perceived benefit). These subtypes may be affiliated with separate neural circuits: where reactive aggression involves threat-related regions (amygdala, dACC, insula) and proactive aggression involves reward-related regions (ventral striatum, medial prefrontal cortex). Using a novel fMRI-based paradigm, this project sought to explore the role of victimization on subtypes of aggression as a main predictor and as a moderator of distinct neural network engagement during social feedback.

Methods: Adolescents (N=45; 47% female; 12.45±1.58 years of age) with a range of PV exposure (83% endorsed exposure) completed the Virtual School and Aggression (VSA) task while undergoing fMRI. Participants were "new students" in an online school and believed they would interact with purported other students with mean or nice reputations. Each VSA trial included feedback from a mean or nice peer, and the subsequent opportunity for the participant to respond with an aggressive response (sending noise blasts to peers, ranging from no volume (0) to max volume (5)). Reactive and proactive aggression were defined as average volume delivered in response to mean or nice peers, respectively. BOLD signal was extracted from a priori threat- (amygdala, dACC, and insula) and reward-related networks (mPFC and ventral striatum) during feedback. A multiple regression analyses and a corresponding Z-test determined if PV uniquely predicted aggression subtype. Linear models tested whether engagement of threat- versus reward-related networks uniquely predicted reactive and proactive aggression. Finally, PV was added as a moderator to those models to probe brain-PV effects on aggression.

Results: Level of pro- and reactive aggression varied as a function of PV ($Z= 2.13$, $p= 0.03$), such that higher PV was associated with lower levels of reactive aggression ($t(44)=-2.20$, $p=0.04$), but was unrelated to proactive aggression. Level of proactive aggression varied as a function of reward, but not threat network engagement ($Z= -2.53$, $p=0.01$), such that greater engagement was associated with more proactive aggression ($t(42)= 2.07$, $p= 0.04$). Level of reactive aggression did not vary as a function of reward or threat network engagement. Finally, PV failed to moderate the relation between pro- or reactive aggression and threat- and reward-network engagement.

Discussion: Results show that PV is linked to diminished reactive aggression, with no relation to proactive aggression. Thus, PV buffered youth against behaving aggressively towards negative feedback from mean peers. Surprisingly, effects were not linked to engagement of brain regions implicated in reward- or threat-processing. This may have been the result of insufficient statistical power to detect complex interactions. However, relations emerged between reward network engagement and proactive aggression. This supports prior work suggesting that proactive aggression may be appetitive in nature. Further work is needed to determine if functional

connectivity with brain regions implicated in goal-oriented behavior may contribute to the expression of proactive aggression.

S130. HOW DO STUDIES USING ABCD STUDY DATA REPORT ON RACE, ETHNICITY, AND CULTURE? A SCOPING REVIEW OF RESEARCH METHODS: AND THEIR ALIGNMENT WITH THE 2023 APA JOURNAL ARTICLE REPORTING STANDARDS FOR RACE, ETHNICITY, AND CULTURE

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Background: The APA Style Journal Article Reporting Standards for Race, Ethnicity, and Culture (JARS-REC; 2023) was created to guide how race, ethnicity, and culture (REC) are included in scientific manuscripts to improve research transparency and strengthen research methodology. This scoping review used the JARS-REC as a framework to characterize reporting on REC in studies using data from the Adolescent Brain Cognitive Development (ABCD) Study. The ABCD Study, a publicly available dataset with extensive longitudinal data, has been used in over 700 publications and has significant potential to advance our understanding of adolescent development and impact psychological science. Rather than make judgments about a particular study's adherence to the JARS-REC, our goal was to understand current trends in REC reporting and the progress needed to integrate these standards into common practice. Here, we present a subset of findings from this scoping review, analyzing a recent snapshot of reporting practices of methodological approaches in studies using ABCD data per the JARS-REC.

Methods: The scoping review followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist and was pre-registered (https://doi.org/10.17605/OSF.IO/85KN2). The corpus was compiled through the ABCD Study Publication Archive (search date: 12/29/2023). Inclusion criteria required that studies be original, published in peer-reviewed journals, and focused on interpreting ABCD data. Articles were excluded if they compared ABCD data with another dataset or solely assessed measurement and methods. Articles were screened by co-authors A.F. and A.W. The final corpus of 50 studies were then data charted by four trained assistants to assess consistency with the JARS-REC. Here we present the subset of results relevant to research methodologies.

Results: The JARS-REC includes recommendations regarding how authors report on research design, participant characteristics, and measures and covariates. The majority (84%) of the studies reported participants' racial-ethnic demographics. However, racial-ethnic categories varied widely, with all studies using some form of racial-ethnic aggregation (as the ABCD study measures race-ethnicity across 26 categories). Yet, few studies (20%) provided either a description of the aggregation (n=5) or rationale (n=7) for the racial-ethnic categories analyzed and many (n=31) used a racial-ethnic category of "other". In regards to measures, validity (14%), reliability (6%), measurement invariance (0%), and cultural validity (4%) of measures were rarely reported.

Discussion: Our review found that current reporting trends largely do not reflect the 2023 JARS-REC, underscoring the need for reporting standards and significant improvements in inclusivity and transparency. Large-scale datasets provide unique opportunities for scientific advancement,

and, with the inclusion of relatively large sub-samples of youth across racial, ethnic, and cultural backgrounds, addressing mental health equity. However, we identified notable limitations in reporting on REC across the corpus. For example, only a handful of studies discussed measures' psychometric characteristics. Transparency about measurement tools is important to understand findings' limitations across racial-ethnic groups. Moreover, while ABCD collected relatively fine-grained data on REC, most authors did not fully utilize it. JARS-REC discourages aggregating race and asks for a clear rationale if aggregation occurs. However, all studies that reported on participant race or ethnicity aggregated data and very few explained how or why this was done. In all, we observed hallmarks of psychology's color-evasive approach, which has served to perpetuate health inequity. Implementing the JARS-REC into future research, including secondary research with ABCD data, is critical to move the field closer to our goal of youth mental health equity.

S131. EXAMINING AN ADAPTIVE ASSESSMENT OF EXECUTIVE FUNCTIONS (ACE-X) IN CHILDREN WITH DYSLEXIA

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Background: Developmental dyslexia (dD) is one the most prevalent learning differences, affecting up to about 15% of children. Despite its prevalence, many schools lack access to comprehensive reading assessment tools. Further, the tools that are available often focus heavily on phonology, and do not attend to other cognitive aspects crucial to a complete understanding of reading difficulties, such as executive functioning (EF). EF encompasses a range of cognitive processes including working memory and attention, both of which are related to reading. Specifically, working memory is broadly recognized as a predictor of reading comprehension, and visual attention is correlated with reading fluency. The current study sought to determine the potential utility of an adaptive, tablet-based measure of visual EF skills (Adaptive Cognitive Evaluation Explorer [ACE-X]) as a predictor of reading performance. ACE-X measures are adaptive, can be administered without a proctor, and take less time to complete, thus conferring some advantages relative to gold-standard measures of EF. Understanding the relationship between these measures and reading performance provides the opportunity to evaluate assessment tools that could eventually be useful for brief cognitive screening in education and healthcare settings. Our objective was therefore to explore relationships between ACE-X and reading performance in a sample of children with developmental dyslexia.

Methods: Sixty nine participants aged 7 – 17 (M= 11.5, SD= 2.24) with dD completed standardized measures of reading performance and ACE-X. Five ACE-X tasks were included: visual working memory (Spatial Span Forward and Backward), selective attention and interference (Posner cueing paradigm, Flanker), and visual search (Treisman and Gelade paradigm). The assessment of reading performance included timed sight word reading (TOWRE-2 Sight Word Efficiency), timed decoding (TOWRE-2 Phonemic Decoding Efficiency), and two scores from a paragraph reading task (GORT-5 Comprehension and Accuracy). Pairwise correlations were performed and highly correlated variables were combined into composite scores. Multiple

regression analysis was performed to explore the predictive value of the ACE-X measures on reading performance, covarying for age and gender.

Results: Within ACE-X, measures of selective attention, interference, and visual search were highly correlated (r=0.7-0.79, ps < .01) and were combined into a single EF composite. Reading subtests were also highly correlated (r=0.69-0.86, ps < .01) and were combined into a reading composite. The regression model thus included Spatial Span Forward, Spatial Span Backward, and the EF composite as independent variables, with age and gender as covariates, and the reading composite as the dependent variable. The model revealed a significant positive effect of EF composite on reading performance (β = 11.21, 95% CI 1.66-20.77, p = 0.02). In a stepwise regression analysis, the EF composite and age were retained as significant predictors. The ACE-X visual working memory tasks were not significant predictors of reading performance.

Discussion: This study supports the potential utility of an adaptive tablet-based measure of visual executive functioning in children with dD. In particular, visual aspects of EF, including selective attention, interference, and visual search, are important cognitive correlates to consider when characterizing reading difficulties. Future directions include validation of ACE-X tasks with standardized neuropsychological measures and more detailed characterization of relationships with specific reading outcomes.

S132. FATHER'S ACCEPTANCE AND YOUTHS' SUICIDAL THOUGHTS VIA INTERNALIZING PROBLEMS: THE MODERATING EFFECT OF SALIENCE NETWORK-AMYGDALA CONNECTIVITY

Anna Grossman*[1], Cullin Howard[1], Avary Evans[1], Linhao Zhang[1], Geoffrey Brown[1], Charles Geier[1], Assaf Oshri[1]

[1]University of Georgia

Background: Adolescent suicide rates are steadily increasing in the US. Less is known on the parenting effects and its interactions with neural network risk in the developmental etiology of suicide risk. Scarce longitudinal data exists on the unique influence of fathers' versus mothers' parenting behaviors on the development of suicidal thoughts, nor the neurocognitive processes that underlie youths susceptibility to their family context. The present study examined the longitudinal impact of mother and father acceptance on youth internalizing problems and suicidal thoughts. Because of the established association between internalizing symptoms and subcortical areas linked to emotional salience (e.g., connectivity between salience network and amygdala) we tested resting state functional connectivity between the salience network and the amygdala (rsFC-SAmyg) as moderator to sensitivity for parental acceptance.

Methods: Data from 8,094 youths were obtained from the ABCD 5.0 data release (MT1age = 9.93 years, 48% female). At W1, youths self-reported their mothers' and fathers' acceptance (CRPBI) and completed an fMRI brain scan to measure resting state functional connectivity patterns among neural networks. Parents reported their child's internalizing symptoms (CBCL), and youths reported if they experienced suicidal thoughts at W1, W3, and W5. Structural equation modeling was used to test the hypotheses via moderated mediation path analysis with mother and father pathways included simultaneously. The moderated path's directionality and region of significance were probed using the Johnson Neyman approach.

Results: Path analysis estimates indicated that only father's acceptance was associated with decreases in youth internalizing symptoms over the next year, which, in turn, was linked to decreased reports of suicidal thoughts over the two-year study period (FatherAcceptance (W1) - > Internalizing (W3) - > SuicidalThoughts (W5) = -.01, 95% CI [-.01, .00]). Furthermore, the influence of father's acceptance on W3 youth internalizing symptoms was moderated by the strength of connectivity between the salience network and the right amygdala at rest. This effect was such that rsFC-SaAmyg became weaker and father acceptance's protective effect on youth internalizing problems became stronger. As the connectivity between these regions increased the protective effect of paternal acceptance on internalizing problems weakened.
Discussion: This study demonstrates both the unique role that father's acceptance has in promoting mental health throughout early adolescence and the neurodevelopmental activation patterns that cause parenting to differentially impact youths. These findings emphasize the need to consider neurocognitive mechanisms, such as rs-FC-SAmyg) when evaluating the protective effects of paternal relationships. Further research is needed to explore the unique protective role of father-child relationships in reducing internalizing problems and suicide risk among adolescents.

S133. STRESS SENSITIVITY, SLEEP IRREGULARITY, AND DEPRESSIVE SYMPTOMS IN ADOLESCENTS

Kira Pawletko*[1], Kendall C. Parks[1], Jessica P. Uy[1], Ian H. Gotlib[1]
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Background: Adolescence is a critical developmental period of risk for depressive symptoms, which are influenced by multiple factors, including irregular sleep patterns and exposure to early life stress. Although sleep variability and stress sensitivity, independently, have been associated with depressive symptoms in adolescents, the interactions among sleep variability, stress sensitivity, and depressive symptoms — and specifically whether sleep variability mediates the relation between stress sensitivity and depressive symptoms, and whether stress sensitivity moderates the effect of sleep variability on depressive symptoms — have not been examined. The aim of this study is to explore these interactions to advance our understanding of factors that contribute to adolescent depression.
Methods: We analyzed data from 133 adolescents (mean age 15.48 years +/-1.18; 53M/80F) enrolled in an ongoing longitudinal study of the effects of exposure to early life stress on the development of psychopathology. Stress sensitivity was operationalized as the residual variance in the severity of subjective stress after accounting for the severity of objective stress assessed using the UCLA Stress Interview administered at entry to the study, at ages 9-13 years. Variability of sleep duration was quantified using the standard deviation of sleep time duration across 14 days of actigraphy data obtained when the participants were 13-15 years of age. At this time depressive symptoms were also measured using the Children's Depression Inventory. Pearson's correlations were computed to examine relations among the variables. Mediation analysis tested whether sleep duration variability mediated the relation between stress sensitivity and depressive symptoms. Moderation analyses were then conducted using multiple regression and simple slopes analyses to probe the possible moderating effect of stress sensitivity on the association of sleep duration variability with depressive symptoms. All analyses controlled for participants' age at entry to the study, sex, race, and family socioeconomic status.

Results: Although stress sensitivity and sleep duration variability positively related to depressive symptoms (r=0.18, p=.041; r=0.23, p < .005), sleep duration variability did not mediate this association (indirect effect=0.04, SE=0.14, 95% CI: [-0.26,0.31]). However, stress sensitivity moderated the significant relation between sleep duration variability and depressive symptoms (B= -0.04, SE=0.02, t(124) = -2.1, p= .045). Simple slope analyses indicated that for adolescents with low stress sensitivity, greater sleep duration variability predicted significantly higher depressive symptoms (B=0.05, SE=0.01, t=3.23, p < 0.001); in contrast, for adolescents with high stress sensitivity, sleep duration variability did not predict depressive symptoms (B=0.01, SE=0.01, t=0.85, p=.4).

Discussion: While both stress sensitivity and sleep variability were independently related to depressive symptoms, sleep duration variability was not significantly associated with stress sensitivity, thus not supporting the mediation model. However, stress sensitivity moderated the association of sleep variability with depressive symptoms, such that the positive association between sleep variability and depressive symptoms was stronger among adolescents with lower stress sensitivity, whereas this association was weaker and not significant among adolescents with high stress sensitivity. These findings suggest that it will be beneficial to promote consistent sleep patterns to decrease depressive symptoms for adolescents who are low in stress sensitivity as they appear more susceptible to the negative effects of sleep variability. Further research is needed, however, to identify interventions that may be effective for adolescents with high stress sensitivity who may require targeted strategies beyond sleep regulation to address their risk for depression.

S134. CHANGES IN MYELINATION OF THE HUMAN BRAIN FROM CHILDHOOD THROUGH EARLY ADULTHOOD IN PEOPLE WITH RARE 7Q11.23 COPY NUMBER VARIATIONS AS MEASURED WITH QUANTITATIVE MYELIN WATER IMAGING

Anna Kelemen*[1], Tiffany A. Nash[1], Shane Kippenhan[1], Michael D. Gregory[1], Caroline B. Raymond[1], Ariana S. Chavannes[1], Madeline H. Garvey[1], Philip D. Kohn[1], Daniel P. Eisenberg[1], Shau-Ming Wei[1], Carolyn B. Mervis[2], Karen F. Berman[1]

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Background: Williams Syndrome (WS) is a rare genetic disorder that results from a hemideletion of approximately 26 genes at chromosomal locus 7q11.23, leaving one copy of affected genes, and presents with a distinct neurobehavioral profile including challenges in visuospatial construction and “hypersociability” (i.e., increased social drive and outgoing personality). In contrast, those with 7q11.23 duplication syndrome (Dup7) have three copies of these same genes (instead of the two copies in typically developing individuals) and have contrasting neurobehavioral traits including relatively intact visuospatial skills and marked shyness and heightened social anxiety. In WS, structural and functional alterations have been identified in brain regions underlying visuospatial processing and social behavior, although more work is needed to explore the effects of gene copy number variation (CNV) across both WS and Dup7. Myelination has been shown to be altered in WS, and one of the affected genes in the 7q11.23 critical region, GTF2I, has been linked to myelination in mouse models. However, the impact of 7q11.23 CNVs myelin in the developing human brain remains unknown. Here, we used cutting-edge magnetic resonance

imaging (MRI) techniques to quantify myelin content in the brains of individuals with WS and 7q11.23 Dup7, and in typically developing controls.
Methods: Longitudinal neuroimaging was performed with a GE 3T MR750 scanner for a total of 209 longitudinal visits of 65 participants: 19 participants with WS (48 cumulative visits; age range= 7-24 years, mean= 15.4 ± 4.7 years; four males), 13 with Dup7 (26 visits, age range= 8-21 years; mean age= 14.4 ± 3.4, six males), and 33 unrelated typically-developing children ([TDs]; 135 visits, age range= 6-22 years, mean age= 15.1 ± 2.4; 10 males). For each participant, Multi-component Driven Equilibrium Single Pulse Observation of T1 and T2 (mcDESPOT) MRI sequences were used to calculate myelin water fraction (MWF) maps in vivo via an irSPGR image, 8 flip angles of Spoiled Gradient-Recalled Echo (SPGR) images, and 8 flip angles of Steady State Free Precession (SSFP) images at phases 0° and 180°. After spatial normalization to a study-specific template, voxelwise linear mixed-effects modeling tested for associations of MWF with 7q11.23 copy number ($p < 0.001$, $q < 0.005$), controlling for both age and sex.
Results: An increase in the copy number of genes at the 7q11.23 locus was associated with higher MWF values throughout the brain. Specifically, participants with Dup7 who have three copies of 7q11.23 exhibited the highest MWF values, followed by typically developing children with two copies, and then by those with WS having one copy of 7q11.23 who had the lowest MWF values. This step-wise, gene-dosage related pattern was consistent across several key white matter tracts in the brain, including the corpus callosum, bilateral inferior longitudinal fasciculus, inferior fronto-occipital fasciculus, forceps major, and external capsule. No associations were observed in the opposite direction (WS > TD > Dup7).
Discussion: Here, we identify white-matter tracts where 7q11.23 copy number variations modulate myelin content during adolescence. The directionality of these findings (Dup7 > TD > WS) is consistent with the hypothesized effects of the GTF2I gene to promote myelination, as an increase in the number of copies of the 7q11.23 CNVs was associated with a higher myelin content. Moreover, the identified white-matter tracts are known to subserve functions that underpin the neurobehavioral profiles of the two CNV syndromes. Further work will explore how these myelin alterations may correspond to the neurobehavioral profiles of people with Williams syndrome and 7q11.23 duplication syndrome.

Poster Session II
Sunday, September 29
5:30 p.m. – 7:00 p.m.

SU1. AMYGDALA FUNCTIONAL NETWORK CONNECTIVITY CHANGES RELATED TO INTERNALIZING SYMPTOMATOLOGY ACROSS CHILDHOOD AND ADOLESCENCE

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[1]University of Minnesota, [2]Earlham College, [3]Charité – Universitätsmedizin Berlin, [4]University of California, Irvine, [5]Oregon Health Science University

Background: Increased internalizing symptoms in childhood and adolescence have been associated with future psychological disorder onset (Rueter et al., 1999), substance misuse (Hussong et al., 2011; Meque et al., 2019), suicidality (Berny and Tanner-Smith, 2022; El-Hourani et al., 2022; Piqueras et al., 2019; Thompson et al., 2024). These symptoms have been associated with amygdala functional connectivity at various developmental stages (Chahal et al., 2021; Herringa et al., 2016; Qin et al., 2014; Rogers et al., 2017), which may differ by sex (Burghy et al., 2012; Padgaonkar et al., 2020) and can be modulated with treatment (Venta et al., 2018). Much work has focused specifically on amygdala-prefrontal cortex circuity. However, given that internalizing symptomology represents an amalgamation of complex cognitive processes, a whole brain approach may yield a more nuanced picture of the longitudinal changes in amygdala network connectivity that may play a role in the development of internalizing symptoms across childhood and adolescence.

Methods: We used high-quality data from a large sample representative of the US population (the Adolescent Brain Cognitive Development, ABCD, study, N=6900, age 9-11) to derive reproducible brain-behavior associations (Byington et al., 2023) related to internalizing symptomatology (IS). Resulting models were used to calculate brain scores of IS in independent samples with individuals of different ages. To do this, we used subjects from the Oregon ADHD 1000, Baby Connectome Project (BCP), and a study at the University of California – Irvine (UCI). First, the resting state functional connectivity of 6900 subjects from ABCD was parcellated according to the regions of interest designated by Gordon et al. (2016). Then, the correlation of the left amygdala with each other brain cortical and subcortical region was calculated. The resulting 351 connections were grouped into 14 networks as defined in Fig. 1A. B-weights were generated by modeling the CBCL internalizing raw score as the weighted contribution of each connection when controlling for collection site, gender, race, and ethnicity (Figure 1B). The B-weights were used to calculate polyneuro risk scores (PNRS, predicted scores of IS given connectivity) by network in 54 1-month-olds in the UCI study, 90 18-60-month-olds in the BCP, and 52 typically developing 11-18-year-olds in the ADHD 1000. In addition, we calculated PNRS for the ABCD sample using a split half approach, where one half of the ABCD subjects were used as the training sample to generate PNRS in the other half and vice versa. Differences in brain scores by network and cohort were tested via ANOVA using aggregated data from all four samples, including the interaction between network and cohort. Finally, linear regressions were run on the connectivity and PNRS scores by network to examine continuous age-related changes.

Results: Results of the ANOVA indicate that there is a significant difference in means by network ($F = 1671.94$, $p = < 0.001$) and an interaction between cohort and network ($F = 15.94$, $p < 0.001$). Thus, network PNRS means are different from one another, and mean scores differ by network across cohorts, indicating age related change in amygdala connectivity. Generally, scores across networks become more negative and amygdala connectivity increases over time, indicating that increased amygdala connectivity to other regions results in lower scores as children get older. These transitions are denoted in Figures 2 (top panel) and 3. In particular, the salience (Sal) and retrosplenial-temporal (ReT) networks appear to make notable transitions from early childhood to adolescence.

Discussion: The results yield evidence that changes in network connectivity to the left amygdala are associated with changes in internalizing symptoms from infancy to adolescence. Further

inquiry into the ways in which the Sal and ReT networks differentially modulate internalizing symptoms across childhood is needed.

SU2. SOCIOECONOMICS: THE ELEPHANT IN THE DEVELOPING BRAIN

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Background: Adolescence is a unique period of lifespan, where there is not only an increased surge of risk-taking behavior and cognitive ability but also the emergence of many psychiatric disorders. Beyond behavior, brain function – commonly measured using resting-state functional connectivity (RSFC) to describe the correlation patterns of the spontaneous fluctuations across brain areas – also exhibits protracted development throughout adolescence. In work from our lab currently in revision, we found that socioeconomic opportunity (SES) had the largest association with brain function across 649 variables. SES comprised the dominant factor detectable in childhood brain organization, subsuming variables previously argued to be primary neurobiological traits, such as general intelligence. Hence, our main goal is to investigate the development trajectory of adolescents of RSFC as a function of SES.
Methods: We used baseline and Year 2 RSFC data from an independent Discovery (N=1,140) and Replication (N=1,080) ABCD Study dataset as a brain development indicator and the corresponding Childhood Opportunity Index (COI), which is a single z-score composite measure of the neighborhood's quality of conditions and resources that are integral to children's healthy lives, as an SES indicator. We first median split RSFC data in both the Discovery and Replication sets to explore the brain development differences between individuals with high and low SES across two time points. We computed univariate association and variance tests between all brain connectivity features and neighborhood-level SES. Next, each participant's correlation matrix is vectorized and concatenated across all individuals and submitted to principal component analysis (PCA). Finally, the principal components are compared and statistically analyzed using ANOVA between high and low SES groups for both time points.
Results: A stable and reproducible pattern was shown in RSFC's robust association with SES across both time points ($r = 0.71$). Brain regions most strongly associated with SES were in sensorimotor networks, salience regions, and the recently discovered somato-cognitive action network. There was also evidence for a non-linear effect, where individuals with lower SES levels have stronger correlations between RSFC and SES compared to individuals from higher SES backgrounds ($p = 0$). Additionally, RSFC differences between individuals from low and high SES backgrounds remained stable across the two time points.
Discussion: This study provided evidence for reproducible associations between brain function and neighborhood-level SES. Therefore, it should serve as a basis to establish more coherent relations between adolescent brain development and other life factors at both whole-brain and network-parcellation levels. Since we have preliminarily observed how SES could affect brain development's relation with other factors, and that SES was a predominant factor that could underlie many other relations, by precisely approximating and predicting the trajectory between SES and brain development, we can regress this factor out of future analyses to eventually identify what factor matters the most for a developing brain and adolescent outcomes.

SU3. FUNCTIONAL NETWORK ORGANIZATION PREDICTS VERBAL ABILITY IN EARLY ADOLESCENCE

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Background: Given its central role in human interaction, altered development of verbal ability - the capacity to understand, interpret, and generate language effectively - can have life-long, wide-ranging impacts for individuals. Individual differences in verbal ability may be reflected in individual differences in the functional organization of the brain. The dense sampling of fMRI data from individuals using precision functional mapping (PFM) is required to accurately characterize regions of high inter-individual variability of functional networks, while thousands of individuals are required to reliably associate brain function to behavior.

Methods: The current work combines these two approaches to determine if regions of high inter-individual variability (cortical network variants) in functional brain networks predict individual differences in verbal ability in a sample of 11-13 year olds from the Adolescent Brain Cognitive Development (ABCD) Study (n = 2713, M = 12.01 years, SD = 0.65 years). First, regions of high inter-individual variability were identified using a child PFM dataset (n = 12, ages 8-12). Neurosynth was used to examine meta-analytic associations between terms and these regions, which revealed that activity in these regions have previously been associated with language. We then computed the Fisher z-transformed correlation between the resting-state fMRI timecourses of 15 regions of high inter-individual variability and the mean timecourse of 14 large-scale functional brain networks (defined using an ABCD group average) for each adolescent in the selected ABCD sample and related those values to measures of verbal ability.

Results: Our results show that functional connectivity between the left posterior cingulate cortex and the retrosplenial temporal network is a positive predictor of receptive vocabulary immediately and two years post-imaging, after adjusting for demographic and socioeconomic factors. These relationships remained significant in mixed-effects linear regression models controlling for age, sex, handedness, components of genetic ancestry, study site, income-to-needs ratio, and the ability to speak multiple languages (with family as a random effect). Additionally, at the initial scanning time point and two years following fMRI data collection, functional connectivity between regions of bilateral posterior middle temporal gyrus (areas typically active in language processing) and the default mode network was positively correlated with receptive vocabulary skills. In contrast, connectivity to the cingulo-opercular/action-mode and dorsal attention networks was inversely related to these skills.

Discussion: Our analysis suggests that connectivity between the posterior cingulate cortex (a region exhibiting high variability in connectivity between individuals) and the retrosplenial temporal network influences verbal ability, which merits further investigation. Our results also suggest that deactivation of networks associated with action planning and top-down visuospatial attention during language processing may facilitate verbal ability. These findings deepen our understanding of the neural mechanisms underlying verbal ability and may guide the development of tailored, biologically-based interventions to enhance language skills.

SU4. A LARGE-SCALE INVESTIGATION OF RESTING-STATE ALTERATIONS ASSOCIATED WITH AUTISM AND ATTENTION DEFICIT/HYPERACTIVITY DISORDER TRAITS AND DIAGNOSIS

Luke Norman*[1], Gustavo Sudre[2], Marine Bouyssi-Kobar[1], Jenny Jean[1], Tonya White[1], Philip Shaw[2]

[1]National Institute of Mental Health, [2]National Human Genome Research Institute**Background:** Autism Spectrum Disorder (autism) and Attention Deficit/Hyperactivity Disorder (ADHD) often coexist, which complicates the understanding of the neural basis of each condition. In this study, we conducted a large-scale comparison of functional connectivity patterns related to autism, ADHD, and their respective traits, focusing on differentiating the alterations unique to each condition from those that are shared.

Methods: Data were pooled from several datasets using mixed-model mega-analytic modeling (N=12,364). A substantial subset (n=10,128) was evaluated for traits associated with both autism and ADHD, utilizing the Social Responsiveness Scale and the Child Behavior Checklist. We conducted statistical comparisons of mixed-model coefficients for autism and ADHD traits to identify unique and shared network associations. Subsequent categorical analyses investigated whether similar patterns persisted when modeling autism (n=690 cases; n=822 controls) and ADHD (n=2078 cases; n=2289 controls) based on clinical diagnoses.

Results: Autism traits and diagnosis were linked to reduced connectivity between the thalamus (d=-0.13, p=0.01), putamen (d=-0.16, p=0.002), and the frontoparietal network. Increased connectivity between the default mode and dorsal attention networks was noted in both autism (d=0.18, $p < 0.001$) and ADHD (d=0.11, $p < 0.001$) compared to controls, but this was specifically associated with ADHD traits (partial-r=0.05, $p < 0.001$). These principal findings persisted in motion-matched sub-samples and after adjusting for key demographic factors and comorbid symptoms.

Discussion: Despite their common co-occurance, autism and ADHD were linked to distinct alterations in neural connectivity, including opposing patterns of subcortico-cortical connectivity and condition-specific alterations in connectivity involving the default mode network. Furthermore, our findings suggest that the previously observed heightened connectivity between default mode and task-positive networks in autism might be attributable to highly comorbid ADHD traits. However, effect sizes were consistently small, indicating subtle associations.

SU5. DOES FRONTOSTRIATAL FUNCTIONAL CONNECTIVITY MEDIATE THE RELATIONSHIP BETWEEN EARLY LIFE ADVERSITY AND DISORDERED EATING?

Gabriella Atencio*[1], Zsofia Cohen[1], Courtney Cooper[1], Florence Breslin[2], Kara Kerr[1]

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Background: There is an established a link between early life adversity (ELA) and disordered eating (DE), demonstrated by a dose-response relationship between the number of adversities experienced and eating disorder symptoms. DE has been linked to reward sensitivity and impulsivity in adolescence. It has been suggested that DE occurs subclinically during preadolescence (ages 10-11 years), which prompts the investigation of DE in younger samples. The frontostriatal network (e.g., prefrontal cortex, orbitofrontal cortex, nucleus accumbens

(NAcc)) has been identified as a critical neural circuit involved in DE due to its involvement in inhibitory control and reward processing. The present study examined if resting-state functional connectivity (RSFC) between the NAcc and the frontoparietal network (FPN) mediates the relationship between ELA and DE. FPN RSFC is available in the tabulated imaging data from the Adolescent Brain Cognitive DevelopmentSM Study (ABCD) dataset, including brain areas that are salient in inhibitory control and reward processing. The NAcc-FPN connection is of interest due to its involvement in reward processing and cognitive control during early adolescence.

Hypotheses: We hypothesized that 1) ELA will predict RSFC between the NAcc-FPN, 2) RSFC between the NAcc-FPN will negatively predict DE, and 3) that the relationship between ELA and DE will be mediated by RSFC between the NAcc-FPN.

Methods: We conducted secondary data analysis of the ABCD dataset (Data Release 5.1). ELA was examined at Baseline (ages 9-10 years) according to the adverse childhood experiences model presented in Karcher et al. (2020) with items on the Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS) and ABCD Longitudinal Parent Demographics Survey. Resting-state fMRI data of the NAcc-FPN connectivity was taken from the tabulated data at Baseline (ages 9-10). We calculated DE via the youth-reported K-SADS in Year 2 (ages 11-12) via items assessing psychological (i.e., "self-worth tied to weight") and behavioral (i.e., "inappropriate compensatory behaviors to prevent weight gain") symptoms. The number of DE items endorsed were summed to create a composite score. R packages lme4 and mediate were used to test the models for mediation. Covariates for the mediation models included age, sex assigned at birth, race/ethnicity, and scanner ID, with random effects for family ID.

Results: We found a significant direct effect between ELA and DE ($b = 0.0429$, 95% CI [0.0255, 0.06], $p < 0.001$; $b = 0.0424$, 95% CI [0.0258, 0.06], $p < 0.001$). We also found significant total effects in both the left ($b = 0.0429$, 95% CI [0.0251, 0.06], $p < 0.001$) and right NAcc-FPN ($b = 0.0425$, 95% CI [0.0258, 0.06], $p < 0.001$) models. RSFC was not found to be a significant mediator for the relationships between ELA and DE for either the left ($\beta = 0.0000$, 95% CI [-0.0003, 0.0000], $p = .85$) or right NAcc-FPN ($\beta = 0.0000$, 95% CI [-0.0002, 0.0000], $p = .78$) functional circuits. These findings suggest that RSFC between the NAcc-FPN specifically, is not a significant mechanism underpinning the relationship between exposure to early adversity and DE.

Discussion: Given the large sample size, this study provides evidence that NAcc-FPN RSFC at ages 9-10 does not mediate the relationship between ELA at ages 9-10 and DE at ages 11-12. Pending the Data Release 6.0, the model will be repeated at Years 3 and 4, when K-SADS DE symptoms are available for these later ages. Future longitudinal analyses may further elucidate the relationships between ELA, DE symptoms, and frontostriatal functional connectivity.

SU6. NEURAL FACTORS THAT CONTRIBUTE TO THE DEVELOPMENT OF VISUAL WORD FORM AREA (VWFA) LATERALITY DURING EARLY CHILDHOOD AND RELEVANCE FOR READING BEHAVIOR

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Background: Human ventral temporal cortex (VTC) contains a variety of areas that show category selectivity for specific visual stimuli like scenes, words, faces, and objects. The Visual Word Form Area (VWFA) is specialized for written scripts, developing only after literacy. Interestingly, this

word selectivity is dominant on the left, unlike e.g. face selectivity which is dominant on the right. What drives the emergence of this functional asymmetry over development? Here we tested four potential sources of this word laterality: 1) the development of face laterality, 2) laterality of the high-level language network in frontal and temporal cortices, 3) ipsilateral structural connectivity with these language regions, and 4) cross-hemispheric structural connectivity.

Methods: We scanned children (3-12 years, prereaders and readers) on an fMRI task to extract functional activation to visual words and faces, as well as a separate auditory fMRI task to localize the frontotemporal language network, and collected diffusion-weighted imaging (DWI) to examine white matter connectivity. Face, word, and (oral) language subject-specific regions were defined, and independent runs were used to extract activation to each condition to calculate selectivity and laterality; probabilistic tractography was used to quantify connections between these regions.

Results: 1) We found that while face selectivity became increasingly right-lateralized with age, it was not related to VWFA laterality; additionally, VWFA laterality was not correlated with age. 2) We found that higher left laterality of frontal (but not temporal) language regions was correlated with higher left laterality of the VWFA. Further, we revealed that this co-lateralization might be enabled by the underlying structural connectivity: 3) in children who were scanned longitudinally, we found that the VWFA's connectivity to ipsilateral left frontal (but not temporal) language regions at an earlier time point significantly predicted VWFA laterality at the later time point. 4) We next explored the potential role of cross-hemispheric VWFA connectivity in shaping laterality. Interestingly, we found that stronger inter-hemispheric connectivity predicted stronger VWFA laterality on the left. Combining laterality of frontal language regions, VWFA connectivity to frontal language, and cross-hemispheric connectivity in a linear model explained over 55% of the variance in VWFA laterality. Finally, combining connectivity and laterality of written and spoken language significantly predicted reading ability in children.

Discussion: In sum, our study tried to tease out the underlying factors that contribute to VWFA lateralization and their behavioral relevance for reading. Our results demonstrate how functional specialization of the high-level language network and its connectivity with visual cortex contribute to changes in laterality of high-level visual cortex, and especially highlight the role of both cross-hemispheric and ipsilateral white matter connectivity in facilitating functional lateralization. Exploring the development of VWFA laterality is critically relevant for understanding the neural correlates of reading acquisition and can pave the way for future research related to education and reading impairment.

SU7. DIFFERENTIAL ANTERIOR VS. POSTERIOR HIPPOCAMPAL FUNCTIONAL CONNECTIVITY REFLECTS CHANGES IN MEMORY CONSOLIDATION OVER TIME IN MIDDLE CHILDHOOD.

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Background: In middle childhood, there is pronounced development in the differentiated patterns of hippocampal functionality along the anterior-posterior dimensions. Structurally they are related to different memory aspects. However, little is known how differentiated functional connectivity of anterior-posterior hippocampus with other brain regions changes as memories pass through time.

Methods: For this purpose, we examined time-related changes in hippocampal functional connectivity in 5-to-7-year-old children (n = 49) during memory retrieval of object-scene association same day after learning (immediate delay), after one night of sleep (short delay), and after two weeks (long delay). We applied functional magnetic resonance imaging and functional connectivity analysis.
Results: Our results showed that over time anterior hippocampus showed increased functional connectivity with the precuneous, occipital cortex, middle frontal gyrus, and cerebellum, suggesting integrative role of anterior hippocampus in linking contextual and sensory aspects of memories as time passes. Conversely, posterior hippocampus showed increased connectivity with inferior and middle frontal gyrus, and parietal operculum cortex, while connectivity with occipital cortex and cerebellum decreased. This suggests that the role of posterior hippocampus extends towards integrating visuo-spatial aspects of memory with memory control processes over time. This differentiated functional connectivity highlights the specialized roles of hippocampal subregions in memory processing in middle childhood.
Discussion: Our results highlight dynamic changes between the anterior/posterior hippocampus and various cortical and subcortical regions in the processing of remote versus recent memories. This can contribute to our understanding of memory consolidation, the temporal dynamics of memory retrieval, and the hippocampal role in linking memories across time and space in middle childhood.

SU8. NUCLEI-SPECIFIC FUNCTIONAL MATURATION OF FRONTO-AMYGDALA CIRCUITRY THROUGH ADOLESCENCE: LONGITUDINAL INSIGHTS FROM 7 TESLA FMRI

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Background: Fronto-amygdala circuitry, crucial for cognitive and emotional processing, undergoes protracted development throughout adolescence. Previous studies show mixed findings as to the shape and direction of neurodevelopmental trajectories of fronto-amygdala maturation, which may be in part due to the amygdala's diverse nuclei, which have unique functions and developmental trajectories.
Methods: We leveraged 7T high-resolution neuroimaging data to identify amygdala nuclei and their functional connectivity across prefrontal (PFC) regions in 156 10-25-year-olds, assessed longitudinally (221 visits), during rest (8min) and when engaged in a cognitive task (with task effects regressed out). We use generalized additive mixed models (GAMMs) to capture non-linear age-related developmental trajectories and applied Bonferroni corrections to control for multiple comparisons. Connections that showed changes with age were further interrogated using cognitive domain mapping to identify their specific function.
Results: The functional connectivity of most amygdala nuclei to PFC regions did not show a significant association with age. Only connectivity between the cortico-amygdala transition area (CAT) and the subgenual/ventral anterior cingulate cortex (ACC) as well as with the lateral PFC, showed age related effects reflected in a U-shaped developmental trajectory. Seed-based connectivity indicated that this circuitry is associated with monitoring internal states (pain, eating,

and anxiety). Finally, U-shaped CAT connectivity with the dorsolateral PFC and ventral ACC was associated with higher externalizing features while low externalizing showed increases with age.
Discussion: Together, results suggest that maturation of fronto-amygdala connectivity is largely in place by adolescence except for functional connectivity between the CAT nucleus and PFC showing a trough in adolescence possibly underlying immaturities in the ability to monitor internal states, which may be more predominant with increasing normative externalizing features. Overall, this connectivity strengthens into adulthood supporting greater executive integration of CAT processing supporting mature processing of internal states.

SU9. LONGITUDINAL FUNCTIONAL BRAIN NETWORK DEVELOPMENT IN PRETERM AND AT-TERM NEONATES

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Background: The human brain undergoes rapid growth during the first years of life. Premature infants, born before 37 weeks of gestation can have consequences on development, even when no anatomical lesions are evident (Rogers et al.,2018). Resting state functional (MRI) naturally sleeping babies allows the characterization of the brain functional connectome, showing decreased long-range connectivity (Smyser et al., 2010). Preterm infants have shown alterations in connectivity measures globally and in specific networks (Gozdas et al., 2018). In this work, we characterize the developmental trajectories in the functional brain network in preterm and at-term neonates.
Methods: We included 369 preprocessed structural/functional datasets from the developing Human Connectome Project (Hughes et al., 2017), acquired between 26 -44 weeks of postmenstrual age (PMA) and with no radiological signs of white matter lesions. For each subject, we estimated the connectivity matrix as the correlation of the BOLD time series between all possible pairs of the 90 regions within the neonate AAL atlas (Shi et al., 2011). Subsequently, these matrices were thresholded to keep only the ten percent of the highest connections. From these thresholded matrices, we computed graph theory measures as clustering coefficient, node strength, global efficiency and shortest path length, using the Brain Connectivity Toolbox. To characterize the developmental trajectories of the network properties here explored, linear, quadratic, and log-linear mixed models were constructed with gestational age at scan as an independent fixed-effect variable. Random effects were added for the intercept and subject ID. Significance was defined as $p < 0.05$, and the model with the lowest Akaike Information Criterion (AIC) was selected as the best model to describe the data.
Results: The best-fitting models showed non-linear trajectories for all the properties in preterm neonates and two of them in at-term neonates. When comparing by sex, significant differences emerged. Female infants at-term age exhibited increased connectivity in node strength ($p < 0.01$, β=0.224857), characteristic path length ($p < 0.008$, β=-0.20133), and global efficiency ($p < 0.02$, β =0.018133). Meanwhile, preterm females showed heightened connectivity in clustering coefficient ($p < 0.01$,β= 0.03140), node strength ($p < 0.003$, β =0.8637), and global efficiency ($p < 0.008$, β=0.06585).
Discussion: Overall, our results confirm that functional brain network integration and segregation properties of the preterm brain follow nonlinear trajectories with a clear sexual dimorphism.

SU10. EFFECTS OF MATERNAL CHILDHOOD MALTREATMENT EXPOSURE ON WHITE MATTER INTEGRITY IN YOUNG CHILDREN

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Background: Childhood exposure to trauma, such as neglect and abuse, is pervasive and far-reaching in its adverse effects on various biological, psychological, and behavioral outcomes (Van der Kolk, 2003). These consequences are shown to endure throughout an individual's lifespan (Bhutta et al., 2023), and emerging evidence suggests that the impact of trauma extends to subsequent generations (Zhang et al., 2023). Offspring of mothers who experienced childhood trauma, even in the absence of maltreatment themselves, are at greater risk for maladjustment and susceptibility to psychopathology (Lê-Scherban et al., 2018). However, our understanding of the specific mechanisms, particularly at the neurobiological level, through which this transmission occurs across generations remains unknown. There is limited research investigating the potential relationship of parental history of childhood abuse and neglect on its impact on the offspring brain (Hendrix et al., 2021; Khoury et al., 2022; Moog et al., 2018; Van Den Heuvel et al., 2023); however, no studies to date have harnessed insights from the preschool brain, a time of significant morphological change paralleling emerging higher cognitive functions.

Methods: The objective of this study was to examine the relationship between maternal childhood trauma exposure and preschool child white matter (WM) structure. Families with children 4-7 years (M = 5.05; SD = 0.85) were recruited from Head Start preschools and community centers. Caregivers completed the Childhood Trauma Questionnaire (CTQ), in addition to other measures of demographics and maternal mental health. Children completed diffusion tensor imaging (DTI) on a Siemens 3T Prisma MRI scanner. Diffusion data were preprocessed using a multistep procedure using FMRIB software library (FSL). Due to the motion often seen in the age of this sample, raw DTI data were visually inspected and volumes of extreme motion were removed. We employed diffusion tensor models to derive scalar DTI maps of fractional anisotropy (FA), a metric reflecting WM integrity, and obtained FA values for regions of interest (ROIs) from the Johns Hopkins University (JHU) white matter atlas. We used linear mixed-effects models to test whether CTQ was associated with mean FA of the ROIs.

Results: Our findings revealed that higher total maternal CTQ scores were associated with higher child FA in pontine crossing tract (PCT) and stria terminalis and lower FA in the fornix and posterior corona radiata. The type of abuse and neglect (i.e., physical, emotional, sexual) was revealed to have differential effects on specific tracts in a regional-dependent manner, such that emotional abuse was associated with higher FA in the PCT and lower FA in the fornix, emotional neglect was associated with higher FA in the cingulum, PCT, and uncinate fasciculus and lower FA in the fornix, physical neglect was associated with higher FA in the uncinate fasciculus, and sexual abuse was associated with higher FA in the stria terminalis. FA values of ROIs were not associated with maternal depression or anxiety, family income, or child gestational age.

Discussion: These results suggest that there may be an intergenerational adaptation for individuals who are forced to develop coping mechanisms to navigate challenging environments. As a result, there is an accelerated development in certain areas, such as neural circuits involved in emotional and stress processing, to cope more effectively with adverse circumstances. However, our findings also reveal less efficient development in circuitries that support higher cognitive abilities. These findings align with previous conceptual models proposing that adversity contributes to allostatic

load, consequently impeding neural development (McLaughlin et al., 2019), and that patterns of adversity exposure are regionally dependent (Gur et al., 2019). This study has implications for interventions targeting childhood maltreatment, in addition to enduring consequences for the next generation.

SU11. THE BUILDING BLOCKS OF VISION: CORTICAL AND SUBCORTICAL ORGANIZATION OF THE NEWBORN VISUAL SYSTEM

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Background: By understanding the anatomical and functional organization of the visual system at birth we may gain critical insights into the mechanisms that support early developing perceptual and cognitive abilities. In the current study, we used resting-state fMRI and diffusion tensor imaging (DTI) to understand the cortical and subcortical organization of the visual system in newborn human infants. We examined the extent to which the neonate visual system already exhibits an adult-like hierarchical organization, and whether there are developmental differences in the maturity of different visual areas. Furthermore, we examined the degree to which developmental motifs discovered in the connectivity of cortical visual areas were mirrored in the maturity of structural connections between each cortical area and the pulvinar – a subcortical structure that is extensively interconnected with the entire visual cortex in adults and plays a crucial role in visual processing (Arcaro et al., 2018).

Methods: We analyzed data from 100 randomly selected neonates (37-42 weeks gestation) from the developing human connectome project and compared them to a dataset of 30 adults (Arcaro et al., 2015; Benson et al., 2018). To identify putative visual areas in neonates, we registered an adult probabilistic atlas of retinotopic maps (Wang et al., 2015) to each neonate. Each neonate's cortical surface was registered to an adult cortical surface template and the adult probabilistic atlas was projected onto each neonate's cortical surface. Precision of the projection was evaluated by comparing the location of individual visual areas to known sulcal landmarks.

The maturity of cortico-cortical connectivity between visual areas was examined by conducting functional connectivity correlations between each visual area in a pairwise fashion, both within and across hemispheres, and comparing each connectivity pattern to adults. Pulvino-cortical connectivity was measured by conducting probabilistic tractography analysis to identify white matter pathways linking the visual cortex and the pulvinar in each neonate.

Results: Our results revealed that the newborn visual system already contains distinct visual areas (i.e., arealization), as evidenced by stronger cross-hemispheric correlations between homologous regions of visual cortex than adjacent regions. Furthermore, multi-dimensional scaling and cluster analysis of the functional correlations between visual areas revealed that these areas exhibit an adult-like hierarchical organization, with distinct clusters for regions of the occipital cortex, as well as ventral, lateral, and dorsal visual pathways. Direct comparisons of the connectivity patterns for each area in neonates and adults further revealed that correlation patterns within occipital and dorsal areas were more adult-like than ventral and lateral areas.

Probabilistic tractography analyses reliably identified white matter pathways between the pulvinar and each cortical visual area. These connections showed region-level specificity and overlapped with homologous pathways of adults. However, we found developmental differences within the fine-grained connectivity pattern of the pulvinar for each visual areas. Although the spatial

connectivity maps for occipital, lateral, and dorsal areas were similar to those of adults, the maps for ventral visual areas were immature and did not show strong specificity within the pulvinar.

Discussion: Altogether, our findings indicate that the large-scale anatomical and functional organization of the visual system is established by birth. However, they also revealed developmental differences in the maturity of different pathways with the dorsal pathway maturing earlier than the ventral pathway. This developmental differences between dorsal and ventral pathways may account for the early development of visuospatial abilities and the late development of visual feature perception in human infants (Xu and Carey, 1996).

SU12. DEVELOPMENTAL TRAJECTORY OF NETWORK-LEVEL FUNCTIONAL CONNECTIVITY FROM NEONATES TO 10-YEAR-OLDS

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Background: Studies on functional connectivity development during infancy have revealed dramatic synchronization of different functional networks during infancy, featuring sequential but interactive growth during the critical first years of life (Gao et al., 2017). However, how do different functional networks continue to develop throughout the entire childhood remains poorly studied. In this study, leveraging a longitudinal cohort of 609 subjects with multiple resting-state fMRI scans, we aim to delineate the longitudinal growth trajectories of nine different functional networks during the first ten years of life.

Methods: 609 subjects from the Early Brain Development Study (EBDS) with successful resting-state functional MRI (rsfMRI) scans on at least one of the seven timepoints (i.e., three-week (n=356), one-year (n=262), two-year (n=212), four-year (n=123), six-year(n=165), eight-year(n=153) and ten-year(n=148)) were retrospectively identified and included in this study. Only subjects with gestational age at birth > = 32 weeks and one of the twins were included. All rsfMRI datasets underwent standard preprocessing including global signal regression and scrubbing for motion correction. All datasets were registered to the same two-year-old template space for analysis (Shi et al., 2011). Subjects < =two years of age were at natural sleep while all later ages were awake (watching cartoons or fixed cross) during the rsfMRI scan.

Nine FC network masks (visual, somatomotor, dorsal attention, ventral attention, limbic, frontoparietal, default mode, amygdala, and hippocampus) were generated independently of the EBDS dataset. Among them, the first seven networks were warped to two-year-old template space from Yeo's seven network tight parcellation (Yeo et al., 2011) in adult space. Amygdala and hippocampus within the limbic networks were separately examined for specific understanding of their respective trajectories. These two seeds were generated from AAL-region-based group-level FC maps (using FC=0.1 as threshold) in Human Connectome Project (HCP) dataset (n=92), and then warped to two-year-old template space. Within-network FC of EBDS dataset were extracted as the mean of the voxel-wise correlation of rsfMRI timeseries within network mask for each subject at each time point. A novel multivariate sparse functional principal component analysis (mSFPCA; Jiang et al., 2022) method was applied to model the developmental trajectory of within-network FC along the gestational age at scan, which can model nine FC measurements simultaneously and report the overall mean curves as well as functional principal component (FPC) curves.

Results: Developmental trajectories of within-network FC for nine networks from neonates to 10-year-olds showed the overall mean curve obtained by mSFPCA, which captured the overall trend of FC for each network. All networks underwent dramatic synchronization from neonates to 1-year-olds except for somatomotor and amygdala which showed higher starting points followed by regressive trends afterwards. Overall, the 10-year growth trajectories roughly grouped into four categories: 1). Starting high followed by a regressive trend from birth (i.e., sensorimotor, amygdala); 2). Emerging and staying synchronized with little variations (i.e., dorsal attention, ventral attention); 3). Emerging followed by a regressive trend after 1 year of age (i.e., limbic, hippocampus); and 4). Emerging in the first year but with both regressive and progressive growths afterwards in later childhood (i.e., visual, default-mode, and frontoparietal control).
Discussion: To our knowledge, this study delineated the first set of functional network growth trajectories from neonates to 10-year-olds based on a longitudinal dataset of 609 subjects with 1419 datasets. Four distinct growth patterns were revealed suggesting network-specific growth trajectories during the first ten years of life. Inter-network connectivity development and behavioral implications will be studies as a next step.

SU13. READING-LEVEL DEPENDENT MODULATION OF NEURONAL TUNING FOR PRINT AFTER ARTIFICIAL LETTER TRAINING

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Background: Reading acquisition starts by associating speech sounds with the corresponding letters. While most people learn to read with ease, 5-10% of the population is affected by developmental dyslexia (DD) and shows difficulties in learning these associations. DD is characterized by aberrant visual text processing and deficient integration of speech sounds and the corresponding written characters. Processing text-like stimuli such as letter strings and false fonts is reflected in the visual N1 event-related potential (ERP ~150-250ms). The visual N1 has been associated with activation in the visual word form area (VWFA) of the left ventral occipito-temporal cortex. Previous studies suggest that grapheme-phoneme correspondence (GPC) learning initiates visual N1 responses to newly learned graphemes. In this study, we investigate the neural processing of trained and untrained false font characters and letters before and after a short (~20 min) artificial letter training (ALT) in school children using ERPs.
Methods: 93 native German-speaking children from 2nd and 3rd grade participated in the 128-channel EEG recordings before (pre) and after (post) an ALT and completed a visual one-back character repetition detection task. During the ALT, participants learned the associations between German speech sounds and unknown false font characters. Each run (pre and post) consisted of 6 blocks composed of 34 trials each (fixation cross ~700-1100ms followed by the stimulus presentation 600ms). Four stimulus types were presented in randomized order: letters (LET), visually familiar false fonts (FFF), control false fonts (CFF), and trained false fonts from the ALT (TFF). TFF, CFF, and FFF were presented pre ALT, while TFF, CFF, and LET were presented post ALT. EEG data was preprocessed using standard preprocessing to derive the ERPs. The mean ERP amplitudes of the visual N1 over left and right occipito-temporal (LOT, ROT) and middle occipital electrode clusters (MO) were analyzed in RStudio. A Linear mixed model (LMM) was computed for the mean N1 amplitudes with the fixed factors condition (TFF, CFF, FFF, LET),

time (pre, post), electrode cluster (LOT, ROT, MO), reading score (standardized word and pseudoword reading and sentence comprehension scores), the covariate age, and a random intercept for the subjects. Post-hoc tests were conducted using Tukey's HSD test.
Results: The LMM revealed a significant interaction of condition, time, and reading score ($F(5, 1504.49) = 4.7552$, $p < .001$) and significant main effects of age ($F(1, 90.59) = 5.81$, $p = 0.018$), electrode cluster ($F(2, 1503.08) = 14.78$, $p < .001$), and condition ($F(3, 1504.89) = 11.01$, $p < .001$). This analysis pointed to a bilateral N1 distribution with lower amplitudes over the MO compared to LOT ($p < 0.001$) and ROT ($p = 0.001$) clusters. Condition-wise post-hoc analyses revealed significant N1 amplitude differences between stimulus types for LET and CFF (pre and post, ps < 0.001), LET and FFF ($p < 0.001$), LET and TFF (pre and post, ps < 0.001), as well as within stimulus type between pre and post ALT recordings: post TFF vs. pre TFF ($p = 0.0038$), post TFF vs. pre CFF ($p = 0.019$),
Discussion: In this study we found that the early ERP N1 amplitude after around 220ms showed a reading level-dependent modulation of neuronal tuning for TFF characters after the short ALT. The N1 amplitudes to TFF increased after the short GPC learning. These results support previous findings that GPC learning leads to visual specialization for new text-like characters in the ventral occipito-temporal cortex, as reflected by the N1, which depends on reading ability.

SU14. PHYSICAL TOUCH RESCUES PRETERM BRAIN FUNCTION

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Background: Touch, as the earliest sense to develop, establishes a fundamental building block for the development of sensory systems and subsequent cognitive, behavioral, and communication skills. For preterm infants in the Neonatal Intensive Care Unit (NICU), their early transition to the extrauterine environment and separation from caregivers disrupt development during a critical period of neuronal growth and organization. In the NICU, infants often experience procedural touch rather than supportive or comforting touch. While touch interventions are increasingly recognized in developmental care, few studies investigate the neurological mechanism behind the role of early touch experiences on neurological development. Here, we examine the role of supportive physical touch on brain signal variability in neonates.
Methods: Study participants include preterm (n= 25) and term (n = 17) infants who underwent an EEG paradigm with two resting conditions – held by a caregiver and swaddled in a bassinet. Data were subjected to multiscale entropy analysis to quantify brain signal variability.
Results: We found a significant interaction between resting condition and birth term. Preterm, relative to term, infants displayed significantly lower brain signal entropy during the non-held resting state condition at all temporal scales; however entropy levels were equivalent for the two groups during the held resting condition within low delta temporal scales – the predominant frequency for neonates.
Discussion: Our results contribute a potential mechanism for the positive effects of touch interventions on preterm infants, demonstrating a rescue effect of physical touch on preterm brain function. Infants most vulnerable to disrupted neurodevelopment may exhibit heightened receptivity to intervention. Such analyses of preterm brain maturation can help support the advancement of neuroprotective practices against developmental delay.

SU15. HYPOXIC BIRTH EVENTS IN THE PRETERM INFANT: EARLY IDENTIFICATION OF AUTISM SPECTRUM DISORDER

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Background: Premature infants experience unique neurodevelopmental outcomes including increased risk of autism spectrum disorder (ASD). One of the most common risk factors for developing a neurological disorder following premature birth is the occurrence of hypoxic - ischemic injury, or a lack of oxygen in the blood. Hypoxia necessitates aggressive ventilation techniques such as positive pressure ventilation that contributes to neural inflammation in as little as 15 minutes through a cascade of inflammatory cytokines. This systemic inflammatory response results in damage to the vulnerable white matter of the developing brain. The connection between white matter damage and neurodevelopmental delay was first identified in animal models when researchers used hypoxic conditions to replicate white matter injuries most often seen in prematurity. These injuries resulted in mice with social and cognitive impairments similar to those occurring with ASD.
Methods: https://osf.io/ur6hm/
Results: MSE analyses revealed increased mean entropy in ventilated infants as compared to their non-ventilated peers during the social resting state condition. This effect was driven primarily by the male babies who had increased mean entropy in the social condition as compared to female babies. In addition, preliminary saliva samples collected from 13 infants showed that infants who received PPV at birth had trending higher mean levels of all inflammatory cytokines tested.
Discussion: This project utilizes neuroscience, neonatology, and inflammatory proteomics to identify infants at the highest risk of developing ASD. Early identification is exceptionally important given that many infants discharged from the UVA NICU go home to areas without a neurodevelopmental clinic within 100 miles.

SU16. EEG APERIODIC ACTIVITY: DEVELOPMENTAL TRAJECTORIES AND ASSOCIATIONS WITH CHILD INTERNALIZING SYMPTOMS

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Background: Elucidating neurobiological markers of brain functioning and mental health in childhood is necessary to better understand brain development and inform early identification strategies for preventing psychopathology. Internalizing symptoms (e.g., anxiety, depression) can cause distress and impairment and serve as a precursor for psychopathology, beginning in early childhood. Recent research has investigated aperiodic EEG, characterized by a variable 1/f exponent in which power decreases as frequency increases. This distribution can vary in 'slope' (i.e., rate at which power decreases as frequency increases) and 'offset' (i.e., uniform shift of power across frequencies). The aperiodic slope and offset are hypothesized to index the synaptic excitatory-inhibitory balance (flattened/reduced slope=increased excitation over inhibition) and broadband neuronal firing, respectively. Studies in adults suggest atypical slope may characterize various forms of psychopathology. Whereas slope decreases with age in studies of adults and older children, emerging research in infants and toddlers shows age-related increases in both measures. Additional research is necessary in order to characterize the developmental trajectories of

aperiodic activity across childhood and examine whether disruption to these trajectories relates to the emergence of internalizing symptoms.

Methods: Data were analyzed from N=401 children and their caregivers enrolled in a longitudinal study with assessments in infancy (5, 7, or 12 months) and ages 3, 5, and 7 years. Participants completed baseline EEG at each assessment, and power spectral density was calculated and subsequently parameterized using the fitting oscillations and one over f (FOOOF) algorithm (modified for use in young children). Parents completed the Child Behavior Checklist when participants were ages 5 and 7 years to assess child emotional and behavioral, including internalizing, symptoms. Developmental trajectories of aperiodic EEG were modelled from infancy to 7 years. Concurrent and predictive associations between aperiodic EEG and internalizing symptoms and disorders were assessed using linear regression and generalized linear mixed models. Potential sex effects were examined given documented sex differences in brain development and psychopathology.

Results: We report non-linear developmental trajectories of aperiodic EEG activity from infancy through 7 years, with mean slope increasing from infancy to 5 years and then decreasing from 5 to 7 years. Offset increased during infancy, remained stable until 3 years, and then decreased through 7 years. Males and females differed in the rate of developmental change in slope and offset. In models stratified by sex, increased offset at 3 and 5 years were each associated with greater internalizing symptoms at 5 years among females. Increased offset at infancy and 5 and 7 years was associated with increased internalizing symptoms at 7 years among females. Slope was not associated with child internalizing symptoms.

Discussion: These findings provide novel insights into the developmental trajectories of aperiodic EEG in early childhood and potential associations with mental health. The observed non-linear pattern combined with sex differences may explain the inconsistent trajectories (increasing vs. decreasing) reported in previous studies in infant versus older samples. The large increase in offset during infancy may reflect the rapid development and neural overproduction that occurs in infancy, followed by synaptic pruning. Changes in slope may represent corresponding changes in inhibitory networks that occur throughout these processes. These developmental changes, in combination with evidence for concurrent and predictive associations with early internalizing symptoms in children, highlight the importance of continuing research into the mechanisms underlying aperiodic EEG during development and potential impact on mental health.

SU17. STUDYING GRAY MATTER SELECTIVITY AND WHITE MATTER INTEGRITY CHANGES IN READING AND WORKING MEMORY NETWORKS DUE TO REPETITIVE HEAD IMPACT IN CHILDREN

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Background: Should parents allow their children to play tackle football? Tackle football usually begins between ages 8-12, a time of rapid brain development. In particular, there exist rapid gains in executive function in this age range. Executive function is supported by the multiple demand (MD) network, which is activated across a number of tasks that involve various aspects of executive function. Prior work suggests long-term disturbances in executive dysfunction in former tackle football players compared to non-football players. Further, working memory deficits are

some of the most common in pediatric traumatic brain injury. Given the rapid growth of the MD network in ages 8-12 and the vulnerability of this network to repetitive neurotrauma, we asked whether the MD network showed blunted development due to football-related neurotrauma.
Methods: We scanned eleven children before their initial season of tackle football to establish a baseline, and followed them longitudinally after the season, and compared their neurodevelopment to an age- and motion-matched control cohort. Participants were scanned on a spatial working memory task with hard and easy conditions, using one run to define the functional regions of interest (fROIs) of the MD network and the other run to extract load-based activation (Hard > Easy). They also were scanned on a diffusion imaging sequence and TRACULA was used to define white matter tracts on each child and extract microstructural properties.
Results: We found significant differences in changes to the working memory response across season between football players and controls within fROIs of the MD network, particularly within the right posterior parietal and superior frontal fROIs. In these fROIs, controls showed a greater increase in load-based working memory activation as compared to football players. Further, we observed trending differences in the change in fractional anisotropy (FA) of tracts that connect the right frontal-parietal regions across the season.
Discussion: Ongoing longitudinal investigations will further explore the gray and white matter of the MD network and dose-response relationship of head impacts on cognitive outcomes.

SU18. LONGITUDINAL INSIGHTS TO CYBERBULLYING INVOLVEMENT IN ADOLESCENTS: PREDICTING PERPETRATION USING RESTING STATE EEG THETA POWER

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Background: Adolescence is a period marked by significant changes in the brain's biology, occurring alongside the emergence of various mental health challenges. With the pervasive use of technology, cyberbullying has emerged as a prominent issue among adolescents. While previous research has explored the links between cyberbullying and psychological factors, there's a scarcity of studies investigating the connection between cyberbullying and neurophysiology, particularly utilizing electroencephalography (EEG). This study is the first to employ EEG to examine how neurophysiological patterns relate to reported cyberbullying experiences in adolescents longitudinally.
Methods: Participants (N = 79) were recruited from the Sunshine Coast, Australia, and completed a maximum of 10 timepoints at 4 monthly intervals. Participants were aged 12 to 16 years across 590 data points. We hypothesized that individuals with cyberbullying experiences would demonstrate differences in their resting state EEG power trajectories. One way ANOVAs and generalized estimating equations were performed to investigate differences in EEG power across cyberbullying categories, and whether this changed over time.
Results: Results revealed that cybervictims exhibited higher averaged frontal delta power compared to those who had no experience of cybervictimization ($p = .01$), however this was not significant across timepoints. Additionally, individuals who had perpetrated cyberbullying showed a slower decrease in averaged temporal theta power across timepoints compared to groups with no experience of cyberbullying perpetration ($p = .04$).

Discussion: These results may indicate emotional dysregulation in young people, as well as potential differences in response inhibition and brain maturation. This might be reflective of difficulties in managing emotions, controlling impulses and a slower rate of brain maturation in those who perpetrate cyberbullying. Findings from this study provide early indication that brain activity may be influenced by different types of cyberbullying involvement, longitudinally. This provides justification for additional, rigorous research into prevention of cyberbullying, with consideration as to how psychosocial and emotional variables could impact the interplay between cyberbullying experience and developing brain activity (as measured by EEG power).

SU19. INTERVENTION IMPROVES READING ABILITY BUT DIFFERENCES IN HIGH LEVEL VISUAL CORTEX OF CHILDREN WITH DYSLEXIA PERSIST

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Background: The debate surrounding the neurobiological underpinnings of dyslexia has long centered on whether the primary deficits lie within phonological processing circuits or extend to visual processing pathways. While traditional literature often emphasizes the former, meta-analysis of neuroimaging studies has revealed that ventral occipitotemporal cortex (VOTC) is the most common location of group differences. VOTC contains a collection of high-level visual regions that selectively process certain categories of visual information, yet surprisingly, few experiments have studied the relationship between category-selective visual responses and dyslexia. To address this gap, we used functional magnetic resonance imaging (fMRI) to investigate the stability and plasticity of visual processing mechanisms in children with dyslexia who completed a comprehensive reading intervention program.

Methods: Forty-four children (ages 8-13y) with a history of reading difficulties underwent an intensive 8-week long reading intervention program focused on improving reading skills. These participants were scanned and given a battery of reading assessments 4 times over the course of the study: once before the start of the intervention, once immediately after the conclusion of the intervention, 6 months later, and a year after the intervention. Additionally, 33 control participants (ages 8-13y; 13 struggling readers and 20 above average readers) who did not receive the intervention underwent the same scanning and assessment protocol.

fMRI data were collected while participants viewed 5 categories of visual stimuli (text, objects, faces, limbs, and false fonts) under two different cognitive tasks: a one-back task in which participants pressed a button every time the stimulus on the screen repeated, and a fixation task in which participants pressed a button whenever the fixation changed color. The one-back task required participants to attend to the stimuli, while the fixation task required participants to ignore the stimuli, thus probing visual responses under different attentional conditions. Text-selective patches in VOTC (i.e., the Visual Word Form Area; VWFA) were manually drawn on the native surface of each participant and the size and response properties of the VWFA were compared over time in children with dyslexia versus typical reading controls.

Results: Standardized reading scores (Woodcock Johnson Basic Reading Skills) significantly improved following the intervention. Despite this increase in reading ability, a functional region of interest analysis revealed relatively stable group differences in the VWFA. VWFAs in dyslexic readers (both for those who received the intervention and those who did not) were significantly

smaller than VWFAs of typical readers. The size difference was persistent across the study duration and did not change dramatically with the intervention. Additionally, a whole-brain group-level analysis revealed compelling evidence of distinct differences in text selectivity within VOTC between dyslexic and typical readers across both task conditions. Specifically, dyslexic readers exhibited persistent reduction in text selectivity along the Occipito-Temporal Sulcus, the canonical location for VWFA, relative to typically-reading peers. This difference was also persistent throughout the length of the study and was not affected by intervention status.

Discussion: The persistence of neurobiological disparities in high-level visual processing regions among dyslexic readers, irrespective of attentional demands and literacy gains, underscores the enduring nature of these differences. Even when dyslexic readers are not focussing on text, as is the case during the attend-fixation task, VOTC activation diverges from typical readers. While much of the focus of the dyslexia literature has been on phonological processing, these findings highlight a stable difference in visual cortex that persists despite intervention.

SU20. NEURAL RESPONSES TO DIFFERENT FORMS OF MAGNITUDE AND CALCULATION PROFICIENCY IN YOUNG CHILDREN

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Background: Children's neural responses to numeric magnitude in the intraparietal sulcus (IPS) have been linked to their mathematics proficiency (Bugden et al., 2012). There is ongoing debate, however, regarding whether an overlapping parietal system supports different types of magnitude processing, including continuous temporal and spatial quantities, in addition to discrete quantities (Szkudlarek and Brannon, 2017; Skagerlund et al., 2016). Indeed, some studies in adults suggest that the right IPS may support all forms of magnitude processing, whereas the left may be specialized for symbolic numeral processing (Capelleti et al., 2013; Dormal et al., 2012; Sokolowski et al., 2021). It is not yet clear whether IPS responses to different types of magnitude relate equivalently to children's mathematics performance, in keeping with the idea of an overlapping magnitude comparison system. Addressing this question may offer promising new pathways for interventions to support children's mathematics achievement. Therefore, the aim of the current study was to determine whether ratio-related activity in IPS regions during numeric, temporal and spatial comparisons correlated with children's calculation performance.

Methods: Thirty-one children aged 7.92 to 11.67 years (58% male, 42% female; 77% White, 3% African American/Black, 3% Asian, 10% Hispanic/Latine, 7% mixed race) completed 3 tasks while undergoing functional MRI. In a dot comparison task, children judged which of two, successively presented dot arrays was more numerous. In a duration comparison task, children judged which successively-presented picture appeared for longest. In a number line task, children identified whether a target appeared at the correct location on a number line. The dot and duration comparison tasks each involved ratios of .5, .75, .83 and .89 between the quantities and the number line task involved differences of 0 .5., .75., and .83 between the targeted and displayed positions. For parsimony, we contrasted the larger vs. the smaller ratio conditions for all tasks and parameter estimates for accurate trials were extracted from ROIs based on the Jeulich atlas IPS regions 1, 2 and 3. Children also completed the Kaufman Test of Educational Achievement (Kaufman and Kaufman, 2015) Calculation and Letter and Word Recognition subtests after exiting the scanner.

Results: For the dot comparison task, increased BOLD responses in right IPS regions 1 (r = .40, p =.04) and 3 (r = .42, p = .03) correlated positively with children's calculation scores. Activity in IPS 3 also correlated with children's accuracy on the dot comparison task (r = .43, p = .02) and activity in all IPS regions correlated with faster task response times (r = -.42 - - .53). However, correlations were substantially attenuated after controlling for children's Letter and Word Recognition performance. Although bilateral IPS activation during the duration task correlated with children's accuracy on that same task (r's = .39 - .53, p's < .05), it was not linked to children's calculation performance. Similarly, IPS activity during the number line task did not correlate with calculation performance. While parameter estimates in left IPS regions for the dot and number line tasks correlated moderately (.35 - .58), there were no correlations with the duration task.
Discussion: Findings suggest that children's IPS responses to numeric quantity are linked to the development of their calculation skills, whereas IPS responses to other forms of magnitude comparison may be less relevant. Concentrating on comparisons of numeric quantities may have relevance for supporting children's development of calculation skills. A limitation of the study is that other mathematics skills, such as geometry or patterning, were not assessed. While findings do not support the idea that a general quantity comparison system in the IPS underlies mathematics development, more research with children is needed to determine how these patterns change with age.

SU21. CHANGES IN PATTERNS OF AGE-RELATED NETWORK CONNECTIVITY ARE ASSOCIATED WITH THE POLYGENIC RISK FOR SCHIZOPHRENIA

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Background: Alterations in brain functional network connectivity (FNC) are associated with the schizophrenia (SCZ) diagnosis and, also, with genetic risk or subthreshold clinical symptoms preceding the onset of SCZ. SCZ onset typically occurs during late adolescence or early adulthood when brain maturation is about complete. Thus, age-sensitive FNC changes may be relevant to SCZ risk-related FNC. We hypothesized that siblings (SIB) of patients would show altered age-related FNC patterns compared to neurotypical individuals (NC), reflecting increased genetic risk for altered brain maturation trajectories. Furthermore, FNC divergent patterns could also be manifest in individuals with sub-threshold psychotic symptoms (PSY). We set out to study FNC changes occurring between early and later adulthood that may reveal age-related brain mechanisms relevant to SCZ risk.
Methods: We investigated FNC patterns in a cross-sectional framework on 9,236 individuals through a fully automated independent component analysis pipeline called Neuromark on resting state, working memory, episodic memory, and emotion recognition tasks during fMRI. Six different cohorts have been analyzed: one obtained from the publicly available Philadelphia Neurodevelopmental Cohort, one obtained from the Adolescent Brain Cognitive Development, two independent cohorts collected at the University of Bari Aldo Moro, one provided by the Lieber Institute of Brain Development, and one from the UK Biobank. We divided individuals into three age stages, i.e., from 8 to 14 years old, 15 to 25 years old, and 30 to 60 years old, relying on the SCZ risk and clinical manifestations' trajectory. To identify potential familial risk–related FNC changes, we compared age-related FNC in first-degree relatives of SCZ patients, mainly including unaffected SIB with NC at the same age stage through linear mixed-effect models. Then, we

examined how polygenic risk scores for SCZ influenced risk-related FNC patterns. Finally, we investigated the same risk-related FNC patterns in adult SCZ patients and young individuals with PSY.

Results: We found that young SIB always followed older NC patterns, with decreased FNC in a cerebellar–occipitoparietal circuit (r=-0.28; pFDR=0.0003) and increased FNC in the medial and dorsolateral prefrontal–sensorimotor circuits (r=0.50; pFDR=0.0002) when compared to young NC. Two FNC alterations were also found in SCZ patients, with one exhibiting a reversed pattern. All were linked to polygenic risk for SCZ in unrelated individuals (squared-r varied from 0.02 to 0.05; pFDR < 0.05). Young individuals with PSY showed FNC alterations in the same direction as SIB compared to NC, suggesting a convergence between familial and clinical risk trajectories. Notably, these age-sensitive risk-related FNCs emerging during adolescence and early adulthood were not detectable before during childhood.

Discussion: Our findings suggest that an anticipated display of FNC patterns characteristic of older age is associated with a high risk for SCZ during late adolescence and early adulthood. Given that this developmental period is susceptible to the onset of psychotic symptoms, the early identification of altered trajectories using MRI holds potential significance for preventive interventions in individuals with liability for SCZ. Moreover, the correlation between these patterns and the polygenic risk for SCZ implies an alignment between familial risk and molecular estimates of polygenic risk. We suggest that exploring changes in FNC across cognitive tasks within a longitudinal framework could further advance early detection strategies for identifying prodromal phases of SCZ.

SU22. YOUTH EMOTION TRAINING INITIATIVE (YETI): A PRE-REGISTERED RANDOMIZED PILOT STUDY OF FMRI NEUROFEEDBACK FOR ADOLESCENT EMOTION REGULATION

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Background: Rates of adolescent psychiatric diagnoses continue to rise and constitute a public health crisis. Yet, intervention measures to address these disorders are limited. Neuroscience-based methods are uniquely positioned to address the prevalence of these conditions through brief, non-invasive modulatory techniques. Real-time functional magnetic resonance imaging neurofeedback (rt-fMRI-NF) is one such approach. Our rt-fMRI-NF paradigm aims to target underlying mechanisms of emotion regulation (ER), a process commonly implicated in psychiatric conditions such as depression and anxiety.

Methods: In this pilot study, 24 female adolescents (ages 13-17) will complete an emotion processing task while undergoing fMRI. Youth will be randomized to neurofeedback or control conditions in a 2:1 ratio stratified by age and handedness. Both groups will complete a brief ER skills training prior to fMRI. Youth will complete five runs of the task, each with four blocks of negative pictures. They will be instructed to regulate their emotional responses during certain blocks by engaging in specific ER skills. The experimental group will receive intermittent visual feedback after each regulation block, reflecting whether they effectively downregulated their anterior insular cortex (aIC) activity. The last run will be a transfer run, with no neurofeedback presented to either group. The neurofeedback signal will be measured as the percent signal change

relative to the previous image block in each run. Trends of aIC activity across all runs will be used for between-group comparisons.

Results: H1) Youth in the experimental group will exhibit a downward trend of aIC activity across runs, while those in the control group will not. H2) Youth in the experimental group will maintain these trends during the transfer run, while those in the control group will have no evidence of change.

Discussion: Data collection is ongoing and anticipated to be completed by July 2024. Data processing and statistical analysis will occur from July 2024 through August 2024. Hypotheses will be examined via linear mixed-effects models. Run number will be included as a fixed effect and nested within subjects as random effects. Beta values for the run number predicter will be evaluated as effect sizes. Age and handedness will be entered into the model as covariates. H2 will compare group differences in the final transfer run only. Preregistration information is publicly available at OSF (https://doi.org/10.17605/OSF.IO/MKRAU).

SU23. DELAY DISCOUNTING IN ADOLESCENCE DEPENDS ON WHO YOU WAIT FOR: EVIDENCE FROM A FUNCTIONAL NEUROIMAGING STUDY

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Background: With age, adolescents increasingly demonstrate the ability to forgo immediate, smaller rewards in favor of larger delayed rewards, indicating reduced delay discounting. Adolescence is however also a time of social reorientation, where decisions not only involve weighing immediate against future outcomes, but also consequences for self versus those for others.

Methods: In this functional Magnetic Resonance Imaging study, we examined the neural correlates of immediate and delayed reward choices where the delayed outcomes could benefit self, friends, or unknown others. A total of 196 adolescent twins aged 14-17 completed a social delay discounting task, with fMRI data acquired from 174 participants. Out of these, 156 adolescents had valid fMRI data, and 138 adolescents had observations in every condition.

Results: Adolescents more often chose the immediate reward when it was larger, and when the delay was longer. Area-under-the-curve (AUC) comparisons revealed that behavior differed across delay-beneficiaries, with AUC being highest for the self, followed by friends, and lowest for unknown others. Neuroimaging analyses showed increased activity in the midline areas medial prefrontal cortex (MPFC) and precuneus, as well as bilateral temporal parietal junction (TPJ) when considering delayed reward for unknown others and friends compared to self. A whole-brain interaction with choice showed that the bilateral insula, bilateral TPJ, the anterior cingulate cortex (ACC) and right dorsolateral prefrontal cortex (DLPFC) were more active for immediate choices for the self and delayed choices for unknown others.

Discussion: These behavioral results suggest that adolescents are more willing to wait for rewards for the self. Additionally, the neuroimaging results suggest a qualitative shift in neural recruitment based on the beneficiary and choice. Potentially overriding the normative choice to delay gratification for the self, while requiring more cognitive control to delay gratification when this

benefits unknown others. This underscores that the neuro-cognitive processing of how delays reduce the value of rewards depends on closeness of the beneficiary.

SU24. RESTRICTION SPECTRUM IMAGING OF SPEECH NETWORKS IN YOUNG CHILDREN AT-RISK FOR SPEECH DISORDERS.

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Background: Children with Attention-Deficit/Hyperactivity Disorder (ADHD) are up to three times more likely to display speech and language problems compared to children who are typically developing. Among the broad categories of speech impairment, disorders of speech articulation are the most prevalent, which includes deficits in the repetition of monosyllabic and bisyllabic utterances. These children may have dysfunction in brain regions and pathways of the comprehensive neural network implementing speech articulation. Crucial regions implicated in the motor control and implementation of effective speech are lateral inferior frontal regions and medial frontal regions, including the pre-supplementary motor area (pre-SMA) and frontal precentral speech areas. The connectivity of these regions has also been identified as potentially important for speech. The frontal aslant tract (FAT), which connects the pre-SMA/SMA with the inferior frontal gyrus, is one white matter pathway which has been recognized in its association with motor speech function. Supporting gray and white matter regions critical for speech are the cortico-cerebellar loops, which provide a direct pathway from the cerebellum to motor regions in the cerebral cortex. To investigate the role of these brain regions and white matter pathways in the structural development of networks supporting speech, we examined a diffusion weighted imaging (DWI) data set in young children (4-7-years).

Methods: The final participating sample consisted of 47 4-7-year-old children diagnosed with ADHD (dual clinician diagnosed) and 47 typically developing (TD) controls (M age = 5.51, SD = 0.82, and 74.45% male). All children were scanned in an MRI (3T Siemens Prisma) with a 102-direction multi-shell DWI acquisition. The RSI model was applied to measure structural development of gray matter, which allowed us to implement a more complex reconstruction of the diffusion signal that parsed out the hindered normalized total signal fraction (HNT) and the restricted normalized total signal fraction (RNT). A novel method known as Automated Fiber Quantification was used to explore white matter connectivity. In addition to diffusion-weighted metrics, data were collected on the Syllable Repetition Task (SRT), a validated measure of phoneme articulation.

Results: Bilaterally, RNT positively predicted SRT in white matter of the frontal aslant tract, and in grey matter of pars opercularis ($p < .001$). RNT positively predicted SRT in cerebellar white and grey matter, and in superior, middle and inferior cerebellar peduncles ($p < .001$). No interactions by group diagnostic status were indicated.

Discussion: In young children (4-7-years), performance on a phonemic articulation task is associated with cellularity (as measured by RNT) in frontal aslant tract (FAT), grey matter of pars opercularis, and all three cerebellar peduncles. Additional analysis using automated fiber quantification (AFQ) indicated specific regions of FAT associated with speech. These results provide converging evidence for the role of specific regions and neural structures in a distributed

neural network of speech, and will further understanding of speech deficits in children at high risk for speech disorders.

SU25. TOPOGRAPHIC ORGANIZATION OF GRAY MATTER MICROSTRUCTURE IN ONE-MONTH-OLD INFANTS

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Background: Individual differences in gray matter (GM) structure have provided key insights into neurological disorders, psychopathology, cognitive functioning, and development. Human cortex undergoes remarkable growth and development during the first months of life, with significant increases in volume, cortical thickness, and cortical myelination. These macrostructural changes have been well-documented. The underlying microstructural development—such as axonal growth, dendritic arborization, and synaptogenesis—that are critical for the establishment of neural networks supporting sensory-motor, cognitive, and emotional functioning, remain unknown. Advanced multi-shell diffusion-weighted magnetic resonance imaging (dMRI) and multicompartmental modeling offer a promising path to delineating the complex features of GM tissue at the microstructural level. Specifically, Neurite Orientation Dispersion and Density Imaging (NODDI), a multicompartmental model of dMRI, provides measures for the Neurite Density Index (NDI) and the Orientation Dispersion Index (ODI). Neurites is a collective term for axons and dendrites. Within the context of cortical GM, NDI indexes the myeloarchitecture of the cerebral cortex (i.e., the density of myelinated axons and, to a lesser extent, dendrites in the cortex). ODI reflects cortical cytoarchitecture (i.e., axonal configurations and dendritic structure and complexity). Moreover, recent investigations have revealed that the brain develops along a sensorimotor–association (S-A) axis, with sensory and motor cortices maturing earlier than association cortices. This maturation hierarchy has been evidenced in cortical volume, connectivity, and myelination, but remains unknown in GM microstructures. Thus, the current project aims to characterize the topographical organization of GM microstructures in one-month-old infants.

Methods: We collected dMRI data from 84 infants aged 2.29-6.13 weeks, including 32 and 64 directions with b-values of 700 s/mm² and 2000 s/mm², respectively. Preprocessing included noise estimation and removal along with eddy and susceptibility distortion corrections using MRtrix3 and FMRIB's Software Library. We are currently in the process of manually editing image segmentations in order to perform surface-space analyses. Following preprocessing, we will compute NDI and ODI using the NODDI Matlab Toolbox. By the time of the conference, we anticipate having completed segmentations for ~60 subjects, enabling detailed analysis of NDI and ODI metrics across the cortical surface. We hypothesize that at age one month, infants will exhibit higher NDI and ODI in primary sensorimotor and visual regions, and lower values in transmodal association areas. To statistically test this hypothesis, we plan to perform Spearman correlations between regional indices of NODDI metrics and regional rankings of the previously identified S-A axis (Sydnor et al., 2021), expecting a strong correlation indicative of systematic organizational patterns.

Results: Initial pilot analysis on one subject with accurate segmentation in the native space revealed a distinct topographic organization: higher NDI and ODI values in the parietal and

occipital lobes, and lower values in the prefrontal and temporal lobes, indicating a potential systematic variation along the S-A axis.
Discussion: This project will, for the first time, characterize the topographic organization of GM microstructure in vivo in one-month-old infants, advancing the theoretical understanding of GM microstructural profiles during this crucial phase of development. It will also facilitate future studies examining potential links between individual differences in GM microstructure and infant behaviors or development.

SU26. LONGITUDINAL INVESTIGATION OF HORMONE-RELATED CHANGES IN HIPPOCAMPAL VOLUME ACROSS PUBERTY

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Background: The hippocampus undergoes substantial structural and functional changes during puberty, and animal studies have demonstrated that puberty-related gonadal hormones may influence hippocampal morphology. However, our understanding of the relationship between puberty-related neuroendocrine processes and hippocampal volume across development in humans remains limited. We longitudinally investigated the possible relationship between the developmental trajectory of hippocampal volume and serum estradiol and testosterone levels in healthy boys and girls from age eight through the pubertal transition to age 18.
Methods: Fasting morning blood samples to measure estradiol and testosterone and 3T structural MRI scans were collected across 561 visits of 133 healthy children (55 girls, mean age across longitudinal measures=12.0±2.7 years; 78 boys, age=11.9±2.6). Repeated measures correlations and longitudinal mixed-effects spline models were used to identify associations between hormone levels and Freesurfer-derived whole hippocampal volume across age.
Results: Estradiol and testosterone levels positively correlated with left and right hippocampal volumes in both sexes, regardless of age (p's < 0.0006, r's > 0.22). Mixed-effects spline modeling of developmental relationships between hormones and hippocampal volumes showed significant age-by-testosterone interactions for left hippocampus, as well as age-by-estradiol interactions bilaterally. Hippocampal volumes increased faster as estradiol levels increased (p's < 0.001), and a similar relationship was found with testosterone for the left hippocampus, where hippocampal volume increased faster with increasing testosterone ($p=0.03$).
Discussion: These data document gonadal hormone-dependent hippocampal structural changes across development, consistent with the prevalence of hormone receptors in this region. Future investigations will focus on investigating other hormone-receptor-rich brain regions such as the prefrontal cortex.

SU28. DEVELOPMENTAL ASSOCIATIONS BETWEEN DNA METHYLATION SCORES OF PRENATAL LEAD WITH GLOBAL AND REGIONAL WHITE MATTER CONNECTOME METRICS IN ADOLESCENCE

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Background: Lead is a toxic substance that is known to affect developmental processes. Exposure to lead in-utero is of particular concern because it is a time of rapid development, including for brain structure, however, prenatal lead exposure is not often measured. To fill this gap, we use an epigenetic proxy of prenatal lead exposure and assessed associations with brain structure in adolescents.

Methods: We analyzed 181 adolescents from the Study in Adolescent Neural Development (SAND). SAND is a subset of participants from the Future of Families and Child Wellbeing Study, a population-based longitudinal cohort study with substantial representation of marginalized youths. Participants provided DNA methylation (DNAm) via saliva samples at ages 9 and 15 as well as diffusion MRI scans of white matter at 15. DNAm surrogates of prenatal lead exposure were calculated in SAND using weights derived from a neonatal epigenome-wide analyses of cord blood, and residualized for known confounders (sample immune cell and fibroblast proportion, batch, and maternal smoking at birth). Diffusion MRI was processed using the MRtrix pipeline that generated 94x94 individualized matrices representing whole-brain structural connectivity connectomes. Graph analysis was then applied to the resulting matrices to generate metrics of network architecture: global efficiency, modularity, and transitivity. To test for regional specificity of the lead methylation score, simulated attacks were conducted on each participant's connectome by choosing one of the 8 subregions and removing it before recalculating global efficiency. All measures were z-score standardized. All analyses controlled for participant age, gender, birth city, race/ethnicity, mother's education at birth, poverty ratio at birth, and current poverty ratio. All results were corrected with false discovery rate correction.

Results: A higher prenatal DNA methylation lead score measured at age 9 was associated with decreased structural global network efficiency in adolescence (β = -0.185, q = .025). No association was found between prenatal lead score and modularity or transitivity using methylation measured at 9 or all three brain metrics at 15. Only the global efficiency of connectomes where the orbitofrontal, limbic, or occipital nodes were removed showed a decrease in correlation between the full and reduced connectomes, indicating that these regions may independently drive the association between global efficiency and prenatal Pb methylation.

Discussion: Results suggest that prenatal lead exposure is associated with differences in white matter connectivity organization in adolescence suggesting methylation markers persist long after exposure and are able to predict brain organization later in life. Lack of an association between prenatal DNAm scores of lead at age 15 and brain metrics may reflect a decay in lead methylation signal between 9 and 15, possibly due to the additional 6 years of postnatal epigenetic modification. The individual removal of orbitofrontal, limbic, or occipital nodes attenuated the association between lead methylation and global efficiency. Prenatal exposure to lead may differentially affect global white matter connectivity through a region-specific manner, particularly in regions associated with cognition and emotional development. This suggests a potential mechanism in which early exposure to lead increases risk for later behavioral outcomes.

SU29. CURVILINEAR ASSOCIATIONS BETWEEN BODY MASS INDEX AND BRAIN MICROSTRUCTURE IN THE ABCD STUDY

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Background: Body mass index (BMI) has been often used as a developmental and clinical marker of both typical and atypical development that can quickly and noninvasively capture certain conditions such as obesity. Previous work has demonstrated an association between the microstructural properties of subcortical grey matter and BMI. In this study, we aim to extend these findings and characterize the developmental associations between BMI and the intracellular environment across the whole brain in a large adolescent cohort using general additive mixed effects models (GAMMs), allowing us to probe nonlinear relationships.

Methods: Body mass index (BMI) data (BMI=11-45) was collected from an adolescent cohort (n=11,009) participating in the Adolescent Brain Cognitive Development (ABCD) Study (release 5.1). Data consisted of 20,184 observations across baseline (n=9999, age 9-10 years), 2-year follow-up (n=7364, age 11-14 years), and 4-year follow-up (n=2821, age 13-16 years). Tissue microstructure was assessed using the restricted spectrum imaging (RSI) model. RSI is a diffusion MRI framework that models the diffusion signal as emanating from the intracellular, extracellular, and free water compartments, reflecting the underlying tissue. Univariate GAMMs were applied at each voxel to measure the associations between the restricted normalized total (RNT) signal fraction, derived from RSI, and BMI. Using Fast and Efficient Mixed Effects Algorithm (FEMA), we represented BMI using natural cubic spline functions. The model included a smooth function of BMI as a single predictor and covariates age, sex, sociodemographics, race, ethnicity, and scanner/site, while accounting for family relatedness.

Results: By applying GAMMs that incorporate a smooth function of BMI as a predictor, we observed a curvilinear relationship between BMI and RNT across multiple regions. This included notable effects in bilateral orbitofrontal cortex, as well as subcortical grey structures, including bilateral nucleus accumbens, caudate, putamen, and pallidum. The main pattern observed in these regions was a U-shaped curve, in which negative associations between RNT and BMI decrease as BMI increases until an inflection point at ~BMI=20-21 after which there was an increasing positive association as BMI increases. The negative association was highest at BMI=11 while the positive association was greatest at ~BMI=30-32.

Discussion: GAMMs enable us to capture a more nuanced and curvilinear relationship between BMI and brain microstructure, that otherwise may have been missed with traditional general linear models. In particular, subcortical structures and cortical areas implicated in reward and decision-making exhibit brain microstructure alterations at higher BMI values (> ~20), changes that align with potential increases in cellularity and neuroinflammation. These microstructural changes may be associated with obesity, or excess fat accumulation. Pediatric obesity is a strong predictor of adulthood obesity and increases the risk of associated physical and mental health problems. Uncovering the relationship between BMI and brain microstructure as a component of understanding neurobiological mechanisms that contribute to excess fat accumulation across childhood and adolescence is key to the development of prevention and treatment strategies.

SU30. MATERNAL MOOD ENTROPY HAS AN ENDURING ASSOCIATION WITH REDUCED HIPPOCAMPAL VOLUME ACROSS CHILDHOOD

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Background: Researchers have examined the association between maternal mental health and children's brain development, but findings in this area are inconsistent. One significant challenge for the field is determining how to best conceptualize maternal mood difficulties to effectively test associations with children's brain development. While most researchers have focused on overall levels of specific mood-related symptoms, recent work has tested other aspects of dysregulated mood, such as mood entropy (i.e., mood instability or variability), as a predictor of child outcomes. Further, most studies have considered children's brain metrics at a single time point, which fails to consider how the association between early experiences and brain development may change over time. Developmental psychologists have proposed longitudinal models for formally testing and comparing different theories of how the effects of early life experiences are carried forward in development. However, few studies have applied these models to longitudinal neuroimaging data. Here, we tested (1) whether maternal mood levels and entropy are uniquely associated with the development of children's hippocampal and amygdala volume, and (2) whether early patterns of maternal mood have a transient association with these regions in early childhood or an enduring relation with them that extends into late childhood.

Methods: We drew on data from Growing Up in Singapore Towards Healthy Outcomes (GUSTO), a longitudinal birth cohort study (N=1498) in which T1-weighted scans were obtained at ages 4.5, 6, 7.5, and 10.5 years of age. To assess maternal mood, mothers completed the State-Trait Anxiety Inventory (STAI) at 3, 12, 24, 36, and 54 months after the child's birth. We computed maternal mood levels as the sum of symptoms, and maternal mood entropy scores by applying Shannon's entropy to the distribution of STAI responses. Maternal mood level and entropy scores were averaged across the four STAI data collection waves. We used path analysis to formally test whether early patterns of maternal mood showed a transient association specific to hippocampal and amygdala volume in early childhood (i.e., ages 4.5 and 6), or an enduring association with brain volumes that persisted across childhood. These models controlled for sex, socioeconomic status (family income, maternal education), and intracranial volume at each neuroimaging assessment wave.

Results: Correlation analyses showed that maternal mood entropy, but not level, was associated with smaller bilateral hippocampal volume at ages 4.5 and 6 (all $rs > -.14$, $ps < .05$). After considering the high rank-order stability of hippocampal volume over time (autoregressive $Bs > .78$, $ps < .001$), maternal mood entropy was directly associated with smaller hippocampal volume only at age 4.5, which is consistent with a transient effect. Through rank-order stability over time, however, maternal mood entropy was indirectly related to smaller hippocampal volume at age 10.5 years (indirect $B=-.08$, $p=.013$). These effects were present over and above the effects of socioeconomic status ($B=.10$, $p=.031$) and intracranial volume ($B=.54$, $p < .001$), and were specific to maternal mood entropy (not levels) and to the hippocampus (not amygdala).

Discussion: Our findings suggest that maternal mood patterns are embedded in brain structure in early childhood, thus setting the stage for subsequent neurodevelopment. Early maternal mood entropy, potentially reflecting intraindividual patterns of mood instability or variability, is implicated in early underdevelopment of the hippocampus that predisposes children to continued underdevelopment in the future. Our findings both contribute to a growing body of research that entropy is an independent and meaningful component of mood dysregulation, and suggest a specific developmental process that characterizes the association between early maternal mood and children's hippocampal growth.

SU31. INFLUENCES OF PHYSICAL ACTIVITY AND SLEEP ON BRAIN VOLUME IN EARLY CHILDHOOD

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Background: Emerging evidence suggests that in addition to cardiorespiratory fitness, physical activity benefits cognitive performance across development. Relations between cognitive ability and movement behaviors, including neurobiological, psychosocial, and behavioral pathways have been proposed yet studied limitedly in children, particularly in early childhood. Additionally, although physical activity, sedentary behaviors, and sleep are co-dependent time-use activities and may have interactive influences on cognition, studies in young children have primarily considered physical activity or sleep independently, but not in tandem. Objective: To determine if physical activity, while accounting for sleep, is associated with brain regions in preschool using two statistical approaches.
Methods: Preschool-aged children repeated measurements at three time points approximately 6 months apart (time 1: n = 22, 3.9 ± 0.4 years, 72.7% female; time 2: 19 = X, 4.5 ± 0.5 years, 42.1% female; time 3: n = 13, 5.1 ± 0.4 years, 53.8% female). Wrist-based actigraphy watches worn for 24-hour periods (12 ± 3.5 days and 10.3 ± 4.4 nights) estimated sedentary time, physical activity, and sleep duration. Volumes of brain regions known to contribute to cognitive functions that physical activity is associated with in children were derived from an MRI T1 weighted image and included the cerebral cortex (total and hemispheric), cerebral white matter (total and hemispheric), total gray matter, and subcortical gray matter volumes.
Results: Multilevel models with restricted maximum likelihood estimation explored associations between total physical activity (activity counts/min: including sedentary activities) and sleep and each brain outcome, adjusting for sex, age, and intracranial volume (ICV). Higher activity levels in children were associated with less total gray matter (B = -79.8, p = 0.03), and the other associations were not statistically significant. Relations with time-use compositions (sedentary time, physical activity, and sleep) transformed into isometric log-ratios were also explored using a collapsed cross-sectional dataset with linear regression models adjusted for ICV. However, neither the overall time-use composition nor physical activity (in relation to the other behaviors) were associated with any of the brain measures.
Discussion: In this sample of preschool children, physical activity levels were not associated with cerebral cortex or white matter volumes, but lower total gray matter was correlated with higher activity levels. Some regional gray matter volumes have been associated with disruptive behavior and depressive symptoms in children, outcomes that have also been linked to time-use behaviors

across development. Therefore, exploring potential bidirectionality of associations in larger samples with more activity and sleep behavior variability may be warranted. Additionally, other neural mechanisms such as connectivity should also be explored to better inform movement behavior and cognition pathways, as well as behavioral targets.

SU32. INVESTIGATING ASSOCIATIONS BETWEEN EARLY-LIFE ADVERSITY AND INDICES OF VENTRICLE STRUCTURE AND FUNCTION

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Background: From over 50 years of previous work, it is clear that early-life adverse experiences are common and often precede and contribute to the development of negative mental health outcomes [1, 2]. Characterizing adverse events in childhood and adolescence as experiences of threat or deprivation [3] have proven to divide along important biological axes. Experiences of threat are thought to alter underlying physiological processes that result in accelerated aging, effectively altering the pace of development [4, 5]. In a meta-analysis across 40 studies and over 100,000 participants, adverse experiences of threat, but not deprivation, were associated with earlier pubertal timing [6].

Differences in brain structure and function have been linked to early adversity. Threat most consistently influences emotion reactivity and regulation processes, and has been associated with reduced medial prefrontal cortex, amygdala, and hippocampal volumes as well as heightened amygdala activation in response to threat [7]. Children exposed to deprivation most consistently showed reduced volume and altered function in frontoparietal regions [7]. Interestingly, ventricles play an essential role in maintaining physical and functional brain health, and yet no studies have explored indices of ventricle structure or function in relation to stress.

In the current study, across two datasets, we plan to examine whether early life adversity (ELA) is associated with indices of ventricle structure. ELA severity, chronicity and dimensions of experience (deprivation and threat) will be examined. As an exploratory analysis, we will investigate indices of ventricle function in relation to stress.

Methods: We will utilize two previously collected datasets: the first dataset includes children (n=159) aged 8-16 years [8], the second includes children (n=183), aged 11-13 years. Comprehensive assessments of exposure to adverse experiences, symptoms of psychopathology and an MRI scan were collected. ELA severity, chronicity and dimensions of experience (deprivation and threat) will be examined. Across both studies, structural T1w images will be used to estimate total ventricle volume (mm3) as an index of ventricle structure. Functional resting state BOLD data will be used to extract mean signal from within the ventricles (a.u.) and will be explored as an index of ventricle function.

Results: Based on previous developmental studies [9, 10], we expect that ventricle volume will be slightly larger in participants who are older, even after adjusting for head size. We predict that individuals who have experienced a greater number of adverse events will have larger ventricle volumes. And further, that ventricle volume will be increased in individuals who have greater experiences of threat, but not deprivation, given the accelerated aging seen with other brain measures [7]. We will also investigate whether indices of ventricle function are associated with dimensions of early-life adversity as this has never been explored.

Discussion: Ventricles contain cerebrospinal fluid (CSF) which provides nutrients, removes waste, and acts as a physical buffer external physical trauma to the brain. Ventricle flow follows a circadian cycle [11] and it was recently discovered that they perform a critical "flushing" or clearance function during sleep [12]. Importantly, given the excellent contrast in neuroimaging data, estimates of ventricle structure and function are highly reliable. In fMRI data preprocessing, it is common practice and has been recommended by several groups [13-15] to use ventricle/CSF signal as a regressor in first-level task-based analyses. However, some have reported that the ventricle signal may contain important fluctuations related to neural activity [16], suggesting the potential loss of important information by regressing. This project will be the first to characterize ventricle structure and stress in an adolescent population, moreover, the first to explore indices of ventricle activity and stress.

SU33. IMPACT OF INTERPERSONAL THERAPY DURING PREGNANCY ON INFANT SUBCORTICAL BRAIN DEVELOPMENT: A RANDOMIZED CLINICAL TRIAL**

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Background: Maternal depression during pregnancy affects between 14 and 23% of women and is robust predictor of development of psychopathology in the offspring. Findings from correlational studies suggest that alterations in infant brain development may be a potential mechanism through which maternal depression contributes to increased risk for psychopathology in the next generation. However, existing research is limited by its reliance on correlational designs. Using a randomized clinical trial (RCT), the current study breaks new ground by examining how treatment to reduce depression during pregnancy, brief interpersonal therapy (IPT) impacts infant structural brain development. Specifically, we examined the effect of brief IPT on infant brain volume within two a priori limbic regions, the amygdala and the hippocampus given their important role in emotion and memory processing.

Methods: A prospective randomized clinical trial (RCT), the Care Project, was conducted among adult pregnant individuals who reported elevated depression symptoms during routine obstetric care screening in general practice and obstetrics and gynecology (OBGYN) clinics. Pregnant participants were randomized to receive brief interpersonal therapy (IPT; n=52) or enhanced usual care (EUC; n=57). Depressive symptoms (Edinburgh Postnatal Depression Scale and Symptom Checklist) were evaluated at baseline and longitudinally across pregnancy. Brief IPT significantly reduced prenatal depression symptoms and MDD compared to EUC. Infant hippocampal and amygdala volumes were assessed using structural magnetic resonance imaging (MRI). Analyses were conducted to examine the effect of the intervention during pregnancy (IPT vs. EUC) on infant bilateral amygdala and hippocampal volume, covarying for postconceptional age at scan and intracranial volume (ICV). In addition to the RCT, a third group of euthymic individuals (euthymic; n=63) who did not exhibit elevated depression symptoms, or have any history of psychiatric diagnosis, served as a healthy comparison group. Differences in amygdala and hippocampal volume were then examined including the infants of euthymic mothers to compare effects across all three groups.

****Flash Talk**

Results: Infants of mothers in the IPT group had significantly lower left hippocampal volumes compared to the EUC group ($F(1,105)= 9.86, p < .002$). No other significant differences were found between treatment groups for right hippocampal volume or bilateral amygdala volumes (all ps > .13). Secondary analyses including infants of euthymic mothers showed that there no significant difference in left hippocampal between IPT and euthymic groups ($p < .46$).
Discussion: The observed reductions in left hippocampal volume among infants of mothers receiving IPT in comparison to enhanced usual care provides novel evidence that a brief form of psychotherapy to reduce depression during pregnancy may have intergenerational consequences for infant brain structural development. Further, our findings that left hippocampal volume among infants of mothers receiving IPT were comparable to offspring of euthymic individuals highlights the potential for therapeutic interventions to mitigate the adverse effects of maternal depression on infant brain development. Given the critical role of the hippocampus in memory and emotional processing, these changes may have long-term implications for the child's cognitive and emotional health.

SU34. DOES EARLIER PUBERTY ACCELERATE INTRACORTICAL MYELIN DEVELOPMENT AS ESTIMATED BY T1W/T2W?

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Background: Adolescence may bring about a developmental shift in learning priorities that is reflected in the opening and closing of windows of heightened plasticity known as sensitive periods. Puberty and its associated hormonal surges mark the onset of adolescence and may regulate sensitive periods. One possibility is that earlier pubertal onset accelerates brain maturation, leading to the premature closing of sensitive periods. This accelerated process may truncate some learning opportunities, impacting youths' mental health and adjustment by contributing to disparities between how adolescents are treated due to their physical maturity and their developmental readiness. Recent advances in non-invasive neuroimaging enhance our capacity to indirectly measure sensitive period plasticity. Cortical myelination during development is a mechanism for closing sensitive periods that helps mature neural systems. Intracortical myelin can be indirectly measured via a bias-corrected ratio of T1-weighted versus T2-weighted MRI images (T1w/T2w). Age-related changes in T1w/T2w are patterned according to the sensorimotor-association (SA) axis, a primary axis of human cortical organization. The sensorimotor pole of this axis is composed of cortical regions that tend toward earlier and faster nonlinear age-related T1w/T2w change from late childhood to early adulthood. Across the same age range, the association pole tends to exhibit later and slower linear age-related T1w/T2w change. For regions in the lower range of the SA axis, the most rapid age-related T1w/T2w change coincides with the onset and progression of puberty.
Methods: Mapping associations between puberty and T1w/T2w may aid in our understanding of established and largely negative effects of early pubertal timing (more advanced puberty relative to same-age peers) on psychosocial development. Our pre-registered analyses (bit.ly/3UJKUzV) utilized cross-sectional data from a subset of the large, sociodemographically diverse Human Connectome Project in Development (HCP-D) selected to cover the full age range of pubertal stages (ages 6-18; n = 1,019). Perceived pubertal stage was operationalized as a composite score

derived from two measures (the Pubertal Development Scale and line drawings from the Sexual Maturity Scale) completed by parents (up to age 9) and participants (from age 9 onward). Using Bayesian generalized additive models, we aimed to characterize non-linear associations between pubertal timing (perceived pubertal stage in models controlling for age) and T1w/T2w signal across parcels of the HCP multimodal atlas. Additionally, we tested whether pubertal timing to T1w/T2w associations varied across the SA axis. We hypothesized that earlier pubertal timing would be associated with faster rates of T1w/T2w change in earlier-developing cortical regions (i.e., regions lower on the SA axis), reflecting an earlier closure of childhood sensitive periods.
Results: Preliminary analyses did not support this hypothesis, as neither early nor late pubertal timing was associated with rates of T1w/T2w change in males or females (i.e. first derivatives did not credibly differ from zero with a 90% uncertainty interval across parcels) after accounting for age, site, and B1+ transmit field correction. Overall, reported pubertal timing effects accounted for only a marginal proportion of the variance of any parcel. However, partial R^2 values associated with pubertal timing were weakly positively correlated with SA axis rank, suggesting that puberty has a relatively greater impact on T1w/T2 in later-developing association regions than earlier-developing sensorimotor ones.
Discussion: We did not identify evidence that earlier pubertal timing is associated with faster rates of T1w/T2 change. Future studies are needed to clarify whether there are within-person effects of early puberty on longitudinal trajectories of T1w/T2w development and to consider the impacts of pubertal hormones in addition to reported perceptions of pubertal development.

SU36. THE EVOLUTION OF WHITE MATTER IN EARLY ADOLESCENCE

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Background: Adolescence is a crucial stage of neurodevelopment marked by white matter microstructure maturation in the brain. While fractional anisotropy (FA) commonly indicates increased white matter integrity, studies using voxel-based analysis (VBA) show inconsistent findings regarding altered regions and directionality of changes. Fixel-based analysis (FBA) overcomes VBA limitations by examining fixels, the smallest fiber bundle elements within a voxel. FBA provides biologically meaningful metrics like Fiber Density (FD), Fiber Cross-section (FC), and Fiber Density and Cross-section (FDC), offering insights into both microscopic and macroscopic white matter differences.
Methods: Leveraging the neuroimaging subset of data from the Co-Venture longitudinal cohort study, we investigate white matter microstructure development using FBA. The collected data involves 150 adolescents across three time points (baseline, 24 months, and 48 months). Ten major fiber pathways will be examined. Linear mixed models will be employed to understand white matter development patterns, considering factors such as sex and brain volume.
Results: In our study, we predict an increase in fiber density, indicating microstructural development during adolescence. FD, FC, and FDC metrics provided insights into the impact of development on white matter morphology, offering a more comprehensive understanding of adolescent brain development.
Discussion: Our study will highlight the dynamic changes in white matter fiber density and cross-section during adolescence. Future research should extend across a wider age range to fully

understand fiber development during adolescence. These findings will contribute to our understanding of adolescent brain development.

SU37. INFANT CEREBELLAR CYTOARCHITECTURE INFLUENCES SUBSEQUENT LANGUAGE AND MOTOR DEVELOPMENT

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Background: It is widely accepted that during the fetal period and infancy, crucial neural groundwork is laid that influences future motor and cognitive abilities (Yi et al., 2022). One brain region that undergoes significant morphological development during this time is the cerebellum (Butts et al., 2014). The cerebellum has an exponential increase in neurons in the third trimester, and continues its rapid growth postnatally (Sepp et al., 2024). Eventually, the cerebellum will contain more than 50% of all neurons in the brain (Knierim, 2020). Periods of rapid development tend to go hand-in-hand with times of exceptional vulnerability. Cerebellar damage from stroke or tumor in infancy and early childhood can result in lasting motor, cognitive, and social deficits (Olson et al., 2023; Stoodley et al., 2016). Even in neurologically intact children, differences in cerebellar white matter and/or gray matter volume, are associated with altered language and cognition (Choi et al., 2021; D'Mello et al., 2016). One study reported that cerebellar gray matter volume at 7 months of age predicted receptive language at 12 months (Can et al., 2013).
Methods: Here we go a step further by asking whether cerebellar microstructure at birth predicts differences in language and motor behavior at approximately 18 months of age. To examine this, we analyzed the developing Human Connectome Project (dHCP) dataset (Edwards et al., 2023). Our sample included 255 infants who were scanned at birth (M = 7.4 days old, range 0 to 55, and later brought in for behavioral testing (M = 19 months old). The primary neural measure of interest came from analyzing the diffusion-weighted MRI scans with an advanced technique called NODDI (Zhang et al., 2012). NODDI, for our study's purpose, describes the underlying neural microstructure by quantifying dendritic complexity. Here we focused on the metric orientation dispersion index (ODI), in gray matter, allowing us to extend prior findings relating cerebellar grey matter volume to language in older infants and children. Behavioral measures were from Bayley Scales of Infant Development (BSID-III; Balasundaram and Avulakinta, 2023).
Results: As expected, cerebellar grey matter volume, as well as ODI, correlated with age at the time of scan, and was significantly different between biological males and females. Importantly, we found that ODI measurements of grey matter at birth predict 4-6% of receptive and expressive language ability at 18-months. The implicated regions of the cerebellum for our language measures include left lobule V (a motor region), Crus II (a social/language region), and right lobule VIIIa (a working memory region). The location of findings is consistent with prior work in older samples (D'Mello et al.,2015; More et al.; 2017). We also found a relationship between cerebellum ODI and fine motor behavioral, with right lobule VIIIb (attention/motor) and right lobule IX (default mode) predicting about 3% variance.
Discussion: These findings indicate that dendritic complexity within cerebellar gray matter at birth can shape the later development of language and motor skills. More generally, these findings indicate that a subcortical region often neglected by researchers, the cerebellum, plays an important role in shaping early developmental milestones.

SU38. EXPLORATION OF PUBERTAL TIMING AND TEMPO'S INFLUENCE ON CORTICAL AND SUBCORTICAL MATURATION IN ADOLESCENCE

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Background: Puberty initiates a cascade of biological, neurological, and psychological changes. In tandem with the social transitions of adolescence, an influx of hormones results in a reorganization of the brain, making this a unique time of increased vulnerability; however, it is also proposed to be a window of opportunity to promote more positive outcomes. Puberty's onset and pace of development (i.e., tempo) vary among individuals, influencing structural brain development. Specifically, those with earlier timing are shown to exhibit accelerated brain development. Initial findings suggest that rapid pubertal tempo may correlate with accelerated cortical maturation in males but not females. However, this prior work was limited by a modest sample size and the use of linear models to assess pubertal timing and tempo in females. More work is needed to uncover more complex, potentially nonlinear pubertal trajectories in males and females and their subsequent effects on structural brain development.

Methods: Our preregistered study (https://osf.io/g3djt) aims to examine the influence of pubertal timing and tempo on structural brain developmental trajectories in the first four waves of the large, longitudinal Adolescent Brain and Cognitive Development Study (aged 9-10 at baseline). Using generalized additive mixed effect models, we'll assess how timing and tempo, extracted from nonlinear puberty growth curves, relate to cortical thickness and subcortical volume changes across adolescence. We will use parent and self-report on the Pubertal Development Scale and convert summary scores to an approximation of Tanner Stages. Our timing measure will be a participant's age at pubertal onset and our measure of tempo will be derivatives from individual puberty curves. We will use FreeSurfer parcels and segmentations to extract regional and global quantifications.

Results: As this is a preregistered project, our analysis is underway and we do not yet have results to report.

Discussion: This research seeks to illuminate nuanced patterns in the interplay between pubertal progression and brain development, contributing to a deeper understanding of adolescent neurobiology.

SU39. AUTISM POLYGENIC SCORE AND TOTAL BRAIN VOLUME IN CHILDREN WITH AND WITHOUT AUTISM

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Background: This study examined the association between a polygenic score for autism spectrum disorder (ASD-PGS) and total brain volume in children during the first two years of life.

Methods: This analysis included 326 children from the Infant Brain Imaging Study (IBIS), all of whom had genotype data and at least one neuroimaging data point. ASD-PGS was calculated using the LDpred2 method from genome wide association data. Brain MRI scans were collected at 6, 12, and 24 months. T1 and T2 weighted structural MRIs were analyzed to generate measures of total brain volume using an established infant-specific multimodal processing pipeline. Total brain volume was defined as the sum of grey and white matter volume of the cerebral cortex. Participants included infants classified as high risk (HR) or low risk (LR) based on sibling history of ASD. Infants were designated as HR if they had an older sibling with a clinical diagnosis of ASD, confirmed using the Autism Diagnostic Interview-Revised (ADI-R). Infants were designated as LR if they had an older sibling without evidence of ASD and no family history of ASD in first or second-degree relatives. At 24 months, participants were further classified as ASD, non-typically development (non-TD), or typically development (TD) based on the Autism Diagnostic Observation Schedule (ADOS), clinician best estimate, and the early learning composite score from the Mullen Scales of Early Learning. We examined correlations between total brain volume and ASD-PGS at each time point, stratified by diagnostic classification. Regression models were used to analyze the relationship between total brain volumes and ASD-PGS, adjusting for child familial risk (HR or LR), child sex, maternal education, maternal age at childbirth, and principal components representing genetic ancestry.
Results: The association of ASD-PGS on children's early total brain volume at 6 or 12 months was dependent on their ASD diagnostic status at 24 months. We found the positive correlations between ASD-PGS and total brain volume at 6 and 12 months among children who were later diagnosed with ASD at 24 months (R=0.21, p=0.21 at 6 months; R=0.21, p=0.24 at 12 months). ASD-PGS and total brain volume were negatively correlated at these times among children with TD (R=-0.15, p=0.08 at 6 months; R=-0.11, p=0.18 at 12 months). At 6 and 12 months, a high ASD-PGS for ASD was associated with larger brain volumes in children with ASD (6 month: beta= 12,756, p-value=0.290; 12 month: beta= 16,340, p-value=0.338) adjusting for child familial risk and other covariates, while this trend was opposite in TD children (6 month: beta=-6,372, p-value=0.260; 12 month: beta=-6,369, p-value=0.357). However, these findings did not achieve statistical significance.
Discussion: Early postnatal brain volumes within the first year of life are potentially predicted by ASD-PGS, with positive correlations found in children later diagnosed with ASD and negative correlations in children with TD at 24 months. These findings underscore the importance of early genetic and neuroimaging assessments in identifying children at increased risk for ASD. Further research is needed to explore how these early brain development differences evolve and relate to later ASD diagnosis, ASD-related traits, and cognitive outcomes in larger samples.

SU40. A PRELIMINARY INVESTIGATION OF READING NETWORKS IN YOUTH: METHODOLOGICAL CONSIDERATIONS, COMMUNITY INVOLVEMENT, AND FUTURE DIRECTIONS

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Background: As of 2022, more than 37% of fourth graders performed below average in reading on the National Assessment of Education Progress (NAEP) basic assessment. To combat this

underperformance, many elementary-age children across the U.S. will participate in and benefit from targeted interventions; yet some children will continue to struggle with reading as they advance throughout their schooling. At present, neuroimaging research has focused on individuals with reading difficulties largely as a homogenous group, failing to consider the broad diversity of strengths and challenges within this population including comprehension, phonics, and fluency. Furthermore, obtaining low-motion MRI data in children has historically proven difficult, particularly in those with dyslexia and/or reading difficulties who are at greater risk for comorbid neurodevelopmental conditions. In this pilot study, our aim was to determine the feasibility of collecting sufficient reading assessment and low-motion rest and task fMRI data in school-age children.

Methods: Twelve children ages 7-9 years with current or past concern for reading difficulties were invited to the University of Minnesota to participate in this study. During the first visit, participants completed a battery of reading assessments and a mock MRI scan. Parents of the participants completed self-report questionnaires assessing the child's reading difficulties, child and familial diagnostic history, and behavior. At visits two and three, participants completed T1 and T2 structural MRI in addition to four 10-minute multi-band multi-echo (MBME) resting state fMRI scans under two visual conditions (cross-hair and Pixar shorts), respectively.

Results: Two participants withdrew prior to scanning completion due to claustrophobia and scheduling challenges. The remaining 10 participants were scanned with the goal of completing at least 20 minutes of low motion (FD < 0.2mm) resting state fMRI data acquisition per condition which was achieved by 9 of 10 participants during the Pixar shorts and 7 of 10 viewing the cross-hair.

Discussion: As the rate of underperformance in reading among school-age children increases, it remains pivotal to understand the heterogeneity of the learning diagnosis and factors influencing intervention success rates. The outcomes of this study will lay the groundwork and determine pragmatics for a future multi-year investigation into characterizing reading networks in this population through both assessment, cognitive tasks inside and outside of the scanner, and low-motion resting state data. As the neuroimaging field moves towards data-sharing models, we anticipate that this data will improve our understanding of learning disabilities and the diverse neurological and social experiences of this multifaceted diagnosis. This dataset will allow us to reliably map the individualized functional networks of each child and better understand functional connectivity as it relates to comprehension, phonemes, and other areas of language and cognition. We will present the specifics of our pilot data collection and directions for our future comprehensive study. As we integrate feedback from families and multidisciplinary experts following this pilot phase, we aim to better characterize the heterogeneity of reading challenges as they present neurologically and behaviorally in hopes of improving interventions.

SU41. THE RELATIONSHIP BETWEEN THE REWARD SYSTEM AND THE RESPONSE INHIBITION SYSTEM IN YOUTH WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD)

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Background: Attention-deficit/hyperactivity disorder (ADHD) is the most commonly diagnosed developmental disorder in the United States (CDC, 2023), and is associated with increased reward-seeking behaviors and decreased response inhibition (Lijffijt et al., 2005; Willcutt et al., 2005). The addition of external rewards (i.e., payment for good performance) during response inhibition tasks improves performance in youth with ADHD to a greater extent than that of their typically-developing (TD) peers, so much so that youth with ADHD perform comparably to their TD peers (Ma et al., 2016; Rosch et al., 2016). One possible neural mechanism underlying this disproportionate improvement in performance may be related to how the brain system underlying response inhibition interacts with the brain system underlying reward responsivity. There have been inconsistent findings regarding whether youth with ADHD exhibited increased or decreased functional connectivity between cognitive control and reward regions (Cortese et al., 2021; von Rhein, D. et al., 2017) in resting-state studies using intrinsic networks. To elucidate these findings, this study proposes using task-based functional connectivity and defining specific task-based networks to test the hypothesis that increased integration between reward and response inhibition networks in adolescents with ADHD may be the mechanism through which rewards improve response inhibition performance.
Methods: We propose to use a Rewarded Go/No-Go task to assess response inhibition in 100 youth with ADHD and 50 TD youth (10-13 years old; ~35% female). We will assess performance using d', which quantifies the ability to accurately respond to Go trials, while correctly inhibiting a response to No-Go trials. Participants will undergo fMRI scans in a 3T Siemens Prisma scanner while completing the task. A high-resolution anatomical MRI scan will also be acquired to register images to standard brain space. fMRI data will be preprocessed using fmriprep (Esteban et al., 2019). Regions of interest (i.e., nodes) that comprise networks related to reward and response inhibition will be defined using the "Paradigm Class Reward" and "Paradigm Class Go/No-Go" maps, respectively, in the BrainMap database (www.brainmap.org). Correlations between fMRI timeseries across each pair of nodes will be computed to generate connectivity matrices. Next, graph theoretical analyses will be conducted to quantify integration across the two brain networks using node dissociation index (NDI; Cary et al., 2017), a measure of inter-network connections relative to all connections.
Results: To investigate how integration between the reward and response inhibition networks relate to task performance in youth with ADHD and TD youth, we will employ a multiple regression model, using NDI between the reward and response inhibition networks during the Rewarded Go/No-Go task to predict Rewarded Go/No-Go d'. We will include age, sex and mean functional connectivity as covariates. We will also investigate interaction effects between ADHD diagnosis and NDI.
Discussion: We hypothesize that youth with ADHD will have higher NDI than TD youth overall and that NDI between the reward and response inhibition networks will be positively correlated with d' (main effects). We further hypothesize that there will be a stronger relationship between NDI and d' in youth with ADHD (interaction). We hypothesize the latter because we expect that youth with ADHD will exert more effort during the task than TD youth, and literature has demonstrated that there are stronger brain-behavior relationships during more difficult tasks. Results from these analyses will contribute to our understanding of the neural substrates and demonstrated behaviors of ADHD and could inform future intervention strategies.

SU42. IMPACT OF PEDIATRIC CEREBELLAR TUMORS ON LONG-TERM COGNITIVE AND NEURAL OUTCOMES

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Background: Children with developmental cerebellar damage are at an increased risk for a range of adverse long-term outcomes. There is extensive evidence indicating that the cerebellum is not only a regulator of motor functions, but also modulates performance in cognitive and behavioral domains. Critically, different cerebellar subregions support these different functions through their interconnections with diverse cerebral cortical networks. Early cerebellar damage has been associated with disrupted grey matter development in interconnected cerebral cortical regions. Based on these findings, we hypothesized that motor, cognitive, and behavioral outcomes will depend on the location of the lesion within the cerebellum and that cerebellar damage in childhood will disrupt grey matter development in the cerebral cortex in a lesion-specific manner, demonstrating developmental diaschisis. Here, we determined the relationship(s) between lesion location and behavioral and neural outcomes in pediatric cerebellar patients. We predicted that lesions of the cerebellar anterior lobe would disrupt motor performance and impact grey matter volumes in sensorimotor cortices; posterolateral tumors would impact cognitive functions and grey matter in association cortices; and posterior midline tumors would impact behavioral regulation and disrupt grey matter in medial prefrontal regions.

Methods: We first conducted lesion-symptom mapping in 32 children with a history of cerebellar tumor resection (18 male, 14 female; age at diagnosis, mean 6.9±4.5 years). Clinical MRI scans and neuropsychological assessment data were used to evaluate the impact of lesion location on motor (peg-moving), cognitive (Wechsler verbal comprehension, working memory, and processing speed indices; verbal fluency), and behavioral regulation measures (parental reports from the BRIEF). Individual lesions were mapped in MRIcroGL using patient T1-weighted MRI scans. To allow for group analyses, all scans were normalized into standard template space with the Clinical Toolbox implemented in SPM12. We also evaluated the impact of early cerebellar lesion on supratentorial grey matter volumes using the CAT12 toolbox in patients with sufficient quality T1 scans. We used voxel based morphometry to compare grey matter volumes between patients with midline lesion (n=16) vs. patients with a lesion involving the cerebellar hemisphere (n=13).

Results: To determine which lesion patterns were associated with impaired vs. preserved task performance, patients were split into above-average and below-average groups for each measure based on standardized neuropsychological scores. Lesion overlap maps were used to assess lesion patterns associated with impaired or preserved performance. As predicted, anterior and medial lesions were associated with impaired motor scores, and lesions in the posterolateral cerebellum were associated with cognitive deficits. When evaluating the long-term distal changes in supratentorial grey matter, preliminary findings showed that the group with midline cerebellar lesions had less grey matter in precentral gyrus and the thalamus, as predicted, but also reduced grey matter in a cluster in the middle frontal gyrus. The children with lesions impacting the hemispheres showed reduced grey matter in both sensorimotor and cognitive regions of the cerebral cortex. Future analyses will investigate the relationships between individual task performance and supratentorial grey matter.

Discussion: These preliminary findings indicate that the location of lesion within the cerebellum is a predictor of later long-term behavioral and neural outcomes in pediatric tumor patients. These results contribute to our understanding of the impact of early cerebellar disruption on motor and

cognitive development, as well as the long-term effects of developmental cerebellar damage on supratentorial structures.

SU43. LEXICAL SEMANTIC PROCESSING IN CHILDREN WITH AUTISM

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Background: 25-30% of children with autism spectrum disorder (ASD) experience language impairment remaining minimally verbal through adulthood (Pickles et al., 2014; Tager-Flusberg and Kasari, 2013). Electroencephalography (EEG) can give insight into the neural mechanisms of language impairment in this population which may contribute to predicting language outcomes and targeting interventions.

The objective for this study is to investigate the event related spectral power (ESRP) correlates for a semantic mismatch paradigm in minimally verbal children with ASD compared to verbal children with ASD and typically developing children to identify potential biomarkers useful in furthering understanding of language impairment in individuals with ASD.

Methods: A total of 42 participants aged 5-11 years old will be included in this analysis. 13 participants were minimally verbal children with autism (MVASD), 14 were verbal children with autism (VASD), and 15 were typically developing children (TD). ASD diagnosis and language level was determined by The Autism Diagnostic Observation Schedule- 2.

EEG was recorded while participants watched a picture-word matching paradigm in which participants were shown photographs of 60 basic nouns on a white Background: paired with either the correct spoken word (match) or a semantically and phonetically unrelated word (mismatch). The paradigm consisted of 4 blocks of 30 trials. Each trial displayed the picture for 2000ms with the spoken word presented 500ms after onset.

The EEG recording will be segmented into 2000ms epochs with picture onset at 0ms and word onset at 500ms and baseline corrected using the pre-stimulus interval. Repeated measure ANOVAs will be used to compare the event related spectral power (ESRP) across groups and conditions.

Results: In a prior analysis (DiStefano et al., 2019), we examined the event related potential (ERP) responses and found that N400 effect was evident in all groups ($F(1)=6.06$, $p=0.018$, $ES=.34$), with a shorter latency in the TD group compared with the ASD groups ($F(2)=13.27$, $p= < 0.001$, $ES=.81$). A late negative component (LNC; 600-900ms after auditory stimulus onset) also differentiated conditions, with a group by condition by region interaction ($F(10)=2.5$, $p=.026$, $ES=0.32$). Post hoc analyses revealed that the LNC was present across multiple regions in the TD group, in the mid-frontal region in MVASD, and not present in the VASD group.

ERSP analysis will examine spectral characteristics of the event-related EEG signal. We will examine event-related changes in spectral power across delta, theta, alpha, beta and gamma frequency bands (up to 50 Hz) and determine whether group differences exist. Based on the ERP results, we hypothesize that the ERSP results will not differ by group in the N400 time window, but will differ in the 600-900ms time window. As changes in all five frequency bands have been associated with language processing tasks, we do not hypotheses regarding specific frequency bands.

Discussion: Initial ERP analyses demonstrated that that children with ASD (including those with minimal language) showed some EEG evidence of semantic processing but altered compared to typically developing children. Our results suggest that as a group, semantic processing is not absent in children with ASD, but it is characterized by delayed speed of processing and limited integration with mental representations. Differences observed in spectral frequency power changes, derived from ERSP analyses, may provide additional information about the underlying neural mechanisms being engaged which account for the observed ERP differences.

SU44. CHARACTERIZING WHITE MATTER ALTERATIONS IN YOUTH AT CLINICAL HIGH RISK FOR PSYCHOSIS

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Background: Schizophrenia and other psychotic disorders are severe mental illnesses with staggering costs at the individual and societal level. The progression to full-blown psychosis is typically preceded by a prodromal phase, during which individuals experience attenuated positive and negative symptoms until the onset of the initial psychotic episode, upon which patients may transition to a chronic psychotic disorder (McCutcheon et al., 2020). This prodromal phase has been referred to as the clinical high risk (CHR) state (Yung and McGorry, 1996). Critically, not all patients who meet criteria for CHR will transition, with conversion rates estimated at 20-40% within 2-3 years (Fusar-Poli et al., 2012).

Previous work has found that patients with schizophrenia show regional microstructural abnormalities across major white matter tracts, which have been linked to cognitive deficits and symptom severity (Peters and Karlsgodt, 2015). However, the evidence regarding whether such white matter alterations precede or predict conversion in CHR subjects is mixed and inconclusive (Di Biase et al., 2021).

The North American Prodromal Longitudinal Study (NAPLS) is a multi-site consortium study that began as an effort to understand risk factors that contribute to conversion to overt psychosis (Addington et al., 2007). We aim to probe differences in white matter microstructure between CHR subjects and healthy controls, as well as between CHR individuals who transition to psychosis

(CHR-C) and those who did not transition over the course of the study (CHR-NC) using data from the most recent phase of the NAPLS project (NAPLS-3).

Methods: Data were collected from 491 CHR participants and 76 controls. Subjects were between the ages of 12 and 30 (CHR mean age=18.62 (4.07), 56.2% male; controls mean age=18.78 (4.43), 49.3% male). CHR subjects met criteria according to the Criteria of Psychosis-Risk Syndromes (McGlashan et al., 2010). Participants were scanned on Siemens or GE scanners across eight sites. Multi-shell diffusion magnetic resonance imaging (dMRI) data were acquired with six interleaved b=0 s/mm2 images and two b-values shells at b = {1000, 2500} s/mm2, with each shell having 30 gradient directions. The sequence included 70 axial slices, 256 mm2 field of view, 2 mm isotropic voxels, a repetition time of 10200 ms, and an echo time of 106 ms.
dMRI data will be preprocessed using tools from FSL, MRtrix, and DIPY implemented in the PreQual pipeline (https://github.com/MASILab/PreQual). Various harmonization approaches will be tested to account for site and scanner effects, such as multi-shell-dMRI harmonization (https://github.com/pnlbwh/multi-shell-dMRIharmonization) and neuroCombat (https://github.com/Jfortin1/neuroCombat). Diffusion tensor imaging (DTI) and neurite orientation dispersion and density imaging (NODDI) metrics will be calculated in the preprocessed dMRI images.

Tract-Based Spatial Statistics (TBSS) will be used for registering subject images into template space. Group differences across each DTI and NODDI measure will be identified using multiple regression analyses covarying for sex and age.

Results: We plan to report the results of differences between CHR and controls for the following regions of interest: forceps major, forceps minor, left/right (L/R) cingulum, L/R inferior fronto-occipital fasciculus, L/R inferior longitudinal fasciculus, L/R superior longitudinal fasciculus, L/R uncinate fasciculus, and whole-brain white matter. We will also examine differences at baseline (i.e., before conversion) between CHR-C and CHR-NC participants.
Discussion: While substantial strides have been made in identifying clinical risk factors for conversion among CHR individuals, the mechanisms underlying the transition remain uncertain. By examining alterations in white matter microstructure in the CHR phase, we hope to gain further insight into the mechanisms of brain changes that coincide with the onset of psychosis and enhance our ability to predict risk of conversion.

SU45. EXPLORING THE EFFECTS OF ADHD AND METHYLPHENIDATE ON FUNCTIONAL BRAIN NETWORK HUBS

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Background: Psychostimulants, like methylphenidate (MPH), are the first-line treatment for ADHD and are effective for most patients. While MPH is known to block dopamine and norepinephrine transport, its precise mechanism in improving ADHD symptoms remains unclear. Functional neuroimaging studies have shown that children with ADHD have altered functional brain network topology. Importantly, highly connected, central nodes in networks called hubs have been theorized to play a role in disease pathophysiology due to their importance in brain networks, but studies on hubs in ADHD are sparse. Hubs may thus be key to understanding how brain network topology is altered in ADHD and how MPH impacts this topology. This study therefore

utilized graph theory metrics to identify and characterize functional brain network hubs in individuals with ADHD on MPH and on placebo and in typically developing (TD) children.
Methods: Participants 8-12 years old participated in this study (n = 22 psychostimulant-naïve children with ADHD, n= 25 TD children). Participants received two fMRI scans, and those with ADHD were administered MPH or placebo at the two MRI sessions in a double-blind, crossover design. Participants completed resting state scans and cognitive tasks, including standard and rewarded versions of a go/no-go task in the scanner. Functional connectivity was estimated from time series concatenated across all tasks. Task events were included as nuisance regressors for task runs to remove task-induced signal. A functional brain atlas including 300 cortical and subcortical spherical regions of interest (ROIs) was used (Seitzman et al., 2020). 35 of these ROIs were excluded due to limited field of view during acquisition, leaving 265 ROIs. Time series data was averaged within each ROI and correlation matrices from these averaged time series were generated. The optimal partition of communities was determined individually for each correlation matrix using the consensus clustering method. Finally, graph metrics were calculated using Brain Connectivity Toolbox. First, degree strength, betweenness centrality, and local efficiency were used as measures of overall hubness of the nodes. A composite score based on the average ranking across these three metrics determined the 40 top hubs for each group (ADHD on MPH, ADHD on placebo, and TD). Next, within-module degree (WD) and participation coefficient (PC) were calculated to assess the degree of network segregation (WD; within-network connectivity) and network integration (PC; between-network connectivity) of these hubs. The three groups were then compared using mixed effects models, using age, biological sex, mean functional connectivity, and mean framewise displacement as fixed effects with random intercepts for participant and ROI. For each graph metric and node, one model compared participants with ADHD on and off MPH and the other model compared participants with ADHD on placebo to TD participants.
Results: Group-specific hubs were distributed across the brain, with network membership in visual, frontoparietal, cingulo-opercular, somatomotor dorsal, dorsal attention, auditory, and salience networks. 24 hubs (60%) were shared among all three groups. Additionally, 29 hubs (72%) were shared among the ADHD placebo and TD groups, and 31 hubs (78%) were shared among the ADHD placebo and MPH sessions. There were 11 hubs in the ADHD placebo group not in the TD group and 9 hubs in the ADHD MPH session not in the ADHD placebo session. Mixed effects models showed that group-specific hubs in children with ADHD exhibited higher PC than those in TD children. Additionally, hub regions in children with ADHD on MPH had lower local efficiency compared to placebo.
Discussion: This study indicates that group-specific hubs in children with ADHD have greater between-network connectivity than hubs in children without ADHD. Further, MPH specifically decreases connectivity within the local neighborhood of hub nodes.

SU46. STRIATAL IRON IN SINGLE VENTRICLE CONGENITAL HEART DISEASE (CHD): A POTENTIAL MARKER OF DISEASE AND COGNITIVE DYSFUNCTION.

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Background: Individuals with CHD are now frequently surviving into adulthood but experience reduced cognitive and executive function. Brain tissue iron, measured with MRI, has the potential to link disease characteristics, such as iron deficiency, with outcomes. Most of the brain's tissue iron is found in the striatum, along with most dopamine neurons, tied together because iron is needed for dopamine synthesis, which in turn plays a key role in cognition and executive function. As such, iron deficiency may impact dopamine synthesis as well as overall neuron health. Iron deficiency occurs in CHD because hypoxic conditions create a demand for iron to increase hemoglobin, causing a maladaptive exodus of iron from tissues to meet demand, which in turn leads to oxidative stress and subsequent dopamine cell death. MRI serves as a potential marker of this process. In normative populations, striatal iron accumulates throughout childhood, where increased MRI-based indices are related to increased cognition and working memory, likely through increased dopamine neuron storage. In CHD, iron may increase above these developmental norms, indicating oxidative stress and cell death. For example, while MRI measures iron in both its ferrous and ferric form, oxidative stress increases the proportion of ferric iron, increasing magnetic susceptibility, as demonstrated with MRI.

Methods: Here, we used MRI to assess iron deposition in a cohort (NHLBI-funded Pediatric Heart Network Single Ventricle Reconstruction Trial III) of single ventricle CHD (N=102) and control pre-adolescents (N=81) that range from 10-16.98 years. We related MRI-based indices of iron to executive function, clinical factors, which may increase oxidative stress through hypoxia and socioeconomic status (SES). To measure tissue iron's magnetic susceptibility, we used the T2* signal from rsfMRI, creating one T2* map per child. We standardized each volume to the median and then aggregated by taking a median over volumes. We measured T2* values for three regions: the pallidum, putamen and caudate.

Results: In the pallidum and the putamen, we found a statistically significant age- interaction ($p=0.03063$, $p=0.03153$) where the SVRIII subjects started with significantly lower iron levels but then demonstrated levels significantly > controls. Finally, we assessed if executive function was related to iron levels, finding opposing results in both groups. Interestingly, in the SVRIII participants, increased tissue iron in the pallidum was related to better performance on the D-Kefs Tower Test (measures multiple high-order executive functions, $p=0.043$), but this relationship was not seen in the controls.

With regards to clinical factors, length of hospital stay (a known predictor of poor neurodevelopmental outcomes in CHD), throughout all three inter-stage surgeries, was not statistically related to iron levels. However, the number of cardiac catheterizations, often indicative of hypoxia, was associated with iron deposition. We found that the more catheterizations an infant underwent throughout their inter-stage surgical period, the higher their iron levels in the putamen and the caudate ($p=0.021$, $p=0.017$). SES may affect access to medical care and diet, both of which could influence iron levels. There was no significant relationship between SES (Child Opportunity Index) and brain iron level.

Discussion: In summary, our results suggest that single ventricle individuals acquire brain tissue iron with an abnormal trajectory, with ultimately increased brain tissue iron that may be indicative of oxidative stress. This trajectory may be influenced by specific clinical factors that indicate hypoxia (e.g. catheterizations) but not variables with a broader impact like SES. Conversely, for

the SVRIII participants, the pallidum appears to be playing a compensatory role, facilitating higher-order executive function in a way that's different from controls.

SU47. BEHAVIORAL STRATEGIES TO MINIMIZE HEAD MOTION REDUCE THE NEED FOR GENERAL ANESTHESIA IN PEDIATRIC PATIENTS UNDERGOING MR NEUROIMAGING

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Background: Many pediatric patients routinely undergo magnetic resonance imaging (MRI) in general anesthesia (GA) despite concerns regarding the long-term effects of GA and increased costs. Results from Denmark and abroad show that it is possible to scan pediatric patients from the age of 3-4 years without sedation or GA by appropriate preparation e.g. by story books or mock-up scanners. Using behavioral strategies to teach the children to lie still in combination with advanced MR image acquisitions, we aimed to reduce the need for GA in a pediatric patient population. In a prospective clinical study, we evaluated the efficacy of preparation in combination with prospective motion correction in pediatric patients undergoing brain MRI. The study was carried out at Copenhagen University Hospital, a tertiary referral center for rare and complex pediatric diseases. Hence, requirements for image quality are very high, allowing only a small degree of residual motion artifact.

Methods: The study enrolled 50 pediatric patients with a wide variety of clinical indications from headache to cerebral tumors. Inclusion criteria were pediatric patients aged 4 to 10 years referred for an elective scheduled clinical brain MR scan in GA. Exclusion criteria were medical conditions interfering with the safety of the MR scan, non-fluent Danish, pronounced visual or auditory impairments, and major physical or developmental challenges. In order to prepare children to lie still during their MRI examination, they were given a custom-made mobile phone app they could use at home and received training in the mock scanner with head motion tracking at the hospital prior to their clinical examination. Anxiety levels were assessed five times using the State -Trait Anxiety Inventory (STAI-C) Questionnaires for children. First, a baseline questionnaire was completed at home and then directly before and after the mock scanner training, as well as directly before and after clinical imaging.

All imaging data was acquired on a Siemens 3 T Magnetom Prisma scanner. Acquisition protocols varied between patients depending on the clinical indication. Motion was recorded for all patients during the mock and real scan sessions using a markerless optical tracking device and applied in half of the patients randomized for prospective motion correction (PMC). Image quality was assessed by a pediatric neuroradiologist for diagnostic purposes and computationally with a non-reference based image quality measure, average edge strength.

The primary outcome of the study was a successful radiological evaluation by sufficient quality of images to assess the respective conditions. Secondary outcomes were a reduction in anxiety as well as an improvement of image quality in the PMC scans.

Results: The gender distribution was balanced (25 M/25 F) with a mean age 7,24(±1,87) years at the time of the scan. Of the 50 pediatric patients, 47 successfully completed the MR scan, and the neuroradiologist approved the quality of the scans for clinical diagnosis, equaling a 94% success rate. Three pediatric patients were referred for a scan with GA.
In a linear mixed model controlling for age, sex and the baseline trait anxiety an overall decline of anxiety over time was detected. Assessing image quality for the most common imaging sequence (MPRAGE, N=45 patients) indicated no significant difference in image quality between PMC ON (N=24) and OFF (N=21) cases.

Discussion: In this study, we demonstrate that high-quality diagnostic images can be obtained in pediatric patients by preparation with an MRI app and mock scanner training in combination with motion correction thereby avoiding the use of sedation or GA. Low levels of head motion were observed following preparation. Therefore, the effect of additional advanced imaging using PMC seems negligible when examining the most common sequence (MPRAGE) used in the examinations. This warrants further examination and we are assessing the effects of the training by itself in a follow-up study.

SU48. LONGITUDINAL WHITE MATTER DEVELOPMENT DIFFERS BETWEEN GIRLS AND BOYS WITH ADHD: EVIDENCE FROM FIXEL-BASED ANALYSIS

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Background: Cross-sectional studies have found white matter differences between girls and boys with ADHD. However, there is a scarcity of longitudinal work examining the impact of sex on white matter fiber development in children with ADHD. To examine if white matter fiber development varied according to sex in children with and without ADHD, this study estimated microstructural and morphological properties of 71 white matter tracts from 390 high angular diffusion scans acquired prospectively on 74 boys with ADHD (153 scans), 25 girls with ADHD (54 scans), and 85 children without ADHD (183 scans).
Methods: High angular diffusion data were collected on a 3T MRI scanner (b = 2800 s/mm2, 60 directions). Participants underwent up to three MRI assessments between the ages of 9.5 and 14.5 years. White matter tracts were reconstructed using TractSeg, a semi-automated tractography method. For each tract, we derived measures of fiber density (microstructure) and fiber bundle cross-section (morphology) using Fixel-Based Analysis (FBA), a novel and fiber specific analysis framework. Linear mixed models were used to compare trajectories of white matter fiber development between girls and boys with ADHD. A longitudinal sample of children without ADHD was included as a reference cohort.
Results: Interaction effects showed that the impact of sex on white matter fiber development differed between children with and without ADHD. Relative to females with ADHD, males with ADHD showed accelerated white matter fiber development in the superior longitudinal fasciculus. This pattern of results was not observed in the non-ADHD group. In children without ADHD, sex-based variations in white matter fiber development were observed in the corpus callosum and in the cingulum. This pattern of results was not observed in the ADHD group.
Discussion: Leveraging longitudinal advanced white matter neuroimaging and clinical data, this study provides new insight into the impact of sex on white matter fiber development in children

with and without ADHD. Our results suggest that the effect of sex on white matter fiber development varies between children with and without ADHD. Our results further indicate that white matter fiber development is differentially affected in girls and boys with ADHD. These findings advance our understanding of the impact of biological sex on structural brain development in ADHD.

SU49. ROLE OF ATTENTION AND SENSORY DISTRACTION IN SOCIAL PROCESSING FOR YOUTH WITH AND WITHOUT AUTISM

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Background: Sensory over-responsivity (SOR), an extreme negative response to aversive sensory stimuli, impacts approximately 56-70% of individuals with autism spectrum disorder (ASD; Ben-Sasson et al., 2008). SOR often co-occurs with other psychiatric conditions (e.g., anxiety) and is associated with difficulties in social and adaptive functioning (Glod et. al., 2015). Furthermore, autistic individuals with SOR may attribute greater attention to extraneous sensory information over social information (Green et al., 2018). A preliminary study that tested the effect of sensory distraction on social information processing found that tactile distractors increased activation in auditory language areas for TD youth whereas it decreased activation in these regions for ASD children (Green et al., 2018). Here, we sought to replicate these findings with more rigorous statistical thresholds, as well as explore these effects in later development (late childhood/early adolescence vs. late adolescence/young adulthood). The objective of this study is to investigate how tactile sensory distraction affects social information processing in ASD compared to TD youth, and how this relates to age.

Methods: We used functional magnetic resonance imaging (fMRI) to examine brain responses in 50 ASD youth and 43 age- and IQ-matched TD participants, ages 8 to 25 years. Participants listened to 16 different social scenarios ending with either a sincere or sarcastic response and indicated if the person meant what he/she said. Participants were provided instructions with every trial. They were first told to “pay attention” and in the last half of the blocks were told to “pay attention to the tone of the voice and the look on the face”. During half of the blocks, participants had their forearm rubbed with a mildly aversive fabric as a sensory distractor. Within- and between-group analyses were thresholded at $Z > 2.3$, $p > 0.05$.

Results: During the social cognition task without tactile stimulation, we found that both groups exhibited activation in auditory regions, and regions associated with social attention and emotional regulation (e.g., prefrontal cortex (PFC) and inferior frontal gyrus). Within the ASD group, age was associated with greater recruitment of these prefrontal regions during the task alone. When tactile distraction was added, all ASD youth regardless of age showed decreased prefrontal activation. In contrast, the TD group, but not the ASD group, also showed increased activation in regions associated with integrating social information (i.e., temporal pole). These results are consistent with prior findings and suggest that the TD group is recruiting more attention to social information to continue to process the social information despite the presence of a sensory distraction. However, when explicit instructions were provided, all ASD youth, regardless of age, exhibited sustained activation in PFC, as well as auditory and language regions, even during tactile distraction.

Discussion: Our findings corroborated previous work (Green et al., 2018) indicating that TD youth show more effortful processing of social information compared to ASD youth, at a more stringent statistical threshold. In addition, we found that during sensory distraction, ASD youth demonstrated decreased PFC activation regardless of age. For the ASD group, difficulties increasing attention and language-processing regions during sensory distraction could contribute to ASD-related social difficulties in real world settings in which there are many competing stimuli. Yet, all ASD youth engaged areas associated with social attention and cognitive after explicit instructions were given and sustained this engagement even with a tactile distractor. These findings suggest that providing explicit instructions can reprioritize attention towards social cues, and may have particular benefits for younger ASD children who are often most affected by sensory distraction in the absence of explicit instructions.

SU50. BRAIN COACTIVATION DYNAMICS IN CHILDREN WITH AUTISM AND/OR ADHD: A TRANSDIAGNOSTIC APPROACH TO INTERINDIVIDUAL BRAIN BEHAVIORAL DIFFERENCES

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Background: Collectively, 10% of children worldwide are affected by autism spectrum disorder (hereafter autism) or attention-deficit/hyperactivity disorder (ADHD), and they often co-occur. Current evidence points towards altered intrinsic brain functional connectivity with convergence on atypicalities in the default mode network (DMN) in both conditions. However, findings within and across diagnoses have been inconsistent. Most prior work has focused on static connectivity and case-control comparisons that may obscure meaningful sources of heterogeneity. As such, dynamic connectivity and dimensional approaches are increasingly used to understand these neurodevelopmental conditions. Prior studies have revealed that greater time spent in a DMN dominant state is associated with fewer autism symptoms and greater ADHD symptoms. However, these studies have been conducted in autism and ADHD youth separately and have not accounted for co-occurring symptoms in a single transdiagnostic sample. This study uses coactivation pattern (CAP) analysis to examine interindividual differences in the associations between dynamic connectivity and symptom severity of autism and/or ADHD in a transdiagnostic youth sample.
Methods: Data from 166 children (6–12 years old) with autism and/or ADHD (75% male) completed T1w structural and 6-minute resting state functional MRI (fMRI) scans on a 3T Prisma Siemens MRI scanner (fMRI: TR=800ms, TE=30ms, voxel size=2.4x2.4x2.4mm). Data with median framewise displacement (FD) < 0.2 mm were preprocessed using the Configurable Pipeline for the Analysis of Connectomes (CPAC) version 1.7.2. Analyses on fMRI timeseries derived eight CAPs across the sample; dwell times, occurrence rates, and incidence rates for each CAP and person were computed. Pearson partial correlations tested for dimensional associations between these CAP properties and autism/ADHD symptom severity, covarying for age, sex and median FD. Symptoms were rigorously measured using the Autism Diagnostic Observation Schedule-2 (ADOS-2) total, Social Affect (SA), Restricted and Repetitive Behaviors (RRB) scores for autism, and the Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS) total, hyperactivity/impulsivity (HI) and inattention (IN) scores for ADHD. A priori analyses focused

on CAPs showing coactivation in the DMN; further analyses explored behavior associations with other identified CAPs.
Results: Two CAP pairs were identified with strong coactivation in the DMN (CAPs 1/2 and 5/6). Dwell time of one of them (CAP 6) positively correlated with ADOS-2 total scores (r=.18, p=.019) and negatively correlated with KSADS ADHD totals (r=-.20, p=.011). When separated by symptom subdomain, these correlations were specific to ADOS SA (r=.16, p=.039) and KSADS HI (r=-.21, p=.008) symptoms. Exploratory analysis of visual and dorsal attention dominant CAP properties revealed that a lower incidence rate of the visually dominant CAP (state 3) was associated with higher ADOS-2 total severity (r=-.26, pFDR=.019) and SA (r=-.25, pFDR=.019) scores.
Discussion: Our findings show a double dissociation by diagnostic symptom domain involving the brain state characterized by simultaneous deactivation of DMN and frontoparietal network and activation of the somatomotor network (CAP 6). While children with higher autism symptoms spent more time in this brain state, children with higher ADHD symptoms had shorter dwell time for this brain state. Results can help clarify prior research on the role of atypical DMN connectivity in autism and ADHD. Follow up analyses will expand on the relationship between brain dynamics and cognition in this transdiagnostic and comorbid sample.

SU51. SHARED AND DIVERGENT NEUROANATOMICAL FEATURES OF ATTENTIONAL DEFICITS IN ADOLESCENTS

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Background: The present study examined the neuroanatomical substrates of two types of attentional problems. The first, Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by predominantly inattentive (ADHD-IN), predominantly hyperactive/impulsive (ADHD-HI), or combined symptom presentations. The second, cognitive disengagement syndrome (CDS), formerly known as sluggish cognitive tempo, is a behavioral construct characterized by hypo-activity or slowed behavior, mental fogginess or confusion, excessive sleepiness, and daydreaming. Several studies have shown that ADHD-IN and CDS are co-occurring but separable constructs. Importantly, both ADHD-IN and CDS are associated with unique constellations of functional impairments, though little research has been done to understand their shared and divergent neurobiological correlates.
Methods: The current study was part of the Colorado Learning Disabilities Research Center (CLDRC) twin study. Participants were 181 adolescents (91 males) ages 10 to 16 (M=13.6, SD=2.5), including 23 sets of monozygotic twins, 60 sets of dizygotic twins, and 15 singletons. The Child and Adolescent Behavior Inventory (CABI) was completed by a parent or guardian to capture symptoms of each ADHD-IN and CDS, which were treated as dimensional instead of using diagnostic cutoffs. Participants completed a T1-MPRAGE sequence on a 3-Tesla MRI scanner. Explanatory variables for whole-brain vertex-based analyses modeled the mean volume across the sample, CDS and ADHD-IN symptom scores, participant age, sex, and mean intracranial volume. Clusters were identified using threshold-free cluster enhancement and subjected to family-wise error-rate corrections. Procedures were repeated in a separate sample of 292 adolescents ages 13 to 20 (M=16.8, SD=1.4) using a 2-item ad-hoc measure of CDS for attempted replication.

Results: In the CLDRC sample, several areas of positive correlation between regional volume and ADHD-IN symptoms were identified when controlling for CDS symptoms. These regions included left dorsolateral, dorsomedial, and ventromedial prefrontal regions, as well as left lateral and medial posterior parietal regions. There were also areas of significant negative correlation between regional volume and CDS symptoms when controlling for ADHD-IN symptoms, including left lateral parietal and temporal regions, as well as left dorsomedial prefrontal regions. In the replication sample, the following significant associations were replicated: positive correlations between volume and ADHD-IN symptoms in left ventromedial prefrontal regions when controlling for CDS symptoms, and negative correlations between volume and CDS symptoms in left lateral temporal regions when controlling for ADHD-IN symptoms.
Discussion: The current study is one of few to examine the neurobiology of CDS and ADHD-IN symptoms, and the first study to use the CABI, which contains a 16-item subscale dedicated entirely to characterizing CDS symptoms. Findings suggest the importance of regions that fall within intrinsic connectivity networks, including the frontoparietal, default mode, and dorsal attention networks, all of which are known to support attentional processes. Notably, these regional volumes showed predominantly positive correlations with ADHD-IN symptoms and negative correlations with CDS symptoms when both attentional factors were included in the same model, suggesting a complex interplay of the intrinsic connectivity networks in these attentional constructs that warrants further study. Additionally, the replication of our findings in an outside sample implicates left ventromedial prefrontal and left lateral temporal regions as important areas on which to focus future research efforts. Additional research on the unique neurobiology of CDS is needed to better understand its underlying etiology, as well as potential interventions.

SU52. MULTIVARIATE PATTERNS OF NEURAL ACTIVATION TO MONETARY INCENTIVES PREDICTING MOOD, MANIA, AND IMPULSIVITY IN ADOLESCENT DEPRESSION

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Background: Adolescent depression is heterogenous, with affected adolescents engaging in either decreased or, less commonly, increased reward seeking. This heterogeneity in reward seeking observed in adolescent depression may be related to differences in symptom presentation. However, the extent to which patterns of corticostriatal reward-related (and punishment-related) brain activity are associated with symptom presentation in adolescent depression remains unclear. The proposed analyses will use machine learning approaches to identify patterns of neural activity during anticipation and/or feedback of monetary reward and punishment that best predict mood (anhedonia, sad mood), mania, and impulsivity in adolescent depression.
Methods: Participants are 174 adolescents (12–18-years-old, 136 with moderate/severe depression) who completed fMRI during a monetary incentive delay (MID) task, a well-validated reward task, and self-report questionnaires on depression symptoms (anhedonia, sad mood), mania, and impulsivity. Our hypotheses and analytic approach were preregistered (Gonçalves, 2024; https://osf.io/e3a89). We will create separate models predicting anhedonia, sad mood, mania, and impulsivity. Inputs will include neural activity during reward and punishment anticipation and feedback in the SMA, ACC, OFC, dlPFC, and striatum; principal components

analysis will be used to reduce number of features. We will employ support vector regression with optimized hyperparameters (e.g., kernel type, C; determined on the training set) using five-fold cross-validation. Performance of models will be evaluated with mean absolute error (MAE) and R2. We will also estimate measures of feature importance and examine the impact of age and sex on predictive performance of models.

Results: Although data has been collected, data analyses are in progress. Thus far, preliminary results demonstrate that the proposed model of neural activity during anticipation of monetary punishment predicting manic symptoms is successful (R2 = .02, MAE = .75 with standardized manic symptom values). Predicted values of manic symptoms are positively correlated with actual values of manic symptoms in the testing set (ρ = .31; p = .049). Full results will be available for the 2024 Flux Congress.

Discussion: Results will increase our knowledge of the pathophysiology of adolescent depression. This can be used to inform targeted interventions of depression symptoms involving deficits in reward seeking and punishment. The aforementioned preliminary result identifies corticostriatal neural activity to punishment as a correlate of manic symptoms in adolescent depression, highlighting the potential of using corticostriatal neural activity to punishment as a treatment target.

SU53. DEVELOPMENTAL DYNAMICS OF READING: EXPLORING THE DIFFERENCE OF AMPLITUDE AND LATENCY BETWEEN CHILDHOOD AND ADULTHOOD

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Background: The hierarchy of cortical processing levels for reading words progresses from low-level visual features to learned letter-form information to learned visual words. Recently, Steady-state Visual Evoked Potential (SSVEP) oddball studies have used clever stimulus contrasts to study each of these distinct levels and their distinct neural sources in adults. Our group has recently discovered that in addition to oddball amplitude, the phase of the evoked brainwave and its harmonics provides a remarkably stable individual subject estimate of 'neural latency' (i.e. eye mind lag) for each of these distinct levels. The current study uses both oddball amplitude and individual subject neural latency estimates for word-form and letter-form processing to study how the functional and temporal dynamics of the visual system changes across development from novice (3rd grade) to adult readers.

Methods: 69 children (age= 11.32 +/- 1.80) and 33 adults (age= 23.34 +/- 2.91) participated in a SSVEP study while 128-channel EEG was recorded. Three conditions—(1) English Words vs Pseudofont, (2) NonWord vs Pseudofont, (3) English Words vs NonWord—were adapted from a study by Lochy et al. (2015), each comprising "deviant" stimuli at 1 Hz frequency embedded in "base" stimuli at 3 Hz frequency. These conditions collectively allow us to examine coarse print tuning (i.e. letter-form information) and lexical processes (i.e. learned whole words). Ten trials of each condition were presented in a random order and counterbalanced among participants.

Following the SSVEP study, all participants completed a battery of cognitive tasks composed of the Edinburgh Handedness Inventory, Matrices of Kaufman Brief Intelligence Test, Test of Silent

Reading Efficiency and Comprehension (TOSREC, Form C), and Test of Word Reading Efficiency (TOWRE-2 Form A).

The EEG data will undergo Reliable Component Analysis (RCA; Dmochowski et al., 2015), which computes optimal spatial weightings of sensor-space data to maximize phase-locked activity. RCA will be performed on all deviant and base harmonics on all conditions to examine reliable components and significant amplitude values. The topographies of the spatial filters will be interpreted to address Hypothesis 1. Hypothesis 2 will be addressed through the following analyses: First, the component-space data will be analyzed to identify stimulus harmonics corresponding to statistically significant response amplitudes, and response latencies will be estimated as the slope of the line fit across phase values for these statistically significant harmonics (Norcia et al., 2020). Individual-participant latency values will be utilized for regression analysis for reading comprehension and fluency analysis.

Results: Based on a previous study, it is expected that adult latency would be in the 140-180 ms range (Wang et al., 2021). We also hypothesized that latency will decrease with age as well as with higher reading fluency and comprehension (Hypothesis 1). Finally, stronger amplitude in deviant frequencies may emerge with age due to increased reading efficiency and fluency (Hypothesis 2).

Discussion: The study underscores the critical role of visual processing and neural responses in the development of reading fluency. By investigating age-related variations in brain amplitude and latency, we aim to fill a significant gap in our understanding of how reading skills differ between different age groups.

SU54. RELATIONSHIP BETWEEN SPELLING ABILITY AND CORTICAL RESPONSES TO FAMILIAR LETTER COMBINATIONS

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Background: While learning to read, our neural networks internalize written and verbal statistical regularities that are foundational to fluency. Neural sensitivity to orthographic structure is emerging as an important cognitive skill underlying literacy development. Our group found longitudinal changes in early readers' brain responses to visual word form structure that were linked to growth in reading fluency (Wang et al., 2021, 2023). Reading and spelling development may be powerfully intertwined and require children to produce orthographic forms from memory, placing a greater demand on orthographic knowledge. Thus, we aimed to assess whether spelling ability is correlated with neural sensitivity to orthographic structure.

Methods: We assessed 1st- and 2nd-graders' sensitivity to orthographic structure using an electroencephalography (EEG) Steady State Visual Evoked Potentials (SSVEP) paradigm (n = 49, ages 6-8 years). Stimuli were created from a set of 12 commonly recurrent rime units (e.g., -oat, -awl), and common onset consonant clusters, all statistically matched on bigram and trigram frequency across conditions. Each SSVEP trial presented letter strings at 3 Hz with a 1Hz "oddball" design in which one of every three presentations was an orthographically legal pseudoword (e.g., cloat). All other stimuli in the 3Hz stream were orthographically illegal nonwords with rime and onset flipped (i.e. oatcl) resulting in reduced bigram and trigram frequencies. The order of SSVEP conditions was counterbalanced across participants. Participants

were instructed to press a button when they noticed the same word form repeat on screen three times in a row, an unrelated task to the process of attending to orthographic structure. Thus, detecting legal orthographic structure may drive significant power at the oddball frequency and its unique harmonics, with oddball amplitude indexing neural sensitivity to orthographically legal pseudoword structure.

Results: H1: The amplitude at the oddball frequency for the first RCA component (RC1) will be statistically significant, under the same operational definitions and statistical criterion used in Wang et al., 2021. Additionally, we hypothesize that RC1 will produce a significantly left lateralized topography (e.g., Wang et al., 2023).

H2: Standardized psycho-educational assessments of spelling ability (Woodcock-Johnson (WJ) Spelling subtest) will be correlated with the amplitude of the RC1 at 1Hz, as assessed by partial correlation analyses controlling for age.

H3: We further predict a developmental shift in the neural sensitivity to orthographic structure, such that mean second grade performance will be larger than mean first grade performance.

We will analyze cleaned EEG data using Reliable Components Analysis (RCA; Dmochowski et al., 2015), to identify spatial components and significant amplitude values by optimizing sensor-space data to maximize trial-to-trial covariance relative to within-trial covariance. We will first compute RCA at 3Hz to confirm that low-level visual features were well-matched across conditions. RCA computed at oddball frequencies will investigate processing differences between pseudowords and nonwords. Then, statistically significant spatial topographic components and amplitude values will be analyzed to address H1. H2 will be addressed by correlating EEG amplitude values across all 3 conditions and normed WJ spelling scores. We will add age and grade as covariates to assess how development affects this relationship to address H3.

Discussion: Following an established connection between orthographic sensitivity and reading fluency, this study aims to link neural sensitivity to orthographic structure and general spelling ability. We further aim to understand if this relationship is modulated by development. Future work could look at familiarity with specific words and the impact of training on neural and behavioral orthographic sensitivity.

SU55. CHILDHOOD MALTREATMENT EFFECTS ON COGNITIVE CONTROL RELATED FUNCTIONAL CONNECTIVITY CHANGES ACROSS ADOLESCENCE: PROSPECTIVE ASSOCIATIONS WITH MENTAL HEALTH OUTCOMES

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Background: It is well established that childhood adversity is associated with long lasting effects on development including both negative physical and mental health outcomes. Recent research posits that 1) there may be developmental periods for which the effects of adversity are most influential on brain development and 2) abuse and neglect may be associated with different developmental mechanisms linking psychopathology. This study used seven years of longitudinal data to investigate how abuse and neglect during three developmental periods (early childhood, school age, and adolescence) are associated with young adult mental health outcomes (ages 19-

20), and how changes in adolescent task-based functional connectivity during cognitive control (between ages 13-14 and 18-19) may mediate this association.

Methods: Hypothesized models were tested via Structural Equation Modeling (SEM) using path analysis to examine direct and indirect effects. The current sample included 167 adolescents (Mage =14 years old at Time 1; 53% male), assessed annually for seven years. Adolescent-reported abuse and neglect during early childhood, school age, and adolescence were assessed retrospectively using the Maltreatment and Abuse Chronology of Exposure (MACE). Substance use was assessed using the Adult Self-Report (ASR). Depressive symptoms were assessed using the Beck Depression Inventory (BDI). Adolescents completed the Multi-Source Interference Task while blood-oxygen-level-dependent (BOLD) responses were monitored with functional magnetic resonance imaging (fMRI). Generalized psychophysiological interactions (gPPI) was used to examine task-based functional connectivity in the insula and dorsal anterior cingulate cortex (dACC) across six years. All models included early adolescent functional connectivity when examining late adolescent connectivity as a mediator to understand dACC-insula connectivity changes across adolescence.

Results: For the direct effects of neglect and abuse on mental health outcomes, abuse occurring during adolescence was associated with higher depressive symptoms (b = .15, SE = .05, p = .001), whereas neglect was associated with higher substance use (b = 2.46, SE = 1.01, p = .014). Further, neglect was associated with weaker dACC-insula connectivity (b = -.09, SE = .04, p = .018), which in turn, was associated with less substance use (b = 10.36, SE = 4.37, p = .018) and lower depressive symptoms (b = .35, SE = .15, p = .018). Significant indirect effects revealed that higher levels of neglect during adolescence predicted lower substance use (CI: -2.547 to -0.132) and lower depressive symptoms (CI: -0.093 to -0.004) through weaker dACC-insula connectivity. We also examined maltreatment chronicity (abuse or neglect occurring in more than one developmental period), and found that chronic abuse was associated with higher levels of depressive symptoms (b = .07, SE = .04, p = .040), whereas chronic neglect was associated with higher levels of both depressive symptoms (b = .07, SE = .03, p = .012) and substance use (b = 1.65, SE = .73, p = .024). Stronger dACC-insula connectivity was associated with higher substance use (b = 9.91, SE = 4.2, p = .019) and higher depressive symptoms (b = .35, SE = .16, p = .022). Indirect effects were significant such that chronic abuse predicted higher depressive symptoms (CI: .001 to .066) and higher substance use (CI: .051 to 1.574) through stronger dACC-insula connectivity.

Discussion: These results suggest that differential patterns of connectivity changes within the salience network during cognitive control may be associated with risk and resilience for future depression and substance use in late adolescence. Additionally, these findings elucidate the distinct effects for the timing of abuse and neglect on salience network connectivity during cognitive control and future mental health outcomes.

SU56. MULTI-LEVEL THREAT PREDICTING IMPULSIVITY THROUGH RESTING STATE FUNCTIONAL CONNECTIVITY

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Background: Impulsivity is a multidimensional construct with detrimental consequences on youth development and adjustment. The dimensional model of adversity has been increasingly validated

in predicting youth adjustment (McLaughlin, Sheridan, and Lambert, 2014). Adversity often is embedded in multiple environmental levels (family, peers, neighborhood), necessitating an ecological neuroscience approach (Hyde et al. 2020). Developmental cognitive neuroscience and developmental psychopathology offer a unified framework to examine these multilevel influences on youth development. This pre-registered project will investigate dimensions of adversity using a multilevel approach by modeling a latent structure of neuro-ecological threat, as well as how neuro-ecological threat predicts adolescent impulsivity through mediation of the cingulo-opercular network's (CON) resting state functional connectivity (rsFC), both within-network and between the CON and the amygdala.

Neural Mechanisms: Childhood adversity has been linked to differences in the rsFC of CON and amygdala function separately (Huang et al. 2021; Brieant et al. 2021). However, the role of CON-Amygdala connectivity has not been fully explored. CON activity has been associated with increased impulsivity (Yang et al. 2022; Hausman et al. 2021), particularly in regions associated with the limbic system, such as the anterior cingulate cortex and the insula. This suggests that the connection between childhood adversity and risk for impulsive behaviors could be mediated via CON connectivity with the amygdala.

Methods: This pre-registered proposal will use data collected from baseline through 4-year follow-up of the Adolescent Brain Cognitive Development (ABCD) study (5.1 release). Adversity: Neuro-ecological threat will be constructed from latent factors of family, peer, neighborhood, and cultural threats. Family threat will use the family environment conflict subscale. Peer threat will use threatening life events, peer bullying, cyberbullying, and peer discrimination subscales. Neighborhood threat will use subscales of school safety, neighborhood safety, and geocoded FBI reports of violent crimes. Cultural threat will use the national discrimination subscale. Impulsivity: The latent structure of impulsivity has been established as the domains of impulsive choice, impulsive action, and impulsive personality traits (MacKillop et al. 2016); therefore, impulsivity will be separated into these domains. Impulsive choice will use the delay discounting task. Impulsive action will use the flanker task, emotional faces Stroop task, and the stop signal task. Impulsive personality traits will use the UPPS-P and BIS/BAS scales. fMRI: We will use the rsFC (a) within the CON, and (b) between CON and bilateral amygdala.

Results: Analysis to be completed: Confirmatory factor analysis will be conducted for the measurement model of neuro-ecological threat. Model fit will be assessed such that comparative fit index > 0.90 and the root-mean-square error of approximation < 0.08, according to recommended criteria (Hu and Bentler, 1999). Model modifications will be considered for significantly optimizing model fit based on the factor loading coefficients. Structural equation modeling will then be used to examine the relationship between neuro-ecological threat and impulsivity as mediated by the CON rsFC. Covariates will include the youth's sex, age, race/ethnicity, household income, parent education, testing site, MRI scanner, and previous impulsivity scores for their potential effect on paths tested in the structural model. The direct path of neuro-ecological threat on impulsivity and the indirect path of neuro-ecological threat on impulsivity through CON rsFC will both be assessed.

Discussion: Identifying the neuroaffective mechanisms underlying the longitudinal association between multilevel neuro-ecological threat on risk for the development of multidimensional impulsivity is critical for preventive intervention programming in adolescence.

SU57. THE NEUROTOXIC EFFECTS OF CHRONIC RADON EXPOSURE ON THE DEVELOPMENT OF NEURAL DYNAMICS SERVING FLUID REASONING

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Background: Fluid intelligence (Gf) is the ability to problem solve when faced with an unfamiliar circumstance or concept and is a highly integrative skill where greater proficiency has cascading effects on cognitive functioning. During childhood and adolescence, Gf and its underlying neural substrates rapidly mature. Critically, this period of development is also marked by heightened physiological sensitivity to the effects of environmental toxins such as radon, a radioactive gas that commonly accumulates in homes. Although radon exposure has an established link to the emergence of lung cancer, limited work to date has explored its effects on the developing brain during periods of heightened plasticity. The present study sought to determine whether chronic home radon exposure may impact the development of neural dynamics underpinning Gf.
Methods: Radon exposure was measured using commercially available home radon test kits for a total of 85 youth ages 8-to-15 years old (M = 12.38 years ± 2.26; 42 males). All participants completed an abstract reasoning task during magnetoencephalography (MEG). Time-frequency spectrograms indicated significant theta (4-6 Hz, 0-250ms) and alpha/beta (10-16 Hz, 450-1000ms) activity during the task. Significant windows were source reconstructed with a beamformer and submitted to whole brain regressions to determine the interactive effects of radon exposure and age on neural dynamics serving abstract reasoning. Identified clusters of significant neural activity were further probed for relationships with task behavior using mediation analyses.
Results: We detected multispectral radon-by-age interactions on the neural dynamics within regions supporting Gf. Specifically, youths with relatively lower levels of radon exposure exhibited weaker theta responses in the left dorsolateral prefrontal cortex as they matured, whereas their peers with greater radon exposure showed stronger theta responses as a function of age ($F= 9.50$, $p= .003$, $\eta p2= .13$). Additionally, youth with greater radon exposure initially showed weaker alpha/beta responses localized to the left caudate that became stronger as a function of age, whereas those with low-to-moderate radon exposure showed minimal activity in this area ($F= 9.01$, $p= .004$, $\eta p2= .11$). Follow-up analyses indicated activity in the left caudate significantly mediated the relationship between age and task accuracy ($\beta= -.036$, 95% CI [-.097, -.005]), and this effect was modulated by radon exposure ($\beta= .056$, 95% CI [-.130, -.012]). Notably, younger youth with high radon exposure exhibited lower task accuracy with less recruitment of the left caudate than their lesser-exposed peers, but task accuracy increased to match expected performance with age as recruitment of the left caudate escalated above that of their lesser-exposed peers.
Discussion: These outcomes indicate that chronic exposure to home radon modulates the development of neural dynamics underpinning Gf, which yields differential, and possibly compensatory, effects on task performance throughout childhood and adolescence. Importantly, our data suggest potential consequences of chronic radon exposure to the sensitive development of higher-order cognitive abilities during a critical period of maturation, which could have lasting consequences for long-term neurocognitive functioning and reserve.

SU58. ADVERSITY AND WHITE MATTER MATURATION OF THE CINGULATE CINGULUM: THE ROLE OF FATHERS' ACCEPTANCE IN ADOLESCENT NEURODEVELOPMENTAL RESILIENCE

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Background: Underlying socio-emotional and executive functioning, the cingulate cingulum (CC) is an integral white matter tract to the Papez (medial limbic) circuit that undergoes notable development during adolescence. Exposure to prolonged and early environmental threats and deprivation constitute stressors that undermine brain structural development. Although burgeoning literature indicates that exposure to chronic stress is specifically detrimental to white matter development, significant gaps in the white matter developmental research persist. In particular, growth trajectories of white matter tracts throughout adolescence have not been fully characterized in the literature, nor have protective factors within family environments. The present study focuses on parenting and tests its moderating effects in the association between adversity and white matter tract development throughout adolescence. Parenting is a salient protective factor for child development across several domains. However, little is known about the potential differential protective effects of fathers versus mothers for neurocognitive development in the context of adversity. This is a considerable knowledge gap because growing evidence suggests that fathers contribute uniquely to resilience throughout all stages of child development. Therefore, this study aimed to 1) investigate if deprivation (SES-hardship), and threat (at family and neighborhood levels) predict baseline levels and growth trajectories in CC white matter tracts, and 2) examine if father acceptance attenuates the harmful effects of adverse rearing environments on CC white matter development.

Methods: Utilizing a subset of the ABCD sample with complete imaging data across 3 waves (N = 2,513; 54% male) and longitudinal structural equation modeling, we characterized white matter isotropic diffusion (via restriction spectrum imaging [RSI]) trajectories over 4 years of early/mid-adolescence (age range: 8.91–15.67 years). Linear parallel growth curves with time-varying covariates were fit to left and right CC data. Latent variables characterizing SES-hardship, family and neighborhood threat, and father/mother acceptance were regressed on intercepts and slopes. Finally, interaction analyses tested how father/mother acceptance moderated the link between threat and CC growth. Covariates included chronological age, pubertal hormones, sex assigned at birth, scanner motion, and clustering for family ID and scanner.

Results: Family threat and SES-harship were associated with decreases in white matter ($b = .01$, $p < .01$; i.e., increased diffusivity) over four years in right and bilateral CC, respectively. Fathers' acceptance directly predicted greater baseline levels of white matter in the left CC ($b = -.11$, $p < .05$) and moderated the effect of neighborhood threat on baseline ($b = .08$, $p < .05$) and growth ($b = -.02$, $p < .01$) in bilateral CC white matter. Specifically, fathers' acceptance attenuated the link between neighborhood threat and decreases in white matter structure by increasing baseline white matter levels (i.e., lower diffusivity intercept) and increasing white matter development over four-years. In contrast, mothers' acceptance only moderated the influence of neighborhood threat on the growth of the right CC. This maternal effect was only significant at high levels of neighborhood threat; that is, low mothers' acceptance accentuated the harmful effects of high neighborhood threat (increasing diffusivity) rather than reducing it. Our overall model explained between 2-9% of the variability in intercept and slopes of the CC over the study period.

Discussion: Results are consistent with prior work on the effect of threatening vs. depriving stressors on white matter tract development in adolescence. We extend previous findings by demonstrating that, compared to mothers, fathers have a unique role in youth neurodevelopmental

resilience. These findings can inform future family-centered interventions and treatments promoting resilience.

SU59. EYE-TRACKING AS AN OBJECTIVE PHENOTYPING TOOL TO IDENTIFY ASSOCIATIONS BETWEEN METAL EXPOSURE AND SOCIAL COGNITION: A PILOT STUDY

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Background: Social cognition, the process of inferring other's states of mind and predicting their reactions, relies on integrated information processing, including the perception of social cues gathered from the faces of others. Emerging research suggests a link between early-life neurotoxicant metal exposure and maladaptive social behavior. Prior findings are based on self- and parent reports, introducing response and observer-dependent biases. In this pilot study, we use eye-tracking as an objective, quantitative, and non-invasive phenotyping tool to record spontaneous gaze behavior toward socially relevant information. We hypothesize that early-life exposure to a metal mixture is associated with changes in social cognition.
Methods: Forty participants (13.6 [12.2-15.3] years, 50% females) from the Mexico City Programming Research in Obesity, Growth, Environment and Social Stressor (PROGRESS) longitudinal birth cohort study completed a naturalistic eye-tracking paradigm consisting of short video clips showing characters engaged in peer-to-peer social interactions. Gaze patterns were recorded using Tobii Pro Fusion, a portable high-performance eye-tracker. Dynamic areas of interest (AoI) were defined around character faces and the number of fixations within each AoI was determined using the Tobii Pro Lab algorithm. A fixation event is defined as such when gaze velocity falls below 30 degrees/second. We used generalized weighted quantile sum (gWQS) regression to examine associations between a mixture of metals (lead, manganese, copper, and zinc) measured in 48-month blood samples, and eye-tracking fixation events.
Results: A higher metal mixture index, driven primarily by lead, was inversely associated with fixations to character faces, indicating reduced social cognition (maximum β = -0.01 [95% CI -0.097, -0.01]).
Discussion: This pilot study supports the hypothesis that mixed metal exposure during early-life adversely impacts social cognition. Eye-tracking offers a sensitive and objective phenotyping tool to measure environmentally induced changes. This pilot study was funded by the National Institute of Environmental Health Sciences (P30ES023515) and nested within R01ES028927.

SU60. THE ROLE OF PERINATAL VS CONCURRENT RISK IN COGNITIVE ABILITY DURING EARLY CHILDHOOD

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Background: Early childhood is a sensitive developmental period that is shaped by a combination of genetics and environment, making it a formative phase for cognitive development. It is a period where experiences can support or undermine the development of foundational cognitive skills that support higher-order cognition (Peng and Kievit, 2020). Ample evidence has shown that early childhood exposure to adversity can disrupt cognitive development. The greater adverse exposure, the greater risk for children to fall behind in cognitive performance. While prior literature has identified various adverse experiences, such as socioeconomic disadvantage, neighborhood deprivation, prematurity, and pregnancy complications, as contributors to cognitive difficulties, less is known about the temporal dynamics or domain-specific effects of these adversities (Elansary et al., 2024; Oeri, et al., 2022; Perou et al., 2019; Reuner et al., 2015, Stanton et al.,1991).
Methods: Thus, the current study examines cognitive performance of 117 children aged 3-7, investigating the impact of adversity exposure at birth along with concurrent risk exposure. Our first aim determined whether perinatal or concurrent risk display a stronger association with cognitive abilities, specifically focusing on verbal comprehension (VCI) and visual-spatial skills (VSI) — measured by the Wechsler Preschool and Primary Scale of Intelligence. Additionally, we explored whether these risk exposures yield differential effects depending on cognitive domains (VSI vs. VCI). For data analysis, we created two composite variables, a perinatal risk composite and a concurrent socioeconomic risk composite. The concurrent risk composite included factors such as income-to-needs ratio, area deprivation, and child opportunity index, while the perinatal composite consisted of binary risk variables such as prematurity status, pregnancy complications, birth complications, and maternal substance use during pregnancy. We ran two linear regression models with the concurrent risk composite and age as predictors and VSI and VCI as response variables.
Results: Our results found that concurrent risk was significantly predictive with both VCI (β = 6.48, $t(81) = 2.55$, $p = .013$) and VSI ($\beta = 8.15$, $t(80) = 4.08$, $p < .001$). There was also a significant effect of age for both VCI ($\beta = 5.71$, $t(81) = 2.45$, $p=.017$) and VSI ($\beta =8.13$, $t(80) = 4.39$, $p < .001$). For the perinatal composite models, we did not find any significant relationships between perinatal risk and either cognitive index, VCI ($\beta = -0.87$, $t(90) = -1.32$, $p < .191$) and VSI($\beta = -2.16$, $t(92) = -0.44$, $p =.271$).
Discussion: Our findings indicate that concurrent risk is more predictive of child cognitive performance than perinatal risk exposure, suggesting that the child's concurrent exposure to risk may have greater impact on child cognitive development compared to retrospective risk. Our findings also demonstrate that concurrent risk is predictive of both verbal and spatial cognitive performance, but the magnitude of the effect is greater for visual-spatial cognition, supporting a domain-specific effect on cognitive development. These results scratch the surface of the temporal dynamics of adverse exposure on cognitive development. Expansion on this work may support future interventions aimed to mitigate the negative effects of adversity exposure on cognitive development.

SU61. ADOLESCENT, BUT NOT EARLY-LIFE, CAREGIVER DEPRESSION IS ASSOCIATED WITH SMALLER HIPPOCAMPAL VOLUMES IN ADOLESCENTS WITH A HISTORY OF PRENATAL DRUG EXPOSURE

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Background: Early adversities, such as prenatal drug exposure (PDE) and caregiver depression, have been linked to long-term negative outcomes in multiple domains. Studies involving children with PDE have linked exposure and early-life caregiving to altered hippocampal volume (Kohn et al., 2023; Riggins et al., 2012). Moreover, studies have suggested that these effects may be additive, such that early-life caregiver mental health may exacerbate the overall impact of PDE on hippocampal volume in adolescence (Kohn et al., 2023). While literature suggests the importance of this interaction, research has yet to longitudinally explore sensitive periods for its impact, focusing largely on infancy. Therefore, we aimed to explore potential sensitive periods by examining the relations between caregiver depression, measured at multiple time points across development, and hippocampal volume at age 14 for those with PDE and community controls (CC).

Methods: Parent-child dyads with substance abuse histories were enrolled at delivery and followed through adolescence (PDE: N=22, 50% female) (Schuler et al., 2000). Eligibility included gestational age > 32 weeks, no NICU admission, and positive (cocaine/heroin) maternal/infant urine toxicology. A community comparison group (CC), matched for age and key demographic variables, was enrolled at 6 years of age (N=20, 60% female).

Caregivers completed the Center for Epidemiological Studies Depression Scale (CES-D) when their children were 6, 8, and 13 years old. At 14 years old, children completed a T1-weighted MRI scan. Volumetric segmentation of the hippocampus was performed using FreeSurfer v5.2. Volume was adjusted for intracranial volume, age, and sex (Keresztes et al., 2017).

Results: CES-D scores significantly differed by exposure status at 6 years (PDE, M=13.64±8.45; CC, M=8.53±8.74; W=96.5, p=.04, HL estimator=1.86) and 8 years (PDE, M= 16.75±11.67; CC, M=8.87±9.81; W=81, p=.02, HL estimator =1.16) but not 13 years. Groups significantly differed in adjusted bilateral hippocampal by exposure status at 14 years (PDE, M=8187.48±699.19; CC, M=7682.07±606.43; t(40)=-2.51, p=.02, Cohen's D=.78).

Linear regression analyses were performed to explore whether CES-D at 6 years, 8 years, or 13 years predicted bilateral hippocampal volume. CES-D scores did not significantly predict bilateral hippocampal volume at 6 or 8 years. However, CES-D scores at 13 years significantly predicted bilateral hippocampal volume at 14 years R^2=9.57%, F(1,39)=4.13, p=.04, such that greater CES-D scores were associated with smaller bilateral hippocampal volumes. Moderation analyses revealed a significant interaction between exposure status and CES-D scores (ß=-393.5, t(37)=-2.56, p=.01) such that higher CES-D scores were associated with smaller bilateral hippocampal volume in the PDE group (ß=-418.07, p < .01), but not in the CC group (ß=-24.60, p=.84). There was also a significant main effect of exposure status (ß=1909.2, t(37)=3.81, p < .01). Analyses of this effect by hemisphere showed the same pattern: CES-D at 13 years significantly predicted right and left hippocampal volumes at 14 years and higher CES-D scores were associated with smaller left and right hippocampal volumes in the PDE group but not in the CC group.

Discussion: Results show significant associations between adolescent, but not early-life, caregiver depression and hippocampal volume. Moreover, moderation results suggest that adolescent caregiver depression has an additive effect on hippocampal volume for those with PDE but not CC. Given the potential additive effects of caregiver mental health and PDE on hippocampal volume, determining the optimal windows for intervention may improve outcomes for children with PDE. Future analyses will model changes over time, include additional time points (7, 9, 10, and 14 years), and examine hippocampal regions. Additionally, we will explore the impact of consistency versus variability in caregiver depression scores over time and adolescent depression.

SU62. TRAUMA-EXPOSED ADOLESCENTS SHOW REDUCED CORTICAL GLUTAMATE DURING INHIBITORY CONTROL WITH NEGATIVE EMOTIONAL STIMULI: A 1H FUNCTIONAL MRS STUDY

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Background: Childhood trauma exposure (TE) is a potent risk factor for multiple mental health disorders in adolescents. A mechanism by which TE may confer increased risk is by elevating emotional reactivity, which in turn may interfere with inhibitory control, disrupting the capacity to regulate emotional responses. In healthy adolescents, fMRI has implicated the dorsal anterior cingulate cortex (dACC) in facilitating task-related inhibitory control, and that dACC engagement is altered in trauma-exposed adolescents when inhibitory control is performed in the context of negative emotion. Underlying dACC engagement is the interplay between glutamatergic excitatory and GABAergic inhibitory neurotransmission. However, it remains unknown if atypical dACC engagement in trauma-exposed adolescents is related to altered excitatory or inhibitory neurotransmission. We investigated task-related changes in dACC glutamate using functional magnetic resonance spectroscopy (1H fMRS) to assess the impact of negative emotional stimuli on excitatory neural processes supporting cognitive control in trauma-exposed youth.

Methods: A median-split based on TE was applied to 53 adolescents (aged 11-15) – Higher-TE (52% female, 13.3±1.5yrs; Mtrauma=6±1events) and Lower-TE: (50% female, 12.9±1.6yrs; Mtrauma=3±1events). TE was assessed using the self-report Traumatic Events Screening Inventory, TESI, and defined as the total number of DSM-5 criterion A traumas endorsed. 1H fMRS from the dACC was acquired during a 2x2 block design, visually-guided inhibitory motor control task requiring participant response to stimuli under two Modes, “Non-Selective” (100% trial response rate, involving motor control) and “Selective” (80% trial response rate and withholding `prepotent` responses on 20% of trials, involving inhibitory control). Both modes were executed across two Stimuli conditions, “Squares” and negative emotional “Faces”. A baseline control condition consisting of crosshair fixation preceded the task runs. Continuous 1H fMRS measurements were acquired with a temporal resolution of 16s throughout each task run using PRESS with OVS and VAPOR (TE=23ms, TR=4.0s, 13 measurements/task run, 4 averages/measurement, 2048 points, TA/task run=3:12min). Glutamate modulation (change in glutamate to total signal ratio relative to baseline control condition) and task performance (response time and accuracy) were tested across TE Group, Stimuli condition, and their interaction within each response Mode using repeated measures generalized estimating equations (SAS GENMOD). In assessing glutamate modulation, baseline control condition glutamate levels were included as a covariate.

Results: During Selective responding, Group-by-Stimuli interaction was significant $\chi 2=4.73$, $p=0.029$). Post-hoc analysis revealed significantly lower glutamate modulation during Faces in High-TE vs Low-TE ($p=.002$). During Nonselective responding, Group was significant ($\chi 2=4.37$, $p=0.037$) demonstrated by lower glutamate modulation in High-TE vs Low-TE independent of Stimuli condition. No significant group difference in glutamate during the baseline control condition was observed ($t(47)=-.89$, $p=.376$). Across both modes, no significant Group differences in task performance were observed between High-TE and Low-TE during both Stimuli conditions ($ps > .05$).

Discussion: We demonstrate distinct task-related differences in dACC glutamate related to trauma exposure during performance of cognitive control. Our results suggest an influence of emotional processing on dACC glutamate modulation specific to inhibitory control in those with high trauma exposure.

SU63. METAL EXPOSURE DURING CRITICAL WINDOWS OF BRAIN DEVELOPMENT

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Background: Behavioral disorders, such as internalizing and externalizing problems, affect 1 in 7 young adults globally and may partially be explained by early life exposure to environmental toxicants. The neural circuitry subserving these phenotypes begins developing in utero and is uniquely vulnerable to perturbation, yet critical windows of exposure are poorly understood.

Methods: In this study of 431 young adolescents (216 females) from the Programming Research in Obesity, Growth, Environment and Social Stressor (PROGRESS) cohort study in Mexico City, we estimated weekly perinatal exposure (14th-week gestation through one year of age) to 10 metals in naturally shed deciduous teeth. In a single visit (8-12 years of age), we administered the Behavior Assessment System for Children (2nd ed) and acquired 3T MRI scans. Cortical reconstruction and segmentation were performed using Freesurfer. We used lagged weighted quantile sum (lWQS) regression to estimate a time-varying mixture effect of the metal mixture on adolescent brain and behavior.

Results: Findings reveal critical windows to metal exposure during the postnatal period; a higher metal mixture index was associated with decreased cortical and subcortical volumes and increased behavioral problems, driven mainly by manganese, tin, lead, and arsenic.

Discussion: These results may help understand the role exposure timing plays in driving neurodevelopmental effects, thereby pointing to future optimal, efficient, and properly timed public health interventions.

SU64. EARLY-LIFE METAL EXPOSURE IS ASSOCIATED WITH INDIVIDUAL DIFFERENCES IN COGNITIVE CONSTRUCTS UNDERLYING ADOLESCENT RISK-TAKING

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Background: Adolescence is hallmarked by an increased propensity for risk-taking relative to childhood and adulthood. The neural circuitry subserving adolescent risk-taking begins developing in utero and is vulnerable to early-life environmental exposures, including metals. However, few studies have examined the impact of early-life metal mixture exposure on cognitive mechanisms underlying adolescent risk-taking. In this study, we aimed to identify early-life critical windows of susceptibility when metal mixture exposure is associated with increased individual differences in risk sensitivity (risk-seeking) and reward sensitivity (reward-seeking) in adolescence.
Methods: Among 187 adolescents (8-14 years; 86 females) enrolled in the Programming Research in Obesity, Growth, Environment and Social Stressors (PROGRESS) longitudinal birth cohort study in Mexico City, we estimated weekly concentrations of 9 metals in naturally shed deciduous teeth using laser ablation-inductively coupled plasma-mass spectrometry (i.e., Manganese (Mn), Lead (Pb), Barium (Ba), Copper (Cu), Lithium (Li), Magnesium (Mg), Tin (Sn), Strontium (Sr), and Zinc (Zn)) from the 21st gestation week through the 43rd postnatal week. A generalized mixed-effects model was used to compute individual-level estimates of distinct cognitive constructs underlying risky choices made during the Cake Gambling Task (CGT), a child-friendly, functional magnetic resonance imaging (fMRI) paradigm for risky decision-making. We used lagged weighted quantile sum (LWQS) regression to estimate the time-varying effect of metal mixture exposure on individual-level estimates of risk sensitivity and reward sensitivity. Models were adjusted for age, sex and socioeconomic status.
Results: We observed that 21st gestation and 43rd postnatal developmental weeks were critical windows when a higher exposure to metal mixture was associated with increased risk sensitivity (maximum $\beta = 0.44$ [95% CI 0.318, 0.571]), driven mainly by Mn prenatally and Pb postnatally. A higher metal mixture index in the 21st-27th gestation weeks and the 17th-43rd postnatal weeks was associated with increased reward sensitivity, (maximum $\beta = 0.31$ [95% CI 0.163, 0.453]) driven mainly by Zn prenatally and Ba, Mg, and Sr postnatally.
Discussion: This study supports the hypothesis that mixed metal exposure during early life may be associated with distinct cognitive mechanisms underlying risky decision-making in adolescence. Our LWQS modeling approach and results may inform the role of exposure timing in driving maladaptive risk-taking behavior in adolescence, thereby pointing to future public health interventions.

SU65. MATERNAL UNPREDICTABILITY INFLUENCES LIMBIC BRAIN STRUCTURE AND INFANT BEHAVIOR IN MOTHER-INFANT DYADIC INTERACTIONS

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Background: Maternal predictability is one of the most salient cues for developing infants, supporting the responsivity required for infants to form strong attachment relationships with caregivers (Ugarte and Hastings, 2023). Unpredictable maternal behaviors hinder infants' ability to predict their mother's next cue and subsequently may impede the development of adaptive social initiations and dyadic responding strategies essential for socioemotional functioning later in life (Aran et al., 2024). However, work has yet to directly investigate how predictability in maternal

signaling influences infant behavior in dyadic interactions with their caregivers, or the neurobiology supporting these associations.

Methods: In the current study, we used a longitudinal cohort of infants (N=147) to investigate how early unpredictability in maternal sensory signals, measured as maternal entropy during mother-infant dyadic interactions (Davis et al., 2017), influenced infant initiations and synchronous behavior during those dyadic interactions. We also investigated associations between maternal unpredictability, limbic brain volume (i.e., accumbens, hippocampus), and mother-infant dyadic behavior.

Results: Results indicated that early maternal unpredictability (at 2 to 5 months old) was associated with fewer infant initiations in later mother-infant dyadic interactions (at 4.5 to 12 months old) and that later maternal unpredictability was linked to lower concurrent mother-infant synchrony. Further, early maternal unpredictability was also associated with proportionally larger right accumbens and hippocampal volumes. Finally, an interaction between maternal unpredictability and right accumbens volume on infant initiations was observed, signifying that the association between maternal unpredictability and infant initiated behavior may depend on developing limbic regions like the accumbens.

Discussion: Overall, findings suggest that maternal unpredictability is an important factor in shaping mother-infant dyadic interactions and the neurobiology supporting these socioemotional processes.

SU66. PRENATAL AIR POLLUTION AND EARLY BRAIN DEVELOPMENT IN INFANTS

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Background: Despite the evidence supporting the effect of air pollution on brain development and risk of autism spectrum disorder (ASD), little is known about how prenatal air pollution may influence the developing brain during the first two years of life – the most dynamic and rapid stage of early postnatal brain development – in individuals later diagnosed with ASD. In this study, we aimed to investigate the relationship between prenatal ambient air pollution and early infant brain development from 6 months to 24 months of age and to determine whether this relationship differs by diagnosis of ASD at 24 months of age.

Methods: Participants of this study were drawn from the Infant Brain Imaging Study (IBIS) (n=365). Participants were enrolled as high risk (HR) if they had an older sibling with a clinical diagnosis of ASD while those who had an older sibling without ASD and no family history of ASD were enrolled as low risk (LR). Ambient air pollution exposures, including NO2, O3, and PM2.5, were estimated based on mother's residential addresses during pregnancy. Brain MRI scans were completed during natural sleep at 6, 12, and 24 months. T1 and T2 weighted structural

MRIs were analyzed to generate measures of brain size using established infant-specific multimodal processing pipelines. Total brain volume was defined as the sum of grey and whitter volume of the cerebral cortex. For this analysis, we examined total brain tissue volume (TBV), cortical surface area (SA), and cortical thickness (CT). Infants were assessed for ASD and classified into ASD, non-typical development (non-TD), and typical development (TD) groups based on the Autism Diagnostic Observational Schedule (ADOS), clinician best estimate of diagnosis for ASD, and the Mullen Scales of Early Learning at 24 months of age. Linear regression models for cross-sectional analysis and linear mixed-effect models with an interaction term of air pollution by age at MRI for longitudinal analysis were employed to examine the effects of air pollution on TBV, SA, and CT by ASD diagnosis at each time point and changes in trajectories.

Results: At 24 months of age, we found that the association between prenatal PM2.5 and SA differed by ASD diagnosis with an effect estimate of -799.4 (95% CI: -1959.4, 360.7) for ASD group, an effect estimate of -460.5 (95% CI: -1136.7, 215.7) for non-TD group, and an effect estimate of -105.2 (95% CI: -433.0, 643.4) for TD group, indicating a greater inverse association between PM2.5 and SA at 24 months in the ASD and non-TD groups compared to the TD group. Although we did not observe any differential associations for TBV and CT by ASD, exposure to higher pregnancy-average PM2.5 was associated with greater CT at 12 months in the non-TD group (β =0.03, 95% CI: 0.0005, 0.06) and in the TD group (β = 0.02, 95% CI: 0.004, 0.03). Results from the longitudinal analysis revealed that prenatal exposure to O2 significantly influenced the changes of TBV over time in the ASD group (O3 by age p-int=0.04) with higher exposure level related to decreases in TBV overall but slower decreases over time. In addition, there was a significant age by PM2.5 interaction (p-int=0.04) observed for the associations with TBV and SA from 6 months to 24 months of age in the TD group, with higher PM2.5 exposure related to reduced decreases in TBV over time. We didn't observe significant changes to our main findings when further adjusted for familial risk (HR vs LR).

Discussion: The current study found that pregnancy-average O3 and PM2.5 influenced early brain developmental trajectories from 6 months to 24 months of age differently by ASD diagnosis. These findings suggest that prenatal exposure to air pollution may contribute to atypical brain development among ASD individuals prior to the emergence of clinical presentation of ASD. Future studies in larger samples should replicate our findings regarding prenatal air pollution exposure and brain development.

SU67. ATTENTION PROBLEMS AND HYPERACTIVITY DIFFERENTIALLY IMPACT INSULA AND TEMPOROPARIETAL JUNCTION ACTIVITY IN HEALTHY CHILDREN AND ADOLESCENTS**

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Background: Childhood and adolescence are critical developmental periods for the acquisition and calibration of increasingly complex skills. These sensitive periods are marked by significant improvements in executive function and are particularly vulnerable to the emergence of psychopathology. Attention problems and hyperactivity, though most commonly associated with attention-deficit hyperactivity disorder, are transdiagnostic measures that have been observed

**Flash Talk

across mental health disorders, including depression, oppositional defiance disorder, and anxiety. However, the impact of such problems on the neural dynamics of executive function remain unclear, particularly in a developmental context. In this study, we examine the impact of attention problems and hyperactivity on temporally and spectrally resolved neural oscillatory responses using magnetoencephalography (MEG).

Methods: MEG data were collected from 84 participants (ages 11-16, mean = 12.74 years, SD = 1.28 years, 37 female) during a modified perceptual feature matching task and were preprocessed and transformed into the time-frequency domain. Self-reported measures of attention problems and hyperactivity were collected via the BASC-3, which were standardized to a mean T-score of 50 and a standard deviation of 10. Significant time-frequency windows were imaged using a beamformer, transformed into standardized space, and then subjected to whole-brain voxel-wise multiple regression analyses with attention problem and hyperactivity T-scores, while controlling for the effect of age.

Results: Both attention problems and hyperactivity were associated with alterations in alpha (12-18 Hz) activity from 1350 – 1750 ms after stimulus onset. Self-reported attention problems were positively correlated with alpha activity in the temporoparietal junction (TPJ; $p < .001$), such that higher levels of attention problems were associated with weaker (i.e., less negative) alpha responses, above and beyond the effects of hyperactivity and age. In addition, alpha oscillations in the insula were negatively correlated with hyperactivity ($p < .001$), such that higher levels of hyperactivity were associated with stronger alpha responses, controlling for attention problems and age.

Discussion: The insula and TPJ were differentially impacted by self-reported measures of attention problems and hyperactivity. Higher levels attention problems were associated with decreased activity in the TPJ, which suggests less efficient engagement of a critical node of the ventral attention network. In contrast, hyperactivity was associated with increased activity in the insula, which may reflect atypical recruitment of a critical component of the salience network. Importantly, the majority of participants did not indicate clinically relevant (i.e., > 70) or at-risk (i.e., > 60) levels of attention problems and hyperactivity, highlighting the sensitivity of these neural processes to subclinical levels of transdiagnostic measures of psychopathology. Taken together, these novel findings indicate the presence of alterations in key attention regions in relation to measures of attention problems and hyperactivity.

SU68. EXECUTIVE FUNCTION MODERATES RELATIONSHIPS BETWEEN WHITE MATTER TRACT "INTEGRITY" AND READING COMPREHENSION GROWTH

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Background: Reading comprehension (RC) requires the involvement and coordination of multiple cognitive processes, their associated brain regions, and the connections between said regions. Cognitively, RC has been shown to rely on word-level, language, and executive functioning (EF) processes, including cognitive flexibility (CF), or the ability to switch between different concepts, and working memory (WM), or the ability to remember and moreover update information. Coordination of these complex processes is thought to rely on the transmission of signals between cortical regions along white matter tracts. While it is well known that the

microstructure of white matter tracts relates to concurrent and longitudinal reading abilities, as well as EF, how EF and these white matter tracts together predict RC growth has yet to be examined. Understanding whether the interactions between different EFs and white matter tract "integrity" predict RC is important because they provide insights as to how EF can facilitate better RC, or, alternatively, serve as a compensatory mechanism for those who have adequate RC despite weaknesses in other underlying processes (e.g., word-level and/or language).

Methods: Interactions between fractional anisotropy (FA), a diffusion weighted imaging (DWI) metric quantifying the direction of water molecule moment along white matter tracts (thought to reflect tract "integrity"), and EF, to predict RC one year later, were investigated in 110 children (8.44 +/- 0.37 years old). Analyses regressed out MRI scanner differences in FA and controlled for prior year RC. FreeSurfer's TRACULA (version 7.2.0) was used to identify white matter tracts previously found to be linked to reading (bilateral superior longitudinal fasciculi 1, 2, and 3, arcuate fasciculi, inferior longitudinal fasciculi, uncinate fasciculi, corticospinal tracts). Exploratory factor analysis was used to create CF and WM metrics.

Results: Significant interactions involving left hemisphere tracts (left superior longitudinal fasciculus 1 and left corticospinal tract, and CF and WM, respectively) revealed that higher FA and better EF skills predicted substantially higher RC growth compared to those with the same FA levels but poorer EF skills. While these findings align with the well-documented relationship between white matter tract "integrity" and reading, they also reveal that EF moderates these relationships, providing insights as to how EF may be linked to RC growth. Other findings involving the right arcuate fasciculus and left superior longitudinal fasciculus 2 revealed that EF may serve as a compensatory mechanism for lower integrity of these tracts: in children with lower FA in the left superior longitudinal fasciculus 2, CF becomes increasingly predictive of RC. This same pattern was evident for WM and the right arcuate fasciculus.

Discussion: Findings revealed that indices of white matter integrity and EF skills, both known to support RC, interact to predict RC growth, although the nuances of these relationships were distinct depending on tract and EF skill. Of note, CF moderated the link between "integrity" and RC growth in the left superior longitudinal fasciculus 1, a tract that connects areas commonly associated with attention and memory [precuneus and superior parietal lobule to superior frontal and anterior cingulate gyri], whereas WM moderated the link between "integrity" of the left corticospinal tract, a tract that connects motor areas typically engaged during fMRI tasks to other cortical regions. In contrast, the right arcuate fasciculus, which connects areas associated with prosody [posterior superior temporal gyrus to inferior frontal gyrus] revealed that better EF skills despite lower "integrity" indices predicted greater RC growth, suggesting insights into compensatory mechanisms. While findings reveal more about the mechanisms by which EF skills may be linked to RC growth, additional research is needed to fully unpack these relationships.

SU69. MATERNAL EXECUTIVE FUNCTIONING, EMOTIONAL FLOODING, AND PARENTING BEHAVIORS DURING CHILD TANTRUMS

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Background: Parental emotional flooding (PEF), or parents' tendency to become overwhelmed by the intensity and unpredictability of aversive child behaviors, is common among mothers whose children exhibit high levels of irritability. Previous work has linked high levels of PEF to more

frequent use of ineffective discipline responses (e.g., overly harsh or permissive) in the context of child emotional outbursts. This poses challenges for caregivers of children with severe irritability, as ineffective parenting can worsen the child's symptoms and contribute to future psychological distress for both the child and parent. Evidence suggests that executive functioning (EF), or the ability to control thoughts and behaviors in a goal-driven manner, is associated with lower levels of harsh parenting and parental emotional reactivity. To date, studies of EF and parental discipline have primarily utilized community samples of preschool-aged children, with parents reflecting on flooding retroactively. By recruiting mothers of school-aged children with clinically severe irritability and collecting reports on flooding the same day tantrum(s) occur, the current study aims to advance our understanding of EF in the context of parenting children with frequent outbursts. It is hypothesized that stronger parental EF skills will be protective against becoming "flooded" during child outbursts and facilitate use of supportive discipline strategies.

Methods: Data collection is ongoing. Participants include mothers of children (ages 6-8.9, diagnosed with ADHD and exhibiting ≥3 outbursts/week in the mother's presence). During an initial online session, they provide self-report data on EF (Behavior Rating Inventory of Executive Function; BRIEF), PEF (Parental Flooding Scale; PFS), and responses to child misbehavior (The Parenting Scale; PS), among other measures. Following this baseline assessment, mothers complete a 14-day event-based-monitoring period, during which they complete the PFS each day an outburst occurs, reflecting on the emotions felt during the event.

Results: Preliminary analyses were conducted with 12 mothers who completed the study protocol. Multiple linear regression analyses revealed that baseline maternal EF was predictive of baseline PEF, but not predictive of future day-of-outburst PEF (β=0.61, t= 2.32, p=.045; β=0.40, t= 1.32, p=.22, respectively). Post-hoc analyses revealed that maternal reports of PEF at baseline (M= 3.12, SD=0.72) were significantly lower (i.e., less perceived flooding) than maternal reports of PEF on the days outbursts occurred (M=4.55, SD=1.85, t(11)=3.07, p=.01). Baseline maternal EF was predictive of overreactive but not lax parenting on the PS (β=0.62, t= 2.36, p=.043; β=0.28, t= 0.87, p=.41, respectively). Additional analyses are planned once additional participants complete the study.

Discussion: The results provide partial support for the hypothesis that higher parent EF is protective against PEF and subsequent ineffective discipline. First, poor global EF in the context of daily functioning (across domains of inhibition, working memory, planning/ organizing, cognitive flexibility, and emotion regulation) was significantly associated with greater emotional flooding, as reported at baseline. Interestingly, the same relationship did not emerge when using EF to predict day-of-outburst reports of flooding. On average, day-of-outburst reports of flooding were significantly higher than mothers' estimates of flooding at baseline. It may be that reports of EF difficulties would have also been inflated if collected each day an outburst occurred, due to lingering effects of acute outburst-related stress or recency bias. Finally, poor baseline maternal EF was predictive of more overreactive (i.e., harsh or aggressive) parenting. If further replicated, this may suggest that cognitive mechanisms which facilitate shifting attention, thinking flexibly, and regulating emotions also contribute to mothers' ability to withhold aggression during outbursts.

SU70. BRAIN MATURATION RELATED TO EXECUTIVE FUNCTION FROM INFANCY TO LATE CHILDHOOD

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Background: The brain undergoes massive change between infancy and late childhood, across the same time period that executive functions (EFs) emerge and mature. As a result, individual differences in brain maturation can contribute to significantly varied executive function abilities. Although recent findings have provided a general understanding of how structural brain development relates to the emergence of EF, it is still necessary to investigate the maturation of EF-related regions and how the specific developmental trajectories relate to diverse outcomes. Previous studies have suggested that although structural brain networks become more segregated with age, the strength of connections within networks increases, and this strength relates to EF ability (Baum et al., 2017). However, we still lack an understanding of how trajectories of the EF-related network develop from birth to late childhood, as well as how these trajectories facilitate EF development.

Methods: On the group level, we aim to capture the maturational trajectory of an EF-related network of brain regions using graph theory. Moreover, on the individual level, we plan to assess the maturational coupling of EF-related brain regions and relate network features of maturational coupling with later EF ability. We collected structural MRI and EF assessments from 752 subjects across ten years from 0-10 years old, at around 2 weeks, 12 months, 24 months, and subsequently every two years until 10 years old. We estimated the cortical thickness within each cortical region according to the Automated Anatomical Labelling (AAL) atlas. Regions of the AAL atlas that have been empirically shown to be related to EF were selected for the current analyses. Children's executive function outcomes at age 10 will cover the domains of working memory, inhibition, and shifting. They are assessed using the Cambridge Neuropsychological Test Automated Battery (CANTAB) Spatial Span task (span length) and the NIH Toolbox Cognition Battery Flanker Inhibitory Control and Attention task (age-corrected score) and Dimensional Change Card Sort task (age-corrected score) respectively. For data analysis, we first plan to calculate a group-level Structural Covariance Network (SCN) of the EF-related brain regions across subjects at each time point by conducting linear regressions relating cortical thickness across each pair of EF-related brain regions across subjects, controlling for sex, age, and mean cortical thickness, to create a structural connectivity matrix. We will then calculate the global efficiency of the EF-related network for each SCN using the Brain Connectivity Toolbox. We will use both General Additive Mixed Model (GAMM) and Linear Mixed Model (LMM) to explore how within-network integration of the EF-related network changes from 0-10 years. To estimate maturational coupling between regions within the EF-related network for each individual, we will calculate subject-based Maturational Coupling Networks (sbMCNs) for each subject by calculating the average cosines across time of each pair of EF-related brain regions for each subject to create a maturational coupling matrix. We will then calculate global efficiency of the maturational coupling matrix and will relate global efficiency of the EF-related sbMCN to executive function outcomes at age 10 using linear regressions that control for sex, age, and mean cortical thickness.

Results: (1) On the group level, global efficiency of the EF-related network will increase across time. (2) On the individual level, global efficiency of the maturational coupling trajectories within the EF-related network will predict executive function at age 10.

Discussion: By leveraging a longitudinal dataset, our findings may provide a more comprehensive understanding of EF-related brain maturation from infancy to late childhood and highlight how the interactive maturation between EF-related regions facilitates the development of EF.

SU71. VOXEL-BASED MORPHOMETRIC ANALYSIS OF ASSOCIATIONS BETWEEN A COMPOSITE MEASURE OF EXECUTIVE FUNCTION AND GRAY MATTER VOLUME IN ADOLESCENTS AND YOUNG ADULTS

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Background: Executive functions (EFs) are crucial for controlling and managing thoughts, emotions, and actions. These functions include the suppression of competing goal-irrelevant information (i.e., inhibitory control), active maintenance or updating of goal-relevant information (i.e., working memory), and fast and flexible adaptation to changing circumstances (i.e., behavioral flexibility. While dissociable, these EFs show considerable overlap (i.e., they display unity), particularly during childhood and adolescence, and are highly interrelated in complex tasks and behaviors. EF dysfunction, when conceptualized as a unitary construct, has also been proposed as a transdiagnostic risk factor for psychopathology. Thus, when measuring EFs and evaluating EF dysfunction in relation to various outcome measures, the use of composite versus individual task measures may allow for a more holistic assessment of EF capabilities by integrating multiple dimensions of EF into a single score. In adults, composite measures of EF have been shown to be valid indices that are as good or better than any of their composite parts. However, few studies have investigated the validity, at neural and behavioral levels, of EF composites in developmental samples. This goal may be particularly relevant in the span from early adolescence to early adulthood, given continued EF development during this time and potential associations with health outcomes. Leveraging a longitudinal accelerated design of individuals assessed biennially up to five times spanning the ages 9 to 30 years, we previously computed a composite measure of EF comprised of performance on several tasks, including Digit Span, CANTAB Spatial Working Memory, CANTAB Tower of London, and spatial delayed response (Lozano Wun et al., under review). We found evidence of developmental increases during adolescence followed by stabilization in young adulthood (i.e., an inverse pattern of age-related variation), consistent with previous reports based on separate measures of EF. In the present investigation, we sought to further validate the composite measure by evaluating performance against brain structure.

Methods: Using the baseline sample of the same dataset (n=177, ages 9-23 years), we conducted whole-brain voxel-based morphometry (VBM) analysis of the associations between regional gray matter volumes and EF performance via FSLVBM. Multiple regression of voxel-wise gray matter volume on natal sex, inverse age (i.e., age-1), EF composite score, and an EF score by inverse age interaction term was conducted using FSL's randomise, with familywise error corrected $p < .05$ cluster thresholding determined by the Threshold-Free Cluster Enhancement procedure and n=5000 permutations to construct an appropriate null distribution.

Results: A significant cluster in the right ventrolateral prefrontal cortex (vlPFC) exhibited an inverse age-by-behavior interaction. When the interaction was investigated, the findings suggested higher gray matter volume in the right vlPFC was associated with lower EF composite scores at the youngest ages in the study, that is, during early adolescence when frontal gray matter thinning is initiated and when greater gray matter volume reflects lesser brain maturation; conversely, higher gray matter volume in the right vlPFC was associated with higher EF composite scores at the oldest ages, that is during late adolescence and early adulthood, indicating that greater EF performance was associated with relatively higher gray matter volume only when maturational thinning of gray matter approaches completion.

Discussion: VBM results in this investigation provide evidence that the EF composite is developmentally sensitive and associated with brain morphology in a region previously implicated in several EFs, including working memory and cognitive flexibility.

SU72. LONGITUDINAL LATENT PROFILES OF EXECUTIVE FUNCTIONS FROM INFANCY TO 2.5 AND 5 YEARS OF AGE: ASSOCIATIONS WITH CHILD BRAIN GRAY MATTER DENSITY AT 5 YEARS

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Background: Executive functions (EFs) refer to higher-order cognitive and self-regulatory processes that enable goal-directed behaviors and adaptive functioning. Early developing EFs, also referred to as core EFs (inhibitory control, working memory and set-shifting), associate with various key child outcomes such as academic achievement and early-onset neuropsychiatric disorders, underlining the importance of identifying sources of variation in early EFs. To this date, there are only few studies on the longitudinal developmental trajectories of EFs and even less is known about the neural structural correlates of EFs in childhood. In this study, we used latent profile analysis (LPA) to examine EF profiles in a large longitudinal sample from infancy to 2.5 and 5 years of age. Furthermore, in a smaller subsample where magnetic resonance imaging (MRI) was conducted, we explored relations between these profiles and child brain gray matter density at 5 years.

Methods: The participants were N = 830 (MRI subsample N = 164) children participating in the FinnBrain Birth Cohort Study based in Finland. EF was assessed at 8 months using a modified A-not-B task, at 2.5 years using the Snack Delay and Spin the Pots tasks, and at 5 years using Spin the Pots task, the Delay of Gratification task, and EF Touch Arrows, Pigs and Farmer tasks. LPA based on EF task estimates generated using Item Response Theory (IRT) was conducted using Mplus program where child age at measurement was regressed out as a covariate. To study links with child brain gray matter density, voxel-based morphometry (VBM) was performed on T1-weighted brain MRI images and associations with EF profiles were tested in SPM12 software using General Linear Model Analysis including child sex and age at scan as covariates of no interest.

Results: Three class solution of longitudinal profiles was selected: “Below average EF” with lower EF across ages and tasks (14.2%), and two “Medium EF performance” profiles, that were only differentiated by Spin the Pots performance at 5 years (above average 29.8%, below average 56 %). Children in the highest performing EF profile had greater gray matter density in the cingulate gyrus, motor and somatosensory cortices and temporal areas of the cortex (compared to the below average profile) and the right middle temporal gyrus (compared to the lower performing middle profile). Finally, children belonging to the below average profile had greater gray matter density in the right anterior insula (compared to the highest EF profile).

Discussion: Using IRT and latent profile analysis, we identified profiles of children performing above average vs. below average in EF tasks from infancy to preschool age. Children belonging to the highest performing profile displayed greater gray matter density in several regions related

in top-down self-regulation and attention, including regions involved in the frontoparietal functional networks. Further, children belonging to the below average profile had larger gray matter density in the anterior insula, which reportedly plays a key role in emotional functioning and addictive/impulsive behaviors. In the conference, final results will be presented and discussed.

SU73. FUNCTIONAL BRAIN NETWORK MODULARITY AS PREDICTOR OF TRAINING-RELATED CHANGE IN TASK SWITCHING IN CHILDREN

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Background: Outcomes of cognitive training have been variable in terms of their success in improving cognitive abilities. It has thus become increasingly pertinent to examine factors that can help predict who will benefit most from a particular cognitive training. One potential predictor of training benefits is the extent to which functional brain networks are organized in a modular manner, i.e., the extent to which brain regions are more strongly connected to regions within the same functional network than to regions outside of the network. Cognitive training studies in adults suggest that individuals showing more modular organization of functional brain networks at baseline benefit more from cognitive training. Notably, child development is marked by protracted network integration and segregation, two key aspects contributing to modular organization of brain networks. Thus, brain network modularity might be particularly important for training outcomes in children.

Methods: We explored the degree to which individual differences in brain network modularity were related to individual differences in training-related improvements in task-switching performance in a training study with 8–11-year-old children who completed nine weeks of either high-intensity task-switching (N = 32) or high-intensity single-task (N = 30) training.

Results: With training, accuracy on a task-switching paradigm increased and response times decreased. These training-related improvements were more prominent in the high-intensity task-switching group relative to the high-intensity single-task group. Drift-diffusion models further showed that especially with high-intensity task-switching training, drift rate and boundary separation parameters increased, suggesting more efficient accumulation of evidence and a more cautious response strategy, respectively. Across training groups, higher modularity of functional networks at baseline was associated with overall higher accuracy and higher drift rates across sessions, suggesting that a more modular organization of brain networks might support more efficient task performance. However, modularity of functional networks at baseline was not associated with training-related changes in any performance measure.

Discussion: Further analyses will explore whether networks become more modularly organized with training, and whether such changes in modularity might predict training-related changes in performance.

SU74. GREATER BRAIN-TO-BRAIN SYNCHRONIZATION DURING STORYTELLING IN SPOKEN VS LITERARY ARABIC: AN EEG STUDY

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Background: Arabic is a Semitic language that possesses a range of unique linguistic characteristics. One of these characteristics is diglossia, which refers to the existence of two distinct forms of the same language: Spoken Arabic (SA), and Literary Arabic (LA). The level of familiarity with LA (vs SA) in children pre-reading age is important for their reading acquisition in school. However, a neurobiological marker for this different cognitive processing between SA and LA in pre-readers is still lacking. The current study aims to examine the differences in joint attention to SA vs LA in pre-reading Arabic-speaking children using the Hyperscanning method that allows the measurement of brain activity of two people simultaneously.
Methods: Twenty-two Arabic-speaking mother-child dyads (children's average age: 5.5 years, SD=0.78, 15 girls) participated in two 5-min dialogic reading conditions: SA and LA. EEG data was recorded simultaneously from the parent and the child, using a 64-channel EEG system (Brain Products, Germany, Ltd). Correlation coefficient matrices for brain-to-brain synchronization were conducted and compared between conditions using fisher-z transformation. Behavioral measures, including language abilities and nonverbal skills, were also collected.
Results: The correlation coefficient matrix for the SA condition showed greater correlation values between mother-child electrodes compared to the LA condition. Moreover, the SA condition was associated with a higher number of synchronized electrodes.
In addition, a significant positive correlation was found between the difference in LA and SA vocabulary levels and the difference in LA and SA listening comprehension ($r=0.5$, $p=0.02$).

Discussion: These results provide a neurobiological confirmation for the decreased joint attention of pre-readers Arabic-speaking children when exposed to LA vs SA. Moreover, a higher difference in LA and SA vocabulary is correlated with a higher difference in LA and SA listening comprehension. Future studies are needed to examine the effect of reading-based intervention on minimizing the gaps between brain-to-brain synchronization during these two conditions.

SU75. IS THE LANGUAGE NETWORK LEFT-LATERALIZED? ASSOCIATIONS BETWEEN HEMISPHERIC LATERALIZATION AND QUANTIFIED AMOUNT OF BILINGUAL EXPOSURE IN YOUNG CHILDREN

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Background: Neuroimaging studies have consistently demonstrated that the language network tends to be bilateral early in life (Olulade et al., 2020; Scaflarski et al., 2005) and becomes left-lateralized throughout development (Powell et al., 2006; Newport et al., 2017; Lipkin et al., 2022). However, this literature has largely been limited to monolingual participants, who are not the norm globally. When considering bilinguals, smaller studies find that those who acquired their second language by the age of 6 years demonstrate bilateral recruitment of both hemispheres when processing language and predominantly left-hemispheric involvement if they acquired their second language after the age of 6 (Hull and Vaid, 2007; Yip and Matthews, 2007). However, compared to other demographic factors (e.g., handedness), the evidence on hemispheric lateralization for bilinguals remains mixed. This study aims to address this gap by examining the effects of both bilingual knowledge as well as bilingual exposure on language lateralization in young children aged 4-6 years-old. In this pre-registered study, we use functional magnetic resonance imaging

(fMRI) to examine monolingual and bilingual children's language network lateralization patterns during a language processing task. We aim to compare the hemispheric language lateralization patterns in monolingual and bilingual children categorized by their language knowledge and exposure from parent surveys, as well as objective, hand-annotated measures of language exposure during home audio recordings.

Methods: Participants were 44 children (55% male) aged 4-7 years (M=5.82 years, sd=.64) from diverse socioeconomic, racial/ethnic, and linguistic backgrounds. Parents reported their children's language knowledge/experiences by filling out the Language, Social, and Background Questionnaire (yielding a binary classification) and then completed two daylong (16 hours) LENA-based home audio recordings on non-school days (n=35), which yielded a continuous measure of bilingual exposure. Children also completed a standard fMRI language localizer comparing listening to forward/comprehensible vs. backward/incomprehensible stories in English. Lateralization will be estimated as the leftward asymmetry of activation in inferior frontal gyri ("Broca's area") and superior temporal gyri + supramarginal gyri ("Wernicke's area"). Analyses will control for child age, handedness, and framewise displacement, with sensitivity analyses controlling for child sex and socioeconomic status.

Specifically, we will examine three hypotheses:

H1. To confirm the validity of the paradigm, whole-brain group level analyses will exhibit activation in the forward > backward speech contrast in the core language regions defined above

H2. At the whole brain level, bilingual exposure (binary and continuous) will be associated with greater activation in right-hemisphere clusters of the language network, indicating more bilateral language activation. However it is unclear whether bilinguals will also show less or equivalent left hemisphere activation.

H3. Within the language-specific ROIs, greater bilingual exposure (binary and continuous) will be associated with more bilateral distribution of language-related brain activation (i.e., more balanced), compared to more left-hemispheric language dominance in monolingual participants.

Results: Data analysis will be completed prior to the Congress and results will be shared.
Discussion: In sum, this study will provide novel information on children's neural language lateralization and variation by bilingual language knowledge and language exposure, using both subjective/categorical and objective/continuous measures of early life language experience. Results have implications for broadening our understanding of early bilingualism as one of the important mechanisms of developing brain organization.

SU76. POP AND LEARN: EXPLORING RISK-RELATED LEARNING IN PRESCHOOL-AGED CHILDREN

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Background: Risk-taking is traditionally associated with maladaptive behaviors that predict adverse outcomes and psychopathology. Indeed, opponent patterns of risk-taking tendencies are observed in common neurodevelopmental disorders such as attention-deficit/hyperactivity disorder (risk-seeking) and autism spectrum disorder (risk-avoidance). Notably, however, the adaptive functions of risk-taking behaviors are often overlooked. Evidence in adolescents and adults shows that context-dependent risk-taking supports implicit learning or learning that occurs

without explicit awareness. Implicit learning is particularly important during the preschool years when children learn stimulus-outcome associations through exploratory risk-taking behaviors. Yet, relations between risk-taking and implicit learning in preschoolers are understudied. The aim of this study is to define associations between risk-taking and implicit learning in neurotypical preschool-aged children. We hypothesized that children who take more risks (i.e., more pumps) early in the task will show more learning (i.e., better overall performance).

Methods: The Balloon Emotional Learning Task (BELT) was used to gauge risk-related learning. During the BELT, participants inflated balloons presented on a computer screen to earn points. If a balloon was overinflated, it exploded, and no points were earned. Unbeknownst to participants, different colored balloons represented fixed (long and short) or varied explosion rates. Participants were expected to engage in risks to implicitly learn the balloon color mapping scheme and improve overall task performance.

Results: To date, 30 preschoolers (4 and 5 years of age; 16 females, 14 males) have contributed data to this ongoing study. Preliminary linear mixed models indicate a significant main effect of balloon type on the number of pumps per balloon: compared to balloons with variable explosion rates, which were pumped an average of 7.18 (SE = 0.33) times, children had significantly more pumps of balloons with fixed, long explosion rates (estimate = 1.68, SE = 0.47, $p < 0.001$) and significantly fewer pumps of balloons with fixed, short explosion rates (estimate = -1.62 , SE = 0.47, $p < 0.001$). Notably, however, the main effect of task block and interactions between balloon type and task block were not significant ($ps \geq 0.30$).

Discussion: Consistent with prior research in preschool-aged children, the results of our preliminary analyses indicate that neurotypical preschoolers implicitly learn patterns associated with advantageous and disadvantageous outcomes during the BELT task. Counter to our primary hypothesis, however, risk-taking did not facilitate improved learning over the course of the task. It is likely that we are currently underpowered in detecting significant interactions given the small sample size and expected variability in performance in this age group. As such, data collection is ongoing. With our planned, larger sample size, we expect to find a relationship that suggests early risk-taking supports advanced learning in this task. Such findings may provide scientific justification for the conceptualization of risk-taking as an adaptive behavior among young children and, consequently, offer unique opportunities for novel clinical intervention and reformed education practice.

SU77. HANDS ON PARENTING: THE INTERACTIVE ROLES PARENTAL GESTURE AND CHILD SPATIAL SKILL IN PARENT-CHILD NEURAL SYNCHRONY DURING A PROBLEM-SOLVING TASK

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Background: Synchronous interactions between parent and child are fundamental for children's cognitive development. During interactions, parents provide rich information through hand gestures, pivotal in children's cognitive development. Here our goal is to examine parental gesture influence neural synchrony patterns during task and how the role of gesture varies as a function of child characteristics.

Methods: In our study, we used fNIRS-based hyperscanning to study 41 parent-child dyads in a tangram puzzle task (4 minutes). Behavioral coding of gesture and neuronal synchronization data

(both concurrent and time-lagged) were aligned. The session was divided into 10-second time windows to examine dynamically changing relations between neural synchrony, parental gesture (coded based on videotapes), child spatial skills (tested based on WPPSI-IV), and task performance (measured based on number of tangrams completed successfully).
Results: Results showed that parent-led synchrony and parental gestures both negatively predicted task. However, both interacted with children's overall spatial skill. For low spatial skill children, parent-led synchrony especially when the parent also provided gestures was associated with higher task performance.
Discussion: Our results highlight the intricate and significant interactions between parental gesture, parent-child synchrony and the characteristics children bring into the context. Future analysis will examine the dynamic role of gesture in different period of interaction.

SU78. ADOLESCENT ALCOHOL AND CORTICAL THINNING: PRELIMINARY ANALYSIS OF A LONGITUDINAL COHORT

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Background: Alcohol is one of the most commonly used recreational drugs among adolescents, however further investigation is needed to distinguish markers of brain-related risk for alcohol use from those of its consequences on adolescent brain maturation.
Methods: Participants (n=151) were invited to undergo 3 MRI scans between ages 12 and 17 years. Participants were drawn from a population-based cohort on the basis of their high- or low-risk for substance misuse. In total, 136 (90%) participants had MRI (T1-weighted) and behavioural data available for two or more time points (381 scans). Alcohol use was disaggregated into between- (vulnerability) and time-varying within-person components using multi-level modeling. Analyses controlled for age, cannabis, and tobacco.
Results: Across the whole sample, greater mean alcohol use was associated with a pattern of cortical thickness that varied across brain regions (region*ALCAVG interaction: $F99,36874=3.8391$, $p < .0001$). Across the whole sample, cortical thickness was lower in years when participants alcohol use exceeded their own average level of alcohol use ($F1,36879=13.0195$, $p=0.0004$). The effect of a within-person increase in alcohol use of once-per-week on thickness was comparable to 17% of the annual rate of age-related cortical thinning. This effect was strongest in brain regions with greatest availability of kappa opioid receptors (rho=.39, pspin=0.017).
Discussion: This study provides evidence that alcohol use during adolescence is associated with brain-wide cortical thinning and highlights the importance of longitudinal analyses using multi-level modeling to disaggregate causes from potential consequences of substance use.

SU79. INVESTIGATING THE ROLE OF BRAIN IRON IN THE DEVELOPMENT OF PSYCHOSIS SPECTRUM SYMPTOMS USING QUANTITATIVE SUSCEPTIBILITY MAPPING MRI**

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****Flash Talk**

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Background: Subcortical dopaminergic dysfunction, including elevated presynaptic dopamine synthesis and neurotransmission, is hypothesized to contribute to psychosis spectrum (PS) symptoms. However, psychosis spectrum disorders emerge during youth when direct measures of dopamine (PET imaging) are not easy to acquire. Brain tissue iron is necessary for presynaptic dopamine synthesis, and atypical brain iron concentration has been linked to dopaminergic dysregulation in conditions such as restless legs syndrome and iron deficiency. Importantly, brain iron can be noninvasively measured using MRI and is easily acquired in pediatric populations.
Methods: To investigate the development of brain iron within the subcortical dopamine system during adolescence and its relationship to PS symptoms, we used Quantitative Susceptibility Mapping (QSM) MRI. We used QSM to measure magnetic susceptibility, reflecting brain iron storage, in basal ganglia and ventral midbrain in a longitudinal sample of adolescents and young adults. This sample included typically developing youth (TD; n = 55; age 8.61 - 26.8 at first visit; M = 18.53, SD = 5.37; male/female = 31/24) or youth with PS symptoms (n = 119; age 9.91 - 27 at first visit; M = 20.37, SD = 4.61; male/female = 66/53). Each participant had up to three longitudinal neuroimaging visits per participant, resulting in a total of 249 scans. Using generalized additive mixed models, we characterized the developmental trajectories of QSM in each group as a function of age, while co-varying for sex and QSM data quality. We corrected multiple comparisons across nine brain regions using FDR.
Results: We found that the developmental trajectories significantly differed between groups in nearly all basal ganglia and ventral midbrain regions investigated. Specifically, in globus pallidus internal, substantia nigra, red nucleus, parabrachial pigmented nucleus, and putamen, QSM trajectories for the PS group plateaued around 20.5 years old, after which they began to decrease. In contrast, the QSM signal in the TD group continued to increase throughout the age range studied.
Discussion: These results suggest reduced brain iron levels in PS youth relative to TD youth which becomes more pronounced with age. Considering the essential role of iron in supporting dopamine function, particularly dopamine synthesis, our results may reflect a difference in the rate of dopamine synthesis or synthesis capacity in PS youth. Speculatively, if the reduced iron content observed in the PS group reflects excess iron demand needed to support atypically high dopamine synthesis, our findings would align with current theories of excess dopamine production in psychosis spectrum disorders.

SU80. CHARTING DEPTH-DEPENDENT MATURATION OF FRONTAL CORTEX MYELOARCHITECTURE AND IMPACTS ON CIRCUIT FUNCTION AND COGNITION

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Background: Cerebral cortex layers differ in their cellular composition, connectivity targets, functional roles, and ontogenic timing. In general, deeper (i.e. infragranular) layers of the cortex have a predominance of pyramidal neurons that project to subcortex. Superficial (i.e. supragranular) layers evolutionarily expanded in human prefrontal cortex (PFC) and are a main source of cortico-cortical connections. During child and adolescent neurodevelopment, the PFC

exhibits protracted increases in myelin content that alter population-level neural activity and limit ongoing circuit plasticity. Yet, how trajectories of myelin growth differ across layers and impact circuit function and maturational phenotypes remains under-described. In this project, we characterize the extent and timing of developmental increases in PFC myelination across cortical depths and elucidate downstream effects on circuit electrophysiology and cognitive processing.

Methods: We leveraged 7T R1 data from an accelerated longitudinal youth sample (140 individuals with 215 scans; 10-32 years; 70 female) to map myelin levels throughout the cortical mantle. R1 (1/longitudinal relaxation rate) is a histologically-validated, myelin imaging approach that measures tissue parameters in quantitative units. R1 maps were derived from B1+ inhomogeneity-corrected T1 map images, projected to individual-specific cortical surfaces, and applied to index myelin at 7 cortical depths in frontal lobe regions (excluding depths near pial and white boundaries). Generalized additive models (GAMs) were used to flexibly model relationships between depth-dependent R1 and age. The curvature and first derivative of age splines were calculated to index trajectory profiles, rates of myelination, and ages of myelin maturation. GAMs were additionally used to quantify associations between regional R1 and both EEG-derived and cognitive measures while controlling for developmental effects.

Results: R1 significantly increased ($pFDR < 0.05$) in > 80% of frontal regions at all cortical depths; gradients of myelin growth rate and maturational timing were visible across depths. R1 increased at a slower rate and matured at later ages when moving from deeper to more superficial depths, mirroring inside-out development of cortical layers in the embryonic period. Regional variation in R1 maturational rate was increased at superficial depths (higher coefficient of variation) and more strongly aligned with the sensorimotor-association axis ($r = -0.47$ versus $r = -0.21$ in superficial versus deep depths). Though depth differences in R1 development were widespread, their nature varied across regions. Clustering of depth curvature profiles revealed a motor cluster (coordination, movement) with high curvature and early R1 maturation at all depths, a dorsolateral PFC cluster (working memory, manipulation) with plateauing trajectories in deeper cortex but protracted myelination in superficial cortex, and a medial PFC cluster (salience, emotion) with linear trajectories at most depths. Combining R1 with EEG and cognitive measures revealed dissociable impacts of myelin on circuit function across depths. Higher R1 in deeper (but not superficial) depths was significantly associated with a flatter aperiodic slope—an E/I linked readout of mature cortical dynamics—across lateral PFC regions ($pFDR < 0.05$ in all electrodes). Higher R1 in superficial depths only was significantly ($pFDR < 0.05$) related to faster responding on an anti-saccade task and to better working memory.

Discussion: Myelin maturation is heterochronous across cortical layers. Myelin matures in deeper cortical layers at the end of adolescence, where it may help to sculpt neural populations with higher E/I balance and dimensionality (flatter aperiodic slopes). Superficial layers of prefrontal association cortex undergo less and more temporally extended myelination, likely facilitating persistent plasticity that enhances the efficiency of cortico-cortical circuits supporting higher-order cognition.

SU81. NEGATIVE EMOTION REDUCES ASSOCIATIVE MEMORY IN CHILDREN AND ADULTS

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Background: Integrating different elements into an episodic memory representation is critically affected by age and emotion. Regarding age effects, an extensive literature has exhibited improvement of associative memory across development. Regarding emotion effects, it has been shown that emotion reduces memory for associations between elements, thereby decreasing the coherence with which a multi-element event is remembered. However, the knowledge about the influence of emotion on associative memory and, consequently, the coherence of memories in children compared to adults remains very limited.
Methods: In this study, we examined the effect of emotion on relational memory in children of 6- to 7-year-olds (n = 22) and young adults (n = 28). In Experiment 2, 6- to 8-year-olds (n = 26), 9- to 11-year-olds (n = 29), young adults (n = 30) participated. In both experiments, participants learned events consisting of three elements (a face, a scene, and an object). Half of the events contained a negative facial expression, while the other half included faces with neutral expressions. Memory was tested across all associations that had been presented in one event. The procedure of the two experiments was identical, but the encoding duration was reduced to 6 sec in Experiment 2 (vs. 12 sec in Experiment 1).
Results: In Experiment 1, we found evidence that negative emotion reduced the associative memory and memory coherence of 6- to 7-year-olds compared to neutral events. In Experiment 2, we found reduced associative memory for negative events across the age groups of 6- to 8-year-olds, 9- to 11-year-olds and adults. Emotion did not affect the memory coherence of children, but only adults with a marginal significance.
Discussion: Both experiments consistently indicated that emotion reduces associative memory in children and adults, albeit with differing effects on memory coherence.

SU82. DIFFERENTIAL DEVELOPMENTAL EFFECTS OF LOAD-DEPENDENT OSCILLATORY ACTIVITY DURING VERBAL WORKING MEMORY PROCESSING IN CHILDREN AND ADOLESCENTS

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Background: Previous neuroimaging investigations have consistently reported both age- and load-dependent effects on neural activity during verbal working memory (WM) tasks, and more recent EEG/MEG investigations have shown unique load effects in the neural oscillatory dynamics during each phase of WM (i.e., encoding, maintenance). However, such studies in the context of development are lacking, and therefore, the purpose of this study was to probe the effects of load and age on verbal WM encoding and maintenance.
Methods: A sample of 51 typically-developing children between the ages of 7-15 successfully completed two blocks of a modified Sternberg verbal WM task during MEG (i.e., 2-low-load and 4-high-load). Neural data was preprocessed, epoched, coregistered with MRI, and transformed into the time-frequency domain. Statistically significant oscillatory responses across all participants and conditions were identified for the encoding and maintenance phases, and responses were separately source-imaged using a beamforming approach. A whole-brain linear-mixed effects model was used to determine the effects of load (low, high) and age (in years) on each significant neural response. Peak power for each statistical peak in each significant cluster was extracted and relationships with task performance and neuropsychological ability were probed using a bootstrapped mediation approach.

Results: There was a significant main effect of age on accuracy ($F(1, 49) = 11.058$, $p < .002$), as well as a significant load-by-age interaction ($F(1, 49) = 4.684$, $p < .035$), such that age-related improvements in accuracy displayed a steeper increase in the high load relative to the low load condition. There was also a marginally significant main effect of load on reaction time ($F(1, 49) = 3.198$, $p < .080$), such that participants were marginally slower to respond in the high load relative to the low load condition. For encoding-related alpha-beta activity, there were significant load-by-age effects in right anterior insula, inferior temporal, parieto-occipital, and fusiform/cerebellar areas, as well as left occipital and inferior cerebellar areas ($F(1, 81) = 8.3531$, $p < .005$). We found that load-related differences in right parieto-occipital encoding-related activity significantly mediated the relationship between age and the difference in task accuracy across conditions ($\beta = -.064$, 95% CI [-.141, -.019]), as well as scores on the CASL grammaticality judgment subtest ($\beta = -.067$, 95% CI [-.136, -.023]). For the right postcentral gyrus, differences in encoding-related activity significantly mediated age-related differences in task reaction time ($\beta = -.064$, 95% CI [-.158, -.016]) and also the CASL sentence expression subtest ($\beta = -.048$, 95% CI [-.127, -.012]). Finally, load-related differences in right cerebellar activity significantly mediated age-related improvements on the CASL sentence expression subtest ($\beta = -.065$, 95% CI [-.148, -.017]). For maintenance-related alpha activity, there were significant load-by-age effects in left and right postcentral gyri ($F(1, 77) = 8.3531$, $p < .005$). Load-related differences in right postcentral gyrus maintenance-related activity mediated the age-related differences in reaction time between conditions ($\beta = -.078$, 95% CI [-.192, -.013]). Lastly, for alpha-beta activity during maintenance, load-by-age effects were restricted to the left superior temporal gyrus ($F(1, 85) = 8.3068$, $p < .005$).
Discussion: Our data suggest that there are significant widespread, phase-specific alterations in the neural dynamics underlying improvements in WM function throughout development, and that these load-sensitive dynamics mediate age-related improvements in both WM and language function. These data further support the notion that developmental improvements in both language and cognitive function rely on a distributed neural network of regions that are sensitive to cognitive load.

SU83. DIFFERENTIAL ANTERIOR VERSUS POSTERIOR HIPPOCAMPUS ENGAGEMENT DURING SPECIFIC MEMORY ENCODING SUPPORTS DEVELOPMENTAL REFINEMENTS IN SUBSEQUENT MEMORY QUALITY

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Background: Prior work has shown developmental shifts in the engagement of hippocampal subregions during memory formation: children engage posterior hippocampus while adults instead engage anterior hippocampus. This subregion shift may reflect developmental increases in specialization as children come to adopt adult-like activity profiles that support better memory. However, recent evidence in animals and human adults suggests memory quality varies continuously along the hippocampus long-axis instead of strictly by the segregation of anterior and posterior subregions. Whether this continuous shift in quality also exists in children remains unexplored. Potentially, considering children's locus of hippocampal activation may reveal more nuanced developmental changes in memory.
Methods: Here, we used fMRI to ask how individual variability in the locus of children's hippocampal engagement during memory formation relates to behavioral measures of memory

quality. Children (7-9 years old; N=36) and young adults (24-35 years old; N=41) viewed scene photographs and were encouraged to encode specific or general memories for these scenes by orienting to their photograph details or scene category, respectively. Outside the scanner, participants completed a surprise recognition memory test that included the studied scenes along with highly similar new scenes (lures) yoked to each studied scene.

Results: Adults had more precise memories than children overall, in that they were better able to discriminate studied scenes from lures; yet, both groups similarly benefited from specific encoding. Despite this similar memory precision benefit for specific encoded experiences, children and adults nevertheless engaged different subregions during the encoding of these memories: Specific encoding engaged posterior hippocampus in children and anterior hippocampus in adults. Considering the coordinates of the voxel most active in the specific encoding task ("peak") for each person revealed that adult peaks were both more tightly clustered and more anteriorly located than child peaks. Interestingly, peak position was differently linked to behavior across groups: More anterior peaks were associated with more precise memories in adults, yet more lure false alarms in children.

Discussion: Our results suggest that the role of anterior hippocampus shifts over development, being associated with reduced memory quality only in children. These findings provide important insight into how considering individual differences in the engagement of hippocampus along its long axis can reveal different consequences for memory granularity in childhood versus adulthood.

SU84. ASSOCIATION BETWEEN TOTAL HIPPOCAMPAL VOLUME, CORTICAL THICKNESS, AND EPISODIC MEMORY IN EARLY TO MID CHILDHOOD

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Background: Hippocampal structure has been implicated in the development of several types of memory processes in young children (Ghetti and Bunge, 2011). Cortical areas in the medial temporal and frontal lobes have previously been implicated in performance on memory tasks in older children and adults. However this link has been underexplored especially in early childhood. The present study investigated whether performance on 4 different memory tasks was related to observed differences in hippocampal volume and cortical thickness in memory-related regions in early childhood.

Methods: The sample consisted of cross-sectional data from 178 typically developing children ages 4 to 8 years old (M = 6.29, SD = 1.49, 87 female), who were part of a larger, longitudinal study investigating the typical development of episodic memory in young children. T1-weighted images were obtained during magnetic resonance imaging (MRI). During a separate visit, participants completed 4 behavioral tasks targeting different aspects of memory. A Recognition of Temporal Order task, requiring participants to remember which picture item came first in a list of 8 or 12; A Recall of Temporal Order task, requiring participants to recall the order of nine pictures; the Lorsbach task (Lorsbach and Reimer, 2005) targeting the children's visuospatial memory by asking them to recall objects and where they were located on a grid; the Source Memory task targeting both fact memory and source memory, wherein the child was taught a fact by an actor (source), and then asked to recall both the facts that they learned as well as their source (See Riggins et al., 2018; Canada et al., 2019).

Results: Multiple linear regression analyses were used to examine associations between task performance and total hippocampal volume and cortical thickness in the superior frontal gyrus (SFG), entorhinal cortex (EC), parahippocampal gyrus (PhG), superior parietal lobule (SPL), and inferior parietal lobule (IPL). These regions were chosen based on prior research suggesting their involvement in memory (Geng et al., 2022). Participant sex and intracranial volume were entered as covariates in each model. ICV and age were highly correlated, thus, only ICV was used. Analyses revealed, after correcting for multiple comparisons, total hippocampal volume was positively associated with performance on the Lorsbach task (Beta = .316, t = 4.333, p < .001) and the source memory portion of the Source memory task (Beta = .206, t = 2.755, p = .006). Additionally, total hippocampal volume was positively associated with performance on the fact memory portion of the Source Memory task (Beta = .154, t = 2.035, p = .043) and the Recall of Temporal Order task (Beta = .167, t = 2.231, p = .027) and thickness of the SFG was negatively correlated with performance on the Recall of Temporal Order task (Beta = -.152, t = -2.053, p = .042), however, these findings did not survive correction for multiple comparisons. EC, PhG, SPL, and IPL thicknesses were not found to be significantly correlated with performance on the memory tasks.

Discussion: Larger total hippocampal volume was found to be associated with better performance on temporal, visuospatial, fact, and source memory tasks in children aged 4 to 8 years old. These findings build upon previous research that found associations between hippocampal structure and memory performance (Canada et al. 2019) and provide additional evidence for the role of the hippocampus in different types of memory in early childhood. Further, cortical structure in the frontal lobe has been linked to temporal memory with thinner SFG being associated with higher memory performance. Findings from this study warrant further longitudinal investigation into the link between hippocampal and cortical structures and memory performance in early childhood. Future research should be done to explore other measures of cortical structure, such as surface area, in relation to memory performance.

SU85. ASSOCIATIONS BETWEEN HIPPOCAMPAL SUBFIELD VOLUMES AND RELATIONAL MEMORY PERFORMANCE IN PERIADOLESCENT CHILDREN: FINDINGS FROM THE PRANK STUDY

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Background: Hippocampal-dependent memory abilities develop throughout childhood and adolescence, and this trajectory of cognitive maturation has been associated with the structural and functional changes in the hippocampus. Age-related differences and developmental changes have been observed in the whole hippocampus but also in its component subfields including cornu ammonis 1 (CA1), CA2/3, dentate gyrus (DG) and subiculum (sub). Some hippocampal subfields have been putatively associated with specific roles in cognition and memory, such as CA1 potentially being associated with relational memory encoding (i.e., binding together arbitrarily-related information). Hippocampal subfields have been reported to increase in volume during childhood development until the ages of 13-15. Given this trajectory, changes in relational memory during development may be attributable to changes in hippocampal subfield volumes. However, the possible association between subfield volumes and relational memory in children is still not

well characterized. For this study we used data from the NIA-funded Polygenic Risk for Alzheimer's disease in Nebraska Kids (PRANK) study (RO1 AG064247), which investigates the impact of the polygenic risk for Alzheimer's disease (AD) on brain and cognitive development. Here, we examined the possible association between hippocampal subfield volumes and hippocampal-dependent relational memory performance in children.

Methods: A sample of healthy children (N=130), age 8-13 years, was derived from the ongoing PRANK study. Participants completed a series of cognitive and behavioral tests, as well as an MRI. MRI protocol was adapted from the Human Connectome Project (HCP) Development/Aging study. T2-weighted quasi coronal slab orthogonal to the long axis of the hippocampus (voxel size = .4 x .4 x 2; slices = 30). The MRI scan was then used to measure the hippocampal subfield volumes. The hippocampus was automatically segmented into subfields with the ASHS software using the "Preston Atlas". For the current project, we focused on the Child and Adolescent Memory Profile (ChAMP) instrument: this cognitive assessment measures properties of memory typically associated with hippocampal function including object and spatial memory. Associations between hippocampal subfield volumes and relational memory performance from ChAMP were tested using the Pearson's correlation statistic.

Results: The correlation analysis revealed that the left ($p < 0.05$) and right ($p < 0.01$) CA1 exhibited a statistically significant correlation with ChAMP performance for objects, but not for places. The left and right CA1 ($p < 0.05$) were also significantly correlated with age. The only other subfield also significantly correlated with age was the right subiculum ($p < 0.05$). Additionally, we found that age was significantly correlated with ChAMP places performance ($p < 0.005$). The association of CHAMP objects performance and both left and right CA1 volume remains significant when controlling for the potential confounding effects of age.

Discussion: This project presents findings from the PRANK study. We observed a statistically significant correlation between the CA1 hippocampal subfield and relational memory performance based on ChAMP objects but not places performance. Future work from the PRANK study will give more insight on the influence of the AD polygenic risk factors on the development of the hippocampus and its subfields.

SU86. HIPPOCAMPAL MATURATION SUPPORTS CHAINING OF TEMPORALLY RELATED EVENTS IN MEMORY

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Background: To form structured knowledge about one's environment, it is necessary to learn statistical regularities about which experiences regularly occur together in time. However, our experiences are not always directly adjacent, as events may be separated in time but still temporally related. For example, a child who regularly packs their backpack, eats breakfast, and then leaves for school may learn that packing their backpack must be done before leaving for school, despite an additional event occurring in between. Adult neuroimaging work demonstrates that events that reliably occur together in time are represented more similarly in hippocampus, with such representational binding allowing one to derive predictive structure from the world to make future decisions. Nevertheless, hippocampus undergoes prolonged development through childhood and adolescence, raising the question of how temporal structure is represented in the developing brain. Behavioral research suggests that adults integrate information across longer temporal windows

than children. In particular, this behavioral evidence indicates that children only link temporally adjacent items in memory, whereas adults chain together longer sequences of events that reliably follow one another in time. Here, we directly compare age-related differences in neural representation of non-adjacent, but predictable temporal relationships.

Methods: We use a developmental statistical learning task combined with functional MRI in children (7-12 years) and adults. Images of 12 novel 3D objects are organized into four temporally ordered triplets (ABC, DEF, etc.). Across four fMRI runs, participants view the objects one at a time, such that objects within a triplet are always presented in the same order (e.g., A-B-C; transitional probability = 1). Thus, objects within the same triplet co-occur in time and are either adjacent (i.e., A-B and B-C) or non-adjacent (i.e., A-C). To measure changes in memory representation brought about during learning, participants also viewed the objects (A, B, and C objects) in isolation before and after the triplet task, in scanned pre- and post-exposure phases. After post-exposure scanning, participants complete a two-alternative forced-choice test in which they view one triplet and one foil, selecting which appears more familiar. This triplet detection tasks provides a behavioral index of whether subjects learned the latent triplet structure based on transitional probabilities during learning.

Results: Behaviorally, all participants perform above chance at triplet detection, though detection performance increases with age. Our preliminary neural analyses indicate that hippocampal representations of non-adjacent items from the same triplet (i.e., A and C items) became more similar after learning with adults showing enhanced hippocampal similarity relative to children. This finding is consistent with our prediction that a mature hippocampus promotes forming extended representations of temporal experience. Moreover, we show that greater hippocampal similarity for non-adjacent triplet items (A-C) predicts accuracy in the triplet detection task. Finally, we show that hippocampal response immediately after a triplet boundary increases across learning runs, with a shift in the locus of boundary sensitivity from posterior to anterior hippocampus with age.

Discussion: Collectively, these findings suggest that hippocampus represents temporal regularities with greater complexity across development, leading to better predictive ability and temporal memory.

SU87. DEVELOPMENTAL DIFFERENCES DURING ENCODING OF MEMORIES FOR SEMANTICALLY VERSUS PERCEPTUALLY RELATED ASSOCIATIONS

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Background: Previous work has shown that similarity between items (e.g., perceptual, semantic) can facilitate learning of new associations, and that the brain regions supporting such learning can differ depending on the nature of the items' similarity. In adults, encoding of semantically related information has been associated with semantic processing and elaboration, and is supported by prefrontal and temporal regions. By contrast, encoding of perceptually similar items tends to engage more occipital and parietal regions linked to visual attention and the processing of visual detail. However, it is unclear how these neural signatures emerge over childhood. Given the earlier development of visual than semantic processing regions and the growth of semantic knowledge across the lifespan, one possibility is that developmental differences will be most evident when considering how memory and its associated neural signatures is influenced by semantic

relatedness. Moreover, there may be differences in hippocampal (HPC) contributions to semantic versus perceptual binding at the subregion level, given evidence that subregions develop at different rates and are differentially associated with memory for semantically and perceptually related information in adults. The purpose of this study was therefore to assess developmental differences in the neural regions engaged during the successful encoding of semantically and perceptually similar item pairs.

Methods: We had children (6-7 years) and adults learn pairs of pictures that were either semantically similar (i.e., similar in meaning, such as carrot-broccoli) or perceptually similar (i.e., similar in colour and shape, such as basketball-pumpkin) during fMRI scanning. Memory for the pairs was then tested outside the scanner using cued recall.

Results: Adults remembered more pairs than children, and both age groups showed better memory for semantic than perceptual pairs. However, despite semantic relatedness conferring a similar memory advantage in children and adults, the brain regions supporting these behaviours showed distinct developmental differences. Specifically, while children and adults alike showed greater engagement in occipital and parietal cortices for remembered versus forgotten semantic pairs, adults additionally showed greater engagement in prefrontal and inferior temporal regions. Within HPC, both adults and children engaged posterior subregions while children alone also engaged anterior HPC, suggesting an increasing specialization of HPC subregions over development. Directly comparing across age groups revealed significant developmental differences in parietal cortex and occipital regions. In parietal cortex, adults showed greater engagement for remembered than forgotten semantic pairs, while children showed the opposite pattern. Conversely, children engaged medial occipital regions more when they later remembered versus forgot pairs, while the opposite was true in adults. Comparing directly across pair types further revealed that effects in visual regions were specific to semantically similar pairs, and were not present for perceptually similar pairs.

Discussion: Overall, our findings suggest that developmental differences in the brain regions that support memory formation are more pronounced for semantic than perceptual associations, with age differences involving a shift from reliance on earlier visual processing regions to more frontal and parietal regions. These findings may indicate that children and adults are differently able to leverage their semantic knowledge during learning, a phenomenon that may be underpinned in the brain by both frontoparietal refinement and increasing specialization in how different hippocampal subregions contribute to memory formation.

SU88. THE IMPACT OF EARLY HIPPOCAMPAL DEVELOPMENT ON SCHOOL-AGE EPISODIC MEMORY PERFORMANCE

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Background: The hippocampus is a subcortical brain structure classically implicated in various aspects of memory processing in both adults and children. As a critical node in memory networks, the volume of the hippocampus has been shown to be associated with episodic memory task performance across development, including as early as preschool age. Less is known, though, about associations between hippocampal volume development and memory performance in the earliest years of life. As the first years of life comprise an important transition from early infantile

amnesia to more adult-like episodic memory, it is critical to fully understand the development of these memory network components. Densely sampled imaging data from the Baby Connectome Project and a new school-aged followup time point with memory data afforded us the opportunity to examine this development.

Methods: We used data from the Baby Connectome Project, a longitudinal study of brain and behavioral development from 0-5 years. As part of the study, children underwent full-brain T1 and T2 structural MRI scans during natural sleep. These scans were processed using the BIBSnet imaging processing pipeline, from which hippocampal volumes were pulled. For these analyses, 524 visits from 232 participants provided hippocampal volumes. A subset of these children returned for a follow-up school-aged behavioral session (N=27, with processing ongoing). At this session children performed a mnemonic similarities task (MST) to index pattern separation abilities, an important component of episodic memory. The trajectory of hippocampal volume development was modeled using a GAMMs approach. From this model, hippocampal volume residuals were averaged across each participant to provide a participant-level measure of early hippocampal development. This early hippocampal development was then compared to memory performance at the school-age follow-up, accounting for age and sex.

Results: Trajectories of hippocampal development showed steep early growth that leveled off, with an inflection point near 10 months. Males on average showed larger hippocampal volumes across this time period. Per-participant hippocampal development during ages 0-4 years showed a quadratic relationship with pattern separation, with both relatively larger and smaller hippocampal volumes correlating with better pattern separation abilities at school age ($F(4,22)=3.91$; $p=0.02$; Quadratic term $p=0.01$). This finding was robust to various approaches to calculating an index of pattern separation abilities. No relationships were found between early hippocampal volumes and a measure of source memory or general IQ scores from the WPPSI-IV, suggesting this finding is so far specific to the pattern separation aspect of episodic memory.

Discussion: More work needs to be done to understand the mechanisms or interactions underlying this unexpected quadratic pattern of association between early hippocampal development and later memory abilities. Future analyses will include more participants to determine the replicability of this finding as updated processed data from this study becomes available (N=51 total participants have both early imaging and school-age follow-up data that will likely become available as processing is completed). With more data, a developmental timing approach may also allow us to tease apart any competing interactions. Finally, future analyses will include subregion analysis of the hippocampus, which may provide a more sensitive measure of the structural development of this network.

SU89. TWO-YEAR-OLDS' WORD MEMORY BENEFITS FROM TESTING EFFECTS

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Background: Infants and young children exhibit phenomenal ability to learn new words and amass a large vocabulary (Golinkoff et al., 2000). Though a large body of research has focused on the cognitive processes underlying how young children learn new words, little is known about how children retain memory for words over time or the persistence of object-referent associations (Booth and Waxman, 2008). The present study aims to understand the conditions under which toddlers retain words more effectively. We leveraged a manipulation which has proven to be robust

in adults and older children for enhancing memory–the testing effect–which shows that actively recalling information from memory enhances long-term retention compared to simply re-studying material (Roediger and Karpicke, 2006; Roediger and Butler, 2011). By engaging in retrieval practice, we can strengthen memory and improve long-term persistence of memory, even days after learning. While this effect is well documented in adults, we aim to elucidate how engaging in retrieval practice may affect toddlers' memory for object referent associations and related episodic detail from initial learning episodes.
Methods: Across two sessions children ages 24-34 months (current N = 50; to be completed by the Conference N = 72) learned novel object-referent pairs associated with episodic content (actions) in different ways to examine how toddlers retain memory for these newly familiarized words and their actions after a week delay. In session 1, some children learned the associations once, some children learned the associations twice, and some children learned the associations once followed by an immediate test of the object-referent pairs. In session 2, all children were tested for their memory of the object-referent associations and their associated actions.
Results: Preliminary results show that toddlers who were tested immediately after learning remembered words better than those who studied words twice and who studied words once.
Discussion: Additional analyses will elucidate whether these conditions extend to memory for the actions or episodic detail associated with the original learning episode. Overall, engaging in active retrieval attempts immediately after learning may help strengthen memories for words, even without feedback on the accuracy of those retrieved labels.

SU90. FAST AND PRECISE QUANTITATIVE MEASURES OF WHITE MATTER DEVELOPMENT WITH MAGNETIC RESONANCE FINGERPRINTING**

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Background: Developmental cognitive neuroscience aims to shed light on evolving relationships between brain structure and cognitive development. To this end, quantitative methods that reliably measure individual differences are fundamental. Commonly used qualitative MRI sequences are influenced by multiple biological factors, scan parameters, and hardware-related biases. In contrast, quantitative MRI measures specific tissue properties at the cost of long scan durations (> 20min) and sensitivity to motion. This poses a critical limitation for studying young children. Here, we examine the reliability and validity of a novel quantitative T1 mapping method - Magnetic Resonance Fingerprinting (MRF) - in children scanned longitudinally. We focus on T1 values in white matter, since quantitative T1 values are known to primarily reflect myelin content, a key factor in brain development.
Methods: 49 children aged 8-13y (mean 10y ±1.4) completed two scanning sessions 2-4 months apart. In each session, two 2-minute 3D-MRF scans were collected to evaluate the effect of scan duration on image quality and test-retest reliability. A separate calibration scan was used to measure B0 inhomogeneity and correct for potential biases. We examined the impact of scan time and B0 inhomogeneity correction on test-retest reliability of values in white matter, by comparing single 2-min and combined two 2-min scans, with and without B0-correction.
Results: Whole-brain voxel-based reliability analysis showed that combining two 2-min MRF scans improved reliability (pearson's r=0.80) compared with single 2-min scans (r=0.75), while

**Flash Talk

B0-correction had no effect on reliability in white matter (r=0.80 vs 0.75 for 4-min and 2-min). Using diffusion tractography, we delineated T1 profiles along major white matter fiber tracts previously associated with cognitive abilities. MRF-derived T1 values along these tracts showed similar or higher reliability compared with diffusion-derived values. Lastly, we found that T1 values in multiple white matter tracts were significantly correlated with age (for example, the left arcuate fasciculus: r = -0.46, p = 0.001). Preliminary data from a longitudinal follow up suggest that MRF-derived T1 values also capture developmental change over the course of a year.
Discussion: MRF-derived T1 values were highly reliable in a longitudinal pediatric sample and replicated known age effects. Reliability in white matter was improved by longer scan duration but was not affected by B0-correction, making it a quick and straightforward scan to collect. In sum, MRF provides a promising avenue for acquiring quantitative brain metrics in children and patient populations where scan time and motion are of particular concern.

SU91. LEVERAGING MIXED-EFFECTS LOCATION SCALE MODELS TO ASSESS THE ERP MISMATCH NEGATIVITY'S PSYCHOMETRIC PROPERTIES AND TRIAL-BY-TRIAL NEURAL VARIABILITY IN TODDLER-MOTHER DYADS

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Background: Trial-by-trial neural variability, a measure of neural response stability, has been examined in relation to behavioral indicators using summary measures, but these Methods: do not characterize meaningful processes underlying variability. Mixed-effects location scale models (MELSMs) overcome these limitations by accounting for predictors and covariates of variability, differences in participant's variability levels, and other potential confounds (e.g., data quality). MELSMs can also improve estimates by taking into account participant's trial counts, common missing data patterns, and expected effect sizes but have been rarely used in developmental studies. Here, we applied MELSMs to the ERP auditory mismatch negativity (MMN), a neural measure of the brain's response to a frequently repeated "standard" stimulus compared to an infrequent "deviant" stimulus. Averaged MMN mean amplitudes have been examined in relation to language and psychopathology but trial-by-trial MMN variability has not been previously reported to our knowledge.
Methods: 84 toddlers and 76 mothers completed a speech-syllable MMN paradigm. MMN extraction, exclusion criteria, and analyses were pre-registered. We extracted early and late MMN mean amplitudes from trial-level waveforms (i.e., the waveform for each deviant trial minus the standard trial immediately preceding it).
Results: We first characterized our sample's psychometric properties using MELSMs and found a wide range of subject-level internal consistency for both toddlers and mothers. These properties are important for interpreting statistical results and estimating statistical power for future studies. Next, we examined the relation between toddler MMNs with theoretically relevant child behavioral and maternal variables after accounting for covariates. MELSMs offered better model fit than analyses that assumed constant variability. We found significant individual differences in trial-by-trial variability but no significant associations between toddler variability and their language, irritability, or mother variability indices. These patterns were consistent for both the early and late MMN time windows.

Discussion: Greater early MMN variability may be associated with greater sensitivity to the environment and greater late MMN variability may be associated with noisier representations of stimulus features. Overall, trial-by-trial neural variability differences may be a common but underexamined feature of ERPs. We illustrate how MELSMs can characterize psychometric properties, answer questions about individual differences in variability, and examine relations to theoretically relevant behavior and covariates.

SU92. EVALUATING PERMUTATION-BASED INFERENCE FOR PARTIAL LEAST SQUARES ANALYSIS OF NEUROIMAGING DATA

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Background: Partial least squares (PLS) is actively leveraged in neuroimaging work, typically to map latent variables (LVs) capturing brain-behaviour associations. However, significance testing in PLS and other multivariate techniques is invariably challenging and a source of controversy. Canonically, LVs are considered statistically significant if they tend to capture more covariance than LVs derived from permuted data (i.e., a null model), with a Procrustes rotation applied to map each set of permuted LVs to the space defined by the original LVs, creating an "apples to apples" comparison. Yet, it has not been established whether applying the rotation makes the permutation test more sensitive to the "true" LVs in a dataset, and more generally, it is unclear if significant LVs can always be interpreted as meaningful, given that they may be unstable across samples or explain a negligible amount of covariance.

Methods: First, we simulated a series of datasets, each with one true LV present. However, our "confidence" in the simulated LV varied across datasets, with more confidence corresponding to (1) a larger sample size, (2) a greater effect strength, or (3) less noise. We also (4) generated a series of randomly generated and whitened datasets with no meaningful between-feature covariance. 1000 different datasets were generated per analysis.

Next, we performed PLS on each dataset, and tracked the following outcome metrics for LV1:

- Significance (permutation testing, with or without a Procrustes rotation)
- Strength (covariance explained)
- Stability (across split-halves)

An ideal outcome metric should track our confidence in the simulated effect (e.g., LV1 should be more significant in larger samples, and should not be significant in whitened data).

Finally, (5) we analyzed brain and behavioural data from 28 804 UK BioBank participants, with the brain matrix composed of cortical thickness in 64 regions and the behavioural matrix composed of 17 lifestyle risk factors linked to adverse aging. We drew 1000 subsamples from the broader pool of participants and evaluated whether significance, strength, and stability depended on sample size for various LVs of interest.

Results: In simulated data, we observed that LV1 was nearly always significant if a rotation was applied during permutation testing, regardless of whether the simulated effect was (1) undersampled, (2) weak, (3) noisy, or (4) present at all. However, if no rotation was applied, all possible LVs tended to be significant in large samples drawn from the (5) UK BioBank. Meanwhile, LV strength and stability metrics scaled with sample size, effect size, and noise level

in simulated data; they remained low in whitened data; and they suggested that most of the significant UK BioBank LVs were not of interest.

Discussion: Together, we observed that conventional rotated permutation tests systematically overestimated the statistical significance of LV1, while unrotated tests were entirely non-selective in large samples. Owing to the limitations of both approaches, we argue that the p-values from either test cannot be interpreted as strict measures of whether a latent variable "exists", and that latent variable strength and stability should be considered as part of a more nuanced formula for determining the effects to report in a PLS analysis. We end by presenting a set of considerations based on our findings for researchers implementing PLS permutation testing:

- Significant latent variables are not necessarily meaningful, regardless of the rotation applied during permutation testing.

- Rotated permutation tests tend to systematically pass early latent variables. Complementary measures of latent variable strength and stability can help determine whether an effect may be meaningful.

- Unrotated permutation tests tend to be overly permissive when N is large. More conservative methods are preferred in large datasets.

SU93. RELIABLE MULTIMODAL BRAIN SIGNATURES PREDICT MENTAL HEALTH OUTCOMES IN CHILDREN

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Background: Mental health problems can impact all facets of life and even life expectancy: suicide is a leading cause of death for young people. It is critical to identify children at risk for poor mental health outcomes and provide interventions that support healthy development. While most mental health problems emerge in adolescence, the specific brain alterations that underlie compromised trajectories may be evident earlier. Neuroimaging studies have been widely useful to examine brain alterations, but most focus on a single modality in isolation; recent advances in multimodal image analysis combined with big data allow for a more comprehensive understanding of the neurobiology underlying mental health. Using the Adolescent Brain and Cognitive Development (ABCD) Study we aimed to (a) identify linked gray and white matter structural signatures that predict mental health scores 1 year later, (b) assess if relevant brain signatures relate to internetwork functional connectivity, and (c) determine if brain signatures differ in a genetically similar sample of twins with and without at-risk behaviours.

Methods: T1-weighted and diffusion MRI data from the ABCD 2.0.1 release (N = 11,875, age 9-10 years) were arbitrarily split into two halves and run independently to achieve feasible processing capacity and test replicability. Images were preprocessed using FSL software, aligned to adolescent MNI space, and quality checked (N=8581 clean datasets). Voxel-based morphometry, fractional anisotropy, axial, and radial diffusivity maps were input into a linked independent component analysis to compute data-driven brain signatures that represent shared inter-subject variations across brain measures. Principal component analysis factorized clinical scores 1 year later. Linear mixed effects models quantified brain signatures that predicted clinical factors while controlling for age, sex, race, familial relationship, site, total household income, and MRI manufacturer. Relationships between brain signatures and structurally implicated functional

networks were assessed using ABCD tabular data and linear regression. Pairwise t-tests evaluated if brain signatures differed between twins discordant for Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS) at-risk behaviours.

Results: A brain signature comprised of cingulate, caudate, precuneus, insular, and prefrontal cortex volumes, linked with diffusion measures along the uncinate and cingulum-hippocampal tracts, predicted anxiety and depression symptoms in both replication halves ($T = 4.2$ and $T = 4.3$, $p < 0.0001$). This signature was significantly related to salience and default mode internetwork functional connectivity ($R2 = 0.007$, $p < 0.0001$ for both halves). A second signature predicted negative urgency ($T = 3.3$, $p < 0.001$) and behavioural inhibition scores ($T = 2.8$, $p < 0.005$) and involved cingulum and thalamic radiation microstructure with smaller thalamus, amygdala, and striatum volume. This signature was significantly different between pairs of twins with and without self-injurious behaviour according to K-SADS ($T = 1.8$, $df = 80$, $p < 0.04$).

Discussion: Our data-driven approach identified reliable linked patterns of white and grey matter structure that predicted mental health scores one year later and replicated across three independent samples. The structure of deep grey matter, default, and salience network nodes, linked with microstructure of white matter tracts that support their communication are potential biomarkers of compromised mental health in adolescence. While the neurodevelopment of emotion-regulation and association cortices of these children is ongoing, we have demonstrated that there are reliable brain alterations in childhood that predict mental health outcomes. Our findings motivate the need for early identification, support, and targeted interventions that will foster resiliency through the volatile and neuroplastic phase of adolescence.

SU94. A NOVEL NON-ORTHOGONAL BASE DECODING METHOD FOR FMRI NEURAL ACTIVATION

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Background: The human brain often conducts behavioral processes involving different underlying types of parallel processing mediated by functionally distinct but spatially overlapping neural networks(Price, C.J. and Friston, K.J.,2005). Before, human functional neuroimaging studies had difficulty revealing these processes from underlying complex physiological signals(Zhang, Z., et al.,2017), making it difficult to model specific processes and mechanisms of the brain(Kragel, P.A., Koban, L., Barrett, L.F. and Wager, T.D.,2018). Recent general frameworks propose two different cognitive processes that engage in parallel during emotional tasks, evaluation (scaled signal value from reward to punishment) and response readiness (contains arousal and attentional salience to aid in the response readiness process)(Fellows, L.K.,2004;Zald, D.H. and Treadway, M.T.,2017).Evaluation and readiness signals are inevitably confounded with each other during the emotion and the reward/punishment processing. Also, the response strength differ from person to person which will cause the unbalanced base(the non-orthogonal bases in this paper). In the present study, we propose a novel approach to decompose the confouded and non_x0002_orthogonal based brain activations.

Methods: In this study, we propose a novel method to decompose each participant's brain activations under different circumstance(denoted as y) with a set of non-orthogonal basis (in the simulation, the base isset to be the form like x=(x1,x2,x3)), where each vector will represent a predefined signal model,e.g. evaluation or readiness. Specifically,'non-orthogonal' in this study

means that any pairwise covariance of vectors all not equal zero,i.e. cov(xi,xj)≠0. If cov(xi,xj)=0 (balanced base like (-1,0,1), (1,0,1)), the regression coefficients β (i.e. the strength of signals for each individual) estimated from a multiple linear model with all vectors were the same as those estimated univariately (of simple linear models). However, in many tasks related to emotion or face response, the situation like the responses' strength are different among two directions (unbalanced base like (-1,0,1), (1,0,2)) will cause cov(xi,xj)≠0. With the non_x0002_orthogonal basis, spurious correlations of signal components (i.e. β) will be introduced by related vectors (i.e. xi are correlated), thus cause the meaningless decomposition. To overcome this difficulty, we model the signals with non-orthogonal basis with multivariate linear model (Fig1), and build a statistic (Fig1) to separate the correlated signals and infer the independence. In Fig1.(A), we use this method to separate simulated signals with different correlations, we can see that the statistic among varied correlations can separate the signals well. In Fig1.(B),we use this method to identify independent signals at a fine-grained level, in the simulations we can find the independent signals at 0.1 correlation level with sample size=1000.

Results: In real psychology experiments, we can not know the real response strength in the unbalanced basis (e.g. (-1,0,1),(1,0,2)or(-1,0,1),(1,0,3), with our method, we can use the model and statistic in Fig1 to find the best base which can decompose the signals most properly. In Fig2, we set the real base is ((-1,0,1),(1,0,4)), only the right base ((-1,0,1),(1,0,4)) has the smallest absolute t_value (two sample t test).

Discussion: We use a generalized linear model to model the activations and build a statistic which can infer the heterogeneity of brain signals. By implementing this method, we can identify the independent signals and separate the signal-pairs with different correlation values. In the unbalanced base(non-orthogonal base) settings, we can find the best base choice which can decompose the signals most properly by using this method, it will help to design the base in the experiments with emotional tasks. In the future work, we can extending our method to higher dimensions and whole brain (Berridge, K. C. (2019);Kauschke, C., Bahn, D., Vesker, M., and Schwarzer, G. (2019)).

SU95. CALLOUS-UNEMOTIONAL TRAITS MODERATE THE RELATIONSHIP BETWEEN YOUTH ANTISOCIAL BEHAVIOR AND NEURAL NETWORK ORGANIZATION.

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Background: Youth antisocial behavior (AB; e.g., aggression, rule-breaking) is associated with poor academic and job performance, increased risk for negative physical and mental health outcomes, and elevated risk for continuing AB into adulthood. Youth AB is believed to be rooted in disruptions across multiple domains of neurocognitive functioning including: socioemotional processing, executive functioning, and reward processing. Recent research suggests that these AB-related deficits may emerge due to differences in the structure and functioning of major neural networks such as the default network, frontoparietal network, and salience network. However, the relationship between youth AB and the overall organization of these networks remains under-researched.

Methods: To address this gap in the literature, the current study applied unweighted, undirected graph analyses to functional magnetic resonance imaging data in a community sample of 500 twins

(ages 10-17, M = 14.78; 46.4% female) living in disadvantaged neighborhoods in Michigan. As prior work indicates that neurocognitive alterations in youth AB may differ depending on an individual's level of callous-unemotional (CU) traits, we examined CU traits as a moderator of the association between brain network organization and AB. Using self-report measures of youth AB and CU traits, we found that the association between neural network organization and youth AB was moderated by CU traits.

Results: Specifically, we found significant AB x CU traits interactions for measures of clustering (gamma; β = .10; p = .0315) and small-worldedness (sigma; β = .08; p = .0315) in the default network demonstrating that youth high on both AB and CU traits showed generally higher rates of clustering (gamma; b = .29; p = .046) and small-worldedness (sigma; b = .22; p = .076) within the default network; however these associations were not present in youth high on AB but low on CU traits (gamma: b = -.15, p = .460; sigma: b = -.10, p ¬= .559).

We found similar AB x CU traits interactions when examining the efficiency (lambda) of the frontoparietal (β = -.10; p = .006) and salience networks (β = .13; p = .003). The frontoparietal interaction revealed that youth high on both AB and CU traits were associated with a more efficiently organized frontoparietal network (b = -.05, p ¬= .009), whereas youth high on AB but low on CU traits did not show this effect (b = .01, p ¬= .659). The salience network interaction also demonstrated that youth AB was associated with a more efficiently organized salience network, but, in contrast to our other findings, this effect was only present in youth with low levels of CU traits (b = -.06, p ¬= .055). Youth high on both AB and CU traits showed the opposite trend (b = .03, p ¬= .222) within this network.

Discussion: These findings not only demonstrate that youth AB is associated with alterations in the overall organization of major neural networks, but these alterations are moderated by the presence of CU traits.

SU96. FINDING CONFIDENCE IN INDIVIDUALIZED FUNCTIONAL NETWORKS: CONFIDENCE MAPPING IN A PRECISION DEVELOPMENTAL DATASET

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Background: In the field of resting-state fMRI, there has been a shift from group-averaged functional network topography to more nuanced, subject-specific network assignments from individual connectivity. Several works have highlighted approaches for network identification in individuals (e.g., Hermosillo et al., 2024). However, these approaches often use binary maps, where brain indices are uniformly coded as either in or out of a given network. Additionally, current methods cannot indicate the certainty of these network assignments or the amount of data needed to achieve reproducible networks at the individual level.

Methods: Here, we introduce a novel extension to prior methods called precision confidence mapping (PCM). PCM identifies individual functional network topography and provides a confidence map for network assignments, which could be crucial for future clinical applications, such as targeting neuromodulation interventions. This method leverages the detailed temporal

nature of resting-state time-series by dividing it into multiple partitions and shuffling them across bootstrap iterations. For each iteration, network identification is applied to a subset of the shuffled data to establish network assignments. These assignments are then compared across iterations, with areas weighted by their stability to create confidence maps. PCM highlights the stability of individual-specific networks, including the recently identified Somato-Cognitive Action Network (SCAN)(Gordon et al., 2023), and offers comprehensive analyses of network characteristics, such as central tendencies, proportions, probabilities, and consistency, thus providing a detailed 'confidence map' of individual functional network assignments across cortical and subcortical connections.

Results: To validate and refine PCM, we applied this method to a developmental precision imaging dataset of typically and atypically developing children ages 9-10. This study aimed to better understand individual differences in functional network topography across individuals with and without Attention Deficit Hyperactivity Disorder and Autism Spectrum Disorder. By applying PCM to this dataset (N=8), we successfully extracted network assignments across a diverse set of participants with up to 140 minutes of low motion (FD $<$ 0.2 mm) Multiband-Multi-Echo resting-state data. Network confidence maps were described for the 14 functional networks of the Gordon Parcellation, as well as the newly identified SCAN network.

We compared network stability in a split-half analysis (~70 minutes each half) against a 10% holdout analysis (~70-minute half compared with ~14 minutes of testing data). Network stability was consistently higher in the split-half analysis, as each vertex's network assignment was more likely to remain the same between the test and holdout data compared to the 10% holdout analysis. The highest stability was observed in the default mode [Half=0.79; 10%=0.63], visual [Half=0.86; 10%=0.71], frontoparietal [Half=0.85; 10%=0.74], and SCAN [Half=0.80; 10%=0.69] networks, with the lowest stability in the posterior medial temporal network [Half=0.49; 10%=0.38]. Overall, confidence maps were fully stable in vertices close to network centers, with lower stability in vertices at the edges.

Discussion: This method underscores the importance of robust data analysis for extracting meaningful network identifications that can improve precision medicine approaches. By producing detailed confidence maps of individual network topography, PCM can inform more meaningful targeted interventions, such as Deep Brain Stimulation and Transcranial Magnetic Stimulation. Moreover, by establishing minimum data requirements for reliable network identification, PCM not only refines research methodologies and therapeutic strategies but also enhances treatment specificity and effectiveness. As PCM advances, it holds promise for integrating precise neuroscientific insights into practical clinical applications to improve clinical outcomes.

SU97. CORTICO-SUBCORTICAL FUNCTIONAL CONNECTIVITY OF SOMATOMOTOR SYSTEMS IN CHILDREN: NOVEL INVESTIGATIONS OF THE SOMATO-COGNITIVE ACTION NETWORK

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Background: Investigating the development of cortico-subcortical connectivity is important for understanding the maturation of diverse cognitive, sensorimotor, and social functions. Our previous research demonstrated stronger functional connectivity between specific subcortical

regions (i.e., posterior putamen, ventral thalamus) and the somato-motor face (SMF) cortical functional network in children compared to adults. However, recent work has shown that the subcortex is also functionally connected to the newly discovered somato-cognitive action network (SCAN), which integrates body control (motor and autonomic) with action planning. Anatomically, the SCAN comprises three nodes along the motor cortex that are adjacent to but between effector specific regions, including two nodes surrounding the SMF. Thus, it is possible that our previous findings of developmental differences in subcortical-SMF functional connectivity were also reflecting SCAN maturation rather than solely reflecting SMF network development.

Methods: In this study, we will test the theory that increased subcortical-somatomotor connectivity in children is characteristic of SCAN, rather than exclusively associated with the SMF network. To test SCAN-subcortical functional connectivity in development, we plan to conduct the following analyses. We will perform a seed-based region of interest (ROI) analysis using a subset (participants with at least 8 minutes of low motion data) of the baseline resting-state functional connectivity (RSFC) MRI data from the Adolescent Brain and Cognitive Development (ABCD) Study (n=7,316, MAge = 9.9 years). Subcortical seed ROI's (posterior putamen, ventral thalamus) will be defined based on the previous studies showing a developmental difference in SMF connectivity. We will create RSFC seed maps from our 2 subcortical ROIs and quantify the spatial overlap of peak connectivity values with the SCAN and with the SMF via the dice coefficient.

Results: We predict that the RSFC seed maps will significantly overlap with SCAN regions, revealing a previously obscured relationship between the subcortical ROIs and the SCAN. Furthermore, we will explore potential age-related differences in subcortical functional connectivity to the SCAN versus subcortical functional connectivity to the SMF within the ABCD child dataset and a separate dataset of 120 adults. If our previous results of stronger SMF-subcortex functional connectivity in children vs. adults were driven by functional connectivity with the SCAN, we hypothesize that children will show higher SCAN-subcortex functional connectivity than SMF-subcortex functional connectivity and that adults will show no difference.

Discussion: Findings from this study will provide insights into the specificity of subcortical connectivity with somatomotor networks. This novel perspective on the developmental role of SCAN could provide a deeper understanding of how complex sensorimotor and cognitive functions emerge and interact during the crucial periods of brain development.

SU98. CHILDREN SHOW DISTINCT PATTERNS OF FRONTOTEMPORAL ACTIVATION WHEN EVALUATING FOOD TASTE AND HEALTH: A FUNCTIONAL NEAR INFRARED SPECTROSCOPY (FNIRS) STUDY

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Background: Pediatric obesity is a public health concern that is associated with early-life metabolic comorbidities and deficits in neurocognitive and socioemotional development. Obesity ultimately Results: from consuming more energy than is expended. Food consumption when not hungry, or hedonic overconsumption, is associated with excess energy intake and may contribute to the development of obesity. Therefore, it is important to identify neural systems underlying how children evaluate attributes of food that impact intake such as taste and health.

Methods: 64 children (8-10-years; 26 male) completed functional near-infrared spectroscopy (fNIRS) during a visual food rating task. Children completed 3 runs where they rated the same 50 food images that varied in properties (i.e., energy density, sweet/savory) on health ('very unhealthy' to 'very healthy'), taste ('very bad' to 'very good'), and how much they wanted to eat each food ('not at all' to 'very much') using a 4-point Likert Scale. Run order was counter-balanced across participants. Images were randomized within runs with each image presented for 2.5 secs and the inter-stimuli-intervals jittered between 0.5-3.75 secs. Oxy-hemoglobin was measured using NIRScout with 16 sources and 16 detectors covering bilateral frontotemporal areas centered at F3 and F4 (International 10-20 system). Functional data was pre-processed with the NIRS Toolbox, which uses an autoregressive model-based approach to adjust for motion and serially correlated errors. A standard data processing pipeline was used to correct for changes in optical density, motion artifacts, and to calculate concentration changes using the modified-Beer Lambert Law with age-adjusted path length factors. The QT-NIRS toolbox was used to assess individual channel signal quality (scalp-coupling threshold = 0.6, Q threshold = 0.7 and peak spectral power threshold = 0.1) and to censor channels with poor quality. Parametric modulation of oxy-hemoglobin by food rating (i.e., health, taste, or wanting) was modeled at the individual level. Group analyses used random intercept models with a random intercept for participants to assess overall associations between activation and attribute rating for each condition. Channels were corrected for multiple comparisons using Benjamini-Hochberg false discovery rate.
Results: There was a positive association between taste ratings and activation in bilateral temporopolar areas and right superior and middle temporal gyri. Higher taste ratings were also associated with lower activation in the pars triangularis region of orbital frontal cortex (OFC), dorsolateral prefrontal cortex (dlPFC), and frontopolar areas. In contrast, higher health ratings were associated with greater dlPFC activation and less activation in superior and middle temporal gyri and temporopolar areas. Wanting was inversely associated with activation in superior and middle temporal gyri, temporopolar areas, and frontal eye fields but positively associated with activation in right dlPFC, left frontopolar, and OFC.
Discussion: When assessing food images for taste and health, children showed opposite patterns of dlPFC engagement, a region implicated in cognitive and executive function. While higher taste ratings were associated with less dlPFC engagement, higher health ratings were associated with greater dlPFC activation. In contrast, greater wanting ratings were associated with greater OFC engagement, which is implicated in encoding the rewarding value of a stimuli. These results demonstrate that neural processes in children are modulated by food attributes in a manner that is consistent with known functions of the appetitive network. Understanding how these neural patterns influence appetitive behaviors and individual differences in the self-regulation of children's food intake can help to elucidate the neural processes that facilitate overconsumption when faced with palatable foods.

SU99. NEURAL CORRELATES OF VICARIOUS REWARD PROCESSING IN CHILDREN WITH PROLONGED PEER VICTIMIZATION EXPERIENCES**

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****Flash Talk**

Background: The period between childhood and adolescence is important for the development of social relationships, as peers start to spend more time with peers and show heightened reward-sensitivity. Negative peer interactions, such as peer victimization, can have long-lasting effects on mental health outcomes. The aim of this study was to examine how children with peer victimization experiences process rewards in social interactions, and how this may affect subsequent behaviors. Therefore, this study examined the neural correlates of vicarious reward processing and subsequent trust behavior in relation to prolonged experiences of victimization in late childhood.
Methods: The sample consisted of children with prospective longitudinal data on peer victimization over the past two years (n behavioral = 83, 49.4% girls, M age = 10.6±1.0 years, n fmri = 62). During a lab visit, participants played an fMRI vicarious reward task in which they could win or lose money for themselves and two other peers. The two other peers were experimentally manipulated to either include or exclude the participant in a Cyberball task prior to the vicarious reward task. Additionally, trust in the two peers was assessed using a one-shot trust game.
Results: Results revealed ventral striatum activation when winning (versus losing) for oneself, and activation in social brain regions when playing for excluders rather than for oneself. Prolonged victimization predicted decreased ventral striatum activation during personal rewards, and increased activation in the dorsomedial prefrontal cortex when playing for excluders rather than for oneself. Finally, prolonged victimization was associated with increased differentiation in trust toward the including and excluding peers.
Discussion: Together, these findings contribute to our understanding of the social cognitions and behaviors of victims of bullying, and may ultimately help identify mechanisms by which peer victimization may affect adolescents' ability to form and maintain social relationships.

SU100. SEX DIFFERENCES IN FETAL BRAIN IRON DEVELOPMENT ESTIMATED BY R2* MAPPING FROM MULTI-ECHO FUNCTIONAL MRI

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Background: During gestation, iron plays a vital role in many neurodevelopmental processes, such as neurotransmitter synthesis, oxygen transportation, and myelination (Reinert et al., 2019). Research on maternal iron deficiency anemia has underscored the importance of understanding brain iron development in utero. Offspring of mothers with low iron levels during pregnancy are at an increased risk of developing neurodevelopmental disorders (Wiegersma et al., 2019). Despite the value of understanding iron in utero, little is known regarding iron development in fetal brains, including how biological sex and age-related changes may interact.

Multi-echo resting-state functional MRI (ME-rs-fMRI) provides a promising approach for investigating brain iron content through R2* mapping, an indirect measure of iron levels by quantifying the signal decay rate over time in response to magnetic field inhomogeneities (Ghadery et al., 2015). While previous research in infants (Ji et al., 2023) and adults (Langkammer et al., 2010) has demonstrated the reliability and validity of R2* estimations of brain iron content, this methodology has not yet been applied to large fetal datasets. The current study seeks to bridge this

gap by employing R2* mapping from ME-rs-fMRI to investigate age- and sex-related differences in iron accumulation across the whole fetal brain throughout prenatal development.

Methods: Eighty-six ME-rs-fMRI scans were collected from 52 healthy fetuses between 22 and 39 weeks of gestation (GA) using a 3T MRI system with a 550g abdominal 4-channel Siemens Flex coil as part of the Perinatal Imaging of Neural Connectivity (PINC) project. Fetal brains were isolated and motion-corrected using MCFLIRT (Jenkinson et al., 2002). A segment of ten low-motion volumes from the time series were identified and averaged, resulting in a single volume for each of the three echoes for every run. T2*, the transverse relaxation rate, was estimated and mapped for each voxel in the image by logarithmically fitting values across echoes. These T2* maps were then normalized to a 32-week GA fetal template. Subsequently, R2*, the reciprocal of T2*, was estimated in four tissue segments (the bilateral gray and white matter) and 110 regions of interest (ROIs) using mean values of non-zero voxels. Mixed linear regression models were used to examine sex-related developmental effects on R2*, adjusting for multiple comparisons (Gholipour et al., 2017).

Results: In line with prior research, R2* estimates of iron concentration significantly increased with age throughout the fetal brain, especially the bilateral cortical gray matter (left: $t(84) = 5.14$, $p < .001$; right: $t(84) = 4.36$, $p < .001$) and white matter (left: $t(84) = 3.39$, $p = .001$; right: $t(84) = 2.67$, $p = .009$). Upon adding biological sex as a covariate, significant age-by-sex interaction effects on brain iron content were observed in the left cortical gray matter ($t(82) = 2.77$, $p = .007$), left white matter ($t(82) = 3.18$, $p = .002$), and left insula ($t(82) = 3.92$, $p = .0002$). Female fetuses exhibited a notably higher rate of increase in brain iron levels across 22 to 39 gestational weeks compared to their male counterparts.

Discussion: This study provides initial evidence of sex-related differences in fetal brain iron accumulation using ME-rs-fMRI R2* estimations. Our findings highlight the importance of considering biological sex as a factor in neurodevelopment, aligning with existing literature indicating the early effects of sexual differentiation on the developing brain (Hines, 2010; Wheelock et al., 2019). In particular, the left cortical gray matter, left white matter, and left insula emerge as regions of interest for future study of brain iron sex differences during this window of heightened developmental plasticity. Moreover, the present study is the first to validate the utility of R2* mapping from ME-rs-fMRI for assessing brain iron levels across the whole fetal brain, opening new avenues for research.

SU101. DIFFERENCES IN RISK APPRAISAL AND NEURAL ACTIVITY IN ADOLESCENTS WITH A HISTORY OF MISCONDUCT

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Background: Adolescents with a history of misconduct and high levels of risk taking are more likely to experience difficulties such as mental health disorders and early mortality. While the neural mechanisms of adolescent risk taking have been studied extensively, most studies have relied on low-risk samples, so whether prominent theories of adolescent risk taking apply to high-risk adolescents is unknown. Research in clinical populations, such as teens with conduct disorder, suggests two potential mechanisms by which reward sensitivity underlies risk taking: (1) high-risk teens show magnified reward sensitivity during risk taking, driving them to increase their risky behavior, or (2) high-risk teens exhibit hyposensitivity in the reward system, driving them to seek

out more extreme risk behaviors to experience thrill. The current study investigates how adolescents with a history of misconduct appraise risk behaviors and whether they exhibit different reward sensitivity in the ventral striatum, an important node in the reward network.

Methods: Participants consist of adolescents (N = 58; 32 female, 26 male; 12 to 17 years (M = 15.6, SD = 1.4)). 24 of the participants attended an alternative school for youth with a history of misconduct (23 had been suspended from school and 12 had been arrested at least once). Data were also collected in 34 adolescents from the same geographic area who were recruited from mainstream schools. Participants completed the Cognitive Appraisal of Risky Events questionnaire, which asks their likelihood to engage in 34 risky behaviors and their perceived positive and negative consequences of each behavior. Participants also completed the Balloon Analogue Risk Task (BART) during an fMRI scan. The BART is a widely used task in which participants inflate a series of balloons to gain an increasing number of points, but risk losing the points if the balloon explodes. We used a parametric modulator centered at the first inflation of each balloon to model increasing risk level. We examined whether the groups differed in linear changes in activation in the nucleus accumbens across increasing risk level by conducting region of interest analyses controlling for age.

Results: Adolescents with a history of misconduct reported significantly higher likelihood to take risks, $b = 0.96$, $SE = 0.23$, $t(54) = 4.20$, $p < .001$, $sr2 = .23$. Additionally, youth with a history of misconduct reported lower perceived negative consequences of risk ($b = -1.27$, $SE = 0.44$, $t(54) = -2.90$, $p = .005$, $sr2 = .14$) and higher perceived positive consequences of risk ($b = 0.68$, $SE = 0.24$, $t(53) = 2.83$, $p = .007$, $sr2 = .12$). No age effects were significant ($ps > .05$).

At the neural level, the two groups exhibited significantly different neural tracking of risk level in the right nucleus accumbens when controlling for age ($b = 2.4$, $SE = 1.0$, $t(54) = 2.36$, $p = .02$). Teens with a history of misconduct exhibited decreasing activity as risk level increased ($M = -1.28$), whereas teens without a history of misconduct exhibited increasing activity as risk level increased ($M = 1.66$).

Discussion: Altered risk perceptions and neural tracking of risk and reward may explain why adolescents with a history of misconduct engage in increased risky behavior leading to negative outcomes. These teens expected increased positive consequences and decreased negative consequences of risk behaviors, which may lead them to engage in these behaviors more frequently. Additionally, teens with a history of misconduct exhibited decreasing activity in the nucleus accumbens as risk level increased, suggesting they may be hyposensitive to reward. They may require more risky behavior to feel the same sense of thrill and reward as their peers, leading them to more extreme risk behaviors. Determining the mechanisms behind the increased risk taking in these teens could inform educational, legal, and policy interventions aiming to keep more adolescents in school and out of the justice system.

SU102. NEIGHBORHOOD DIMENSIONS, PSYCHOPATHOLOGY, AND POSSIBLE UNDERLYING MECHANISMS**

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Background: Dimensional models of adversity have primarily focused on proximal experiences (e.g., child abuse, neglect). Adopting a more distal lens by assessing neighborhood features dimensionally could help us identify specific processes of influence and understand the

**Flash Talk

development of psychopathology across the lifespan. Work exploring candidate neural, neurocognitive, and emotion regulation processes is limited. The current study assesses dimensions of neighborhood exposures and relations to psychopathology symptoms, while exploring neural, cognitive, and emotion regulation processes that could underlie these links.
Methods: Linear mixed models were run, with neighborhood deprivation and threat predicting attention difficulties, internalizing, externalizing, and psyhotic-like experiences (PLEs), accounting for age, sex, income-to-needs ratio, family and site. Indirect effects analysis were run within an SEM framework including task-based fMRI task-active ROIs for the emotional N-back and Stop-signal task, amygdala to resting state network connectivity, and within-network resting state connectivity.
Results: The ABCD sample included 11,868 participants. An indirect effect was observed on the effect of neighborhood threat and psychopathology symptoms (attention difficulties, internalizing, PLEs), through default mode network within-network connectivity. Indirect effects were observed on the effect of neighborhood deprivation and psychopathology symptoms across the board through executive function performance. Indirect effects were observed on the association between neighborhood threat and deprivation and PLEs, through amygdala to sensorimotor and cingulate-opercular, within-visual, dorsal-attention, cingulate-opercular, retrosplenial temporal and visual network connectivity.
Discussion: Results provide insights into neural and cognitive processes underlying observed links between different neighborhood components and psychopathology, with implications for prevention and intervention efforts at the individual and societal level.

SU103. ACCELERATED DEVELOPMENT OF CORTICOLIMBIC CIRCUITRY BUFFERS AGAINST INTERNALIZING SYMPTOMS IN SOCIOECONOMICALLY DISADVANTAGED YOUTH: LONGITUDINAL EVIDENCE FROM THE ABCD STUDY

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Background: Dynamic interactions within the corticolimbic circuitry are pivotal for fear extinction and negative affect regulation. Functional connectivity of corticolimbic circuitry, indexed by amygdala - cingulo-opercular network (CON) resting-state functional connectivity, undergoes changes across childhood and adolescence. A shift towards more negative “adult-like” coupling within this circuitry may signify neural maturation in top-down processes for negative affect regulation (Gee et al., 2013). Early adversity may “accelerate” the development of corticolimbic circuitry (Callaghan and Tottenham, 2015), with protracted development potentially providing short-term adaptive mental health benefits (Brieant et al., 2021; Ip et al., 2021). However, existing studies are constrained by cross-sectional data and limited sample diversity. Moreover, prior research on early adversity and corticolimbic circuitry has primarily focused on family-level indicators, overlooking upstream macro-social factors such as neighborhood conditions.

Objectives: Using 3-wave data from the Adolescence Brain Cognitive Development (ABCD) Study, we explore individual differences in longitudinal changes of corticolimbic circuitry, and examine whether this circuitry mediates the association between socioeconomic disadvantage and adolescent internalizing problems.

Methods: The study used data from baseline (T1), two-year (T2), and four-year (T3) follow-up data from the ABCD 5.1 release, comprising 1845 participants with valid amygdala-CON connectivity data (58% White, 9% Black, 21% Latino, 2% Asian, 10% Other; 52% Male). Socioeconomic disadvantage was assessed using confirmatory factor analysis (CFA) incorporating area deprivation index, neighborhood safety, income-to-needs ratio, and material hardship at T1. At T3, parents reported youth internalizing symptoms. Multilevel growth mixture models were applied to analyze longitudinal amygdala-CON connectivity profiles from T1 to T3. Additionally, multilevel mediation analyses were conducted to examine the association between T1 socioeconomic disadvantage, amygdala-CON connectivity profiles, and youth internalizing symptoms at T3.
Results: The growth mixture models identified a three-profile solution, comprising: (a) accelerated maturation (6%: initially high with fast nonlinear decline in amygdala-CON connectivity); (b) early maturation (8%: initially low with slow nonlinear increase), and (c) regular maturation (86%: initially high with slow nonlinear decline). Accelerated and early maturation profiles had a higher percentage of Black and Latino youth compared the regular maturation profile ($\chi 2$ (8) = 62.819, $p < .001$). Mediation analysis revealed that amygdala-CON connectivity profile membership mediated the association between socioeconomic disadvantage and youth internalizing symptoms. Youth with higher socioeconomic disadvantage were more likely to belong to the accelerated and early maturation profiles, which in turn were associated with lower internalizing symptoms over time (Indirect effect accelerated maturation: B (SE) = -.029 (.012), p = .014; Indirect effect early maturation: B (SE) = -.028 (.014), p = .040). Additionally, higher T1 socioeconomic disadvantage was associated with higher T3 internalizing symptoms (Direct Effect: B (SE) = .291 (.114), p = .011)).
Discussion: Findings suggest that early and accelerated corticolimbic circuitry development may serve as a buffer for youth exposed to higher socioeconomic disadvantage, reducing their risk for internalizing symptoms. These results support the stress acceleration hypothesis, suggesting that youth experiencing heightened adversity exhibit more mature coupling in the corticolimbic circuitry as a short-term adaptation to adverse environments, thereby challenging the deficit model of poverty.

SU104. DISCRIMINATION MODULATES THE ORGANIZATION OF LARGE-SCALE ATTENTION NETWORKS IN ADOLESCENCE: EFFECTS ON SCHOOL PERFORMANCE

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Background: Racial discrimination, or being treated differently or unfairly because of the color of one's skin, is a salient life experience for many youth of color. Several studies have shown that discrimination has widespread effects on adolescent functioning, including executive (e.g., attention) and academic functioning. However, only recently has research begun to identify the neural mechanisms underlying such effects. Given the ongoing development of the adolescent brain, negative life experiences such as discrimination can have lasting impacts. The present pre-registered study (https://osf.io/kvhjx) has two aims: (1) Examine how discrimination influences longitudinal changes in resting state functional network connectivity between the dorsal (DAN)

and ventral (VAN) attention networks; (2) Determine whether changes in functional network connectivity affected by discrimination have implications for adolescents' school functioning.
Methods: This longitudinal study will use data from the Adolescent Brain and Cognitive Development (ABCD) Study. Participants will include 4588 non-White adolescents (Black n = 1396, Hispanic n = 1936, Asian n = 197, Other n = 1059) age 9.92 years (SD=.062) at Baseline. Data for demographics (age and race), self-reported discrimination (T1), and parent-reported school performance (T2, T3) will be retrieved from the ABCD Data Repository Release 5.0. Resting state fMRI data from BL and T2 assessments will be derived from Collection 3165-ABCD-BIDS. First, we will estimate a latent change score for change in DAN and VAN connectivity between BL and T2 using two graph theory metrics: system segregation (i.e., separation between DAN and VAN) and participation coefficient (i.e., integration of DAN and VAN with other networks in the brain). Then, we will conduct mediation analysis to examine whether discrimination (T1) leads to worse school performance (T3) via its effect on the developmental change in DAN and VAN segregation and integration (from Baseline to T2).
Results: At the time of submission, all authors are in the process of requesting access to ABCD Data Release 5.0 through the NIMH Data Archive. BL (N = 5775) and T2 (N=5726) resting state fMRI data from BIDS Collection 3165 are currently housed in a data repository at UNC Chapel Hill. The data are preprocessed, and co-authors are working on motion correction and construction of functional connectivity matrices. The rest of collection 3165 is in the process of being transferred to the repository at UNC. It is anticipated that all data will be cleaned, aggregated, and analyzed by Flux 2024.
Discussion: Adolescence is a formative developmental period wherein life experiences such as discrimination can have lasting consequences for functioning. Nevertheless, the neural plasticity that is a hallmark of adolescence also presents an opportunity for interventions that support and protect youth. Findings from this study will contribute to a small but emerging body of research identifying the impact of discrimination on neurodevelopment using a large, nationally representative sample.

SU105. INTERNALIZING PROBLEMS AND SCREEN TIME STRATIFIED BY PARENTAL INCARCERATION: A CROSS LAGGED ANALYSIS OF THE ABCD® STUDY

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Background: Among younger adolescents (< 12), screen time has a small but significant correlation with internalizing problems. However, these studies do not address a critical gap in the literature: a number of parental factors also impact both screen time and internalizing behaviors. Notably, parental discord, parental depression, and parental incarceration are all associated with internalizing problems. Indeed, in some contexts of parental discord, screen time has been used as a bonding activity, challenging familial norms around screentime balance. To date, however, there has not been an examination of how screentime may impact internalizing behaviors among individuals who have incarcerated parents.
Methods: Using the ABCD study 5.1 data release, which contains complete samples from the 2-year and 3-year follow-ups, the 4-year follow-up is approximately half of the sample. Youth self-report data was used to obtained if they had a parent incarcerated currently or ever in their lifetime,

the Brief Problem Monitor summary score for internalizing behaviors and time spent on social media (hours and minutes) on a normal weekday and weekend. Separate cross-lagged panel models were estimated for those youth with (n=526) and without a parent (n=18,857) who had gone to jail at the baseline time point to estimate the longitudinal relationship of social media screen time (average of total use across a typical week) and internalizing problems at the Year 2, Year 3 and Year 4 follow-ups. Models controlled for race, sex, and parent education level at each time point. Internalizing problem scores and time spent on social media (minutes) were standardized and entered in the model.

Results: Among youth with un-incarcerated parents screen time at the 2-year follow-up had a small but significant influence on internalizing problems at the 3-year follow-up (B=0.03, SE=0.01, $p < .001$), but screen time at the 3-year follow-up did was not statistically significantly related to internalizing problems at the 4-year follow-up (B=-0.01, SE= 0.01, p=0.26). Internalizing problems at the 2-year and 3-year follow-up had a small but significant association with screen time at the 3-year (B=-0.02, SE=0.01, p=.01) and the 4-year follow-up (B=.04, SE= .01, $p < .001$), respectively.

Similarly, youth with an incarcerated parent experience screen time at the 2-year follow-up was associated with internalizing problems at the 3-year follow-up (B=0.08, SE=0.03, p=.008). And like the previous model, screen time at the 3-year follow-up was not associated with internalizing problems at the 4-year follow-up (B=-0.06, SE=.03, p=.08). Unlike in the un-incarcerated model, youth experiences of internalizing problems at the 2-year follow-up were not associated with screen time at the 3-year follow-up (B=-0.04, SE=.05, p=.45), and internalizing problems at the 3-year follow-up were not associated with screen time at the 4-year follow-up (B=0.06, SE=0.05, p=.20).

Discussion: Motivations for social media use are frequently context specific. Indeed, in disruptive family situations, social media can be used as a distraction from the current context or as a source of social support. In these analyses, youth that have experienced parental incarceration did not see a significant increase in social media use associated with internalizing behaviors. We hypothesize that social media use may be a different experience in these two populations; youth with incarcerated parents may use social media to connect with family or share their incarcerated parent's story. Comparisons of social media use by different groups of youth can help to address gaps in the research for incarcerated parents. Pending the release of the ABCD 6.0 dataset, we will repeat the model in with the full 4-year follow-up.

SU106. EXPLORING THE EMOTIONAL LANDSCAPE ACROSS DEVELOPMENT: VALENCE AND AROUSAL OF PICTURES AND WORDS IN CHILDREN, TEENS, AND YOUNG ADULTS

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Background: Individuals tend to dichotomize emotions by valence (e.g., positive and negative); however, with development, individuals can conceptualize multiple aspects of emotions (e.g., valence and arousal) (Nook et. al., 2017). While emotions are increasingly described in more complex ways, shifts in appraisals may become more refined. In this study, we aim to examine how development influences judgments of valence and arousal in response to International Affective Picture System (IAPS) pictures and emotional words.

Methods: In an MRI study, 82 healthy individuals (Mean: 15.8, SE: 3.65 years, 9-20 year olds, 47 females, 63% Hispanic, 24% minority) completed an emotion evocation task and self-other appraisal task. Outside of the scanner, individuals rated the valence of each stimulus using a 1 (extremely negative) to 9 (extremely positive) scale. Then, individuals rated arousal using a 1 (not at all) to 9 (extremely intense) scale. The stimulus type (i.e., pictures, words) was presented in the same randomized order as in the scanner. However, stimuli were presented until a judgment was recorded via button press. Repeated measures ANVOA investigated interactive effects between stimulus type, valence, and age using alpha=0.05. Mean and standard deviation of ratings of valence and arousal were examined separately.

Results: When considering valence ratings, several findings emerged. First, valence ratings of evocative pictures and words were correlated for both positive ($R(79)=0.663$, $p < 0.001$) and negative ($R(79)=0.433$, $p < 0.001$). Second, positive words were rated more positively (Mean: 7.17, SE: 0.09) than positive pictures (Mean: 6.93 SE: 0.10); however, negative pictures (Mean: 2.46, SE: 0.08) were rated more negatively than negative words (Mean: 3.09, SE:0.07, Stimulus x Valence interaction ($F(1,77)=8.35$, $p < 0.005$). Third, with increasing age, individuals rated positive words more positively ($R(81)=0.302$, $p < 0.006$), but no other age effects were detected with the other stimuli (all $p > 0.115$, Stimulus x Valence x Age: $F(1,77)=5.13$, $p < 0.026$). Finally, when considering the variability of the valence ratings, Stimulus x Age ($F(1,77)=6.749$, $p < 0.011$) and Valence x Age ($F(1,77)=16.649$, $p < 0.001$) interactions emerged. With increasing age, valence ratings were less variable for positive words ($R(81)=-0.402$, $p < 0.001$), positive pictures ($R(80)=-0.481$, $p < 0.001$) and negative pictures ($R(80)=-0.341$, $p < 0.002$). Age was not related to variability in valence ratings for negative words ($p > 0.183$).

Like valence ratings, arousal ratings of evocative pictures and words were correlated for both positive ($R(77)=0.6$, $p < 0.001$) and negative $R(77)=0.543$, $p < 0.001$). No effects were noted for mean arousal ratings (all $p > 0.25$). However, more variable levels of arousal were reported in response to evocative pictures than words ($F(1,75)=6.04$, $p < 0.02$) and in response to negative stimuli than positive stimuli ($F(1,75)=6.39$, $p < 0.01$). Age-related effects in arousal were not detected (all $p > 0.11$).

Discussion: Verbal skills and visual complexity may explain differences in appraisals of emotional pictures and words. Individuals are exposed to many more negative words (e.g., sad, angry, fear) than positive words (e.g., happy). Increased exposure and salience of negative words suggest that classifying negative emotions as such occurs at an early age. Whereas, appraisals of positive words may became more valenced as vocabulary for positive words increases with development. In addition, across this age range further refinements in appraisal may be detected through less variability of responses. The complexity of emotional pictures may delay these refinements. The developmental effects were limited to valence ratings, suggesting that the attribution of the arousal to an appropriate valence is developing. Future research should examine how individual differences in emotional regulation and clinical diagnoses alter these developmental patterns.

SU107. DEVELOPMENT OF THE SOCIAL BRAIN FROM AGE ELEVEN TO FOURTEEN YEARS

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Background: Adolescence is a period of social reorientation (Nelson et al., 2016) that prepares adolescents for a complex social world. Mentalizing, the ability to recognize and interpret the intentions and emotions of others (Frith and Frith, 2003), is important for navigating the social world. During adolescence, the mentalizing network changes in structure (Mills et al., 2014) and function (Redcay and Warnell, 2018). These changes may be guided by pubertal hormones which reorganize the brain and support the development of adult behaviors (Herting and Sowell, 2017; Sisk and Zehr, 2005).

Mentalizing behavior is often measured using explicit tasks. However, in everyday life it is more likely that mentalizing behaviors occur spontaneously. Spontaneous mentalizing may be particularly important for adolescents as they learn to navigate increasingly complex social interactions (Koski et al., 2015). Previous work used a spontaneous mentalizing paradigm to examine social brain development in children 3-12 years (Richardson et al., 2018). While fMRI data were collected, children and adults watched a short film that highlighted character's physical pain (pain network) and mental states (mentalizing network). They found greater mentalizing network specialization, as measured by within- and between-network correlations and within mentalizing network response magnitude, related to age and mentalizing abilities. The current study aims to replicate and extend this previous work during adolescence and in relation to pubertal development.

We hypothesize: 1) Adolescents will exhibit weaker positive within-network correlations and weaker negative between-network correlations compared to adults. 2) Greater age will relate to more positive within-network correlations and more negative between-network correlations for adolescents. Age effects will be weaker, but may still be present, in adults given emerging adulthood. 3) For both adolescents and adults, mentalizing task performance will positively relate to greater positive within mentalizing network correlations and response magnitude. 4) In younger adolescents, later pubertal development will relate to mentalizing behavior and this relation will be mediated by greater positive within mentalizing network correlations and response magnitude. The relation will be strongest for metrics capturing spontaneous mentalizing behavior.

Methods: Data collection is ongoing for adolescents and completed for adults. Based on a-priori power analyses, at least 100 adults and 90 adolescents will be included. Participants watch a short film while fMRI data are collected. They complete a free response mental state comprehension task about the film. Participants also complete a visual-affective task. Adolescents complete a spontaneous mentalizing task and they and parents complete the Pubertal Development Scale.

Results: We will use path models to assess our hypotheses. Evidence in support of hypothesis 1 would be that adolescents exhibit weaker positive within network correlations and weaker negative between network correlations compared to adults. Evidence in support of hypothesis 2 would be that with greater age adolescents exhibit more positive within-network correlations and more negative between-network correlations. Adults may also exhibit similar relations, due to emerging adulthood. Evidence in support of hypothesis 3 would be that for both adolescents and adults mentalizing behavior is positively associated with greater positive mentalizing network connectivity and greater response magnitude. Evidence in support of hypothesis 4 would be that later pubertal status is associated with greater mentalizing behavior, particularly for tasks more strongly associated with spontaneous mentalizing, and that this relation is mediated by positive within mentalizing network correlations and response magnitude.

Discussion: Our analyses will provide valuable insight into social brain and mentalizing behavior development during adolescence.

SU108. EXAMINING RELATIONSHIPS BETWEEN SELF-CLARITY AND LONELINESS IN EMERGING ADULTHOOD USING LONGITUDINAL AND COMPUTATIONAL MODELING

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Background: In 2023 the U.S. Surgeon General issued a warning that loneliness is an urgent public health threat. Although loneliness can occur throughout the lifespan, loneliness tends to be higher during adolescence and emerging adulthood, which are key periods for self and social development. Loneliness is a subjective experience and converging evidence highlights the important role that self-related processes play in loneliness. Having a clear, consistent, and confident understanding of oneself—that is greater self-clarity—is negatively associated with loneliness in emerging adulthood, but few studies have examined longitudinal relationships or built computational models of how evaluating oneself may differ as a function of loneliness.

Methods: The present study addresses these gaps in the context of a 3-wave longitudinal study on well-being during college. Incoming college freshmen reported self-clarity and loneliness using survey measures during fall (N = 262) and spring (N = 246) quarters of freshman year, and again fall quarter of senior year (N = 128). A subset of these participants (N=105) also completed a self-evaluation task while in the MRI scanner the summer before freshman year. During the task, they saw well-being statements (e.g., "lonely", "satisfied with life") taken from validated measures of well-being and responded whether or not they were true for themselves.

Results: First, we considered how self-clarity and loneliness are related longitudinally during college. Using random intercept cross-lagged panel models to examine within-person relationships between self-clarity and loneliness across college, we observed concurrent and bi-directional lagged relationships between self-clarity and loneliness across all time points. That is, people who reported greater clarity about themselves than average at one time point also tended to report lower loneliness than average at the next time point (i.e., fall to spring freshman year, and spring freshman year to fall senior year), and vice versa. These bi-directional associations suggest reciprocal pathways between self-clarity and loneliness during emerging adulthood, and highlight how intimately intertwined self and social development are.

Given these robust relationships between self-clarity and loneliness, we next sought to understand computationally how the act of evaluating oneself may be altered in the context of loneliness. We modeled binary responses and reaction times during the well-being self-evaluation task. We found that participants who were lonelier were also slower to reject negative well-being self-descriptors and endorse positive well-being self-descriptors. We then used drift-diffusion modeling to extract computational parameters—drift rate, starting point bias, non-decision time, and boundary separation—underlying these responses. We found that although individual differences in loneliness were not related to starting point biases or boundary separation, they were negatively correlated with drift rate and non-decision time. Consistent with the longitudinal evidence that lonely individuals tend to have less self-clarity, they also tended to have slower evidence accumulation and more sensory-motor processing while making decisions about their well-being.

Discussion: Together, these longitudinal and computational results highlight the importance of considering the role of self-clarity in loneliness in emerging adulthood. Results presented at Flux

will also include exploratory analyses examining neural differences in self-evaluation as a function of loneliness.

SU109. THE NEURAL DYNAMICS UNDERLYING FACIAL EXPRESSION PROCESSING ARE DIFFERENTIALLY IMPACTED BY DEVELOPMENT

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Background: Facial expressions are important social cues carrying information on the emotional states and behavioral intentions of others. During development processing and interpreting these cues becomes much more automated, and alterations in the development of these processes have been implicated in mental health disorders. While the neural architecture supporting the processing of emotional faces is present as early as infancy, few studies have examined the development of multispectral brain activity supporting these processes. In this study, we utilized magnetoencephalography (MEG) in a large sample of children and adolescents to map the development of multispectral brain responses supporting the processing of angry, happy, and neutral emotional face expressions.

Methods: We collected MEG data from 183 healthy youth (ages 6-16, 83 females) while they viewed emotional faces (i.e., angry, happy, neutral) presented on a screen. Participants were instructed to respond to the gender of the stimulus. MEG data were transformed into time-frequency space and nonparametric permutation testing revealed two oscillatory alpha/beta responses (11-20Hz, 150-450ms and 450-750ms), which were imaged using a beamformer. The resulting functional maps were subjected to voxel-wise, whole-brain analysis of covariance (ANCOVA) to investigate the main effects of age and task condition, as well as the age-by-condition interaction.

Results: Our most interesting findings were age-by-condition interaction effects in the right middle temporal gyrus (MTG) and right ventral prefrontal cortex ($p < .005$). Specifically, alpha/beta oscillatory responses to neutral faces became stronger in the right MTG (i.e., more negative relative to baseline) with increasing age in both time windows, while no age-related changes were detected for the angry and happy faces. In contrast, alpha/beta oscillations in response to angry faces became weaker with increasing age in the right ventral prefrontal cortex during the second time window (450-750ms).

Discussion: Whole-brain ANCOVA analyses illuminated robust age-related alterations in alpha/beta oscillatory responses in the right MTG and ventral prefrontal cortex. These Results: suggest that the processing of neutral, but not emotionally arousing, faces increase throughout development in the right MTG, perhaps reflecting a shift away from the fast and automatic processing toward more effortful interpretation for ambiguous emotional information throughout adolescence. Conversely, the processing of angry faces in the right ventral prefrontal cortex continues to be fine-tuned with age as participants develop toward adolescence. Together, these results are consistent with extant literature showing that neurodevelopmental changes in facial expression processing are region and emotion specific and extend well into adolescence.

SU110. SENSITIVITY TO SOCIAL PRESSURE IS ASSOCIATED WITH DIGITAL MEDIA ENGAGEMENT AND BETTER MENTAL WELLBEING IN ADULTS, BUT NOT ADOLESCENTS

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Background: Recent discussions regarding digital media engagement focus on its potentially detrimental effects on well-being, but few studies have explored the relationship between social sensitivity and digital media habits. Here, we test whether and how sensitivity to social feedback is associated with mental well-being and engagement with digital media.
Methods: In two cohorts (young adults ages 18-20, N=132, Mage=19.2, Females=93; non-adults ages 7 to 17, N=60, Mage=11.3, Females =30) participating in an ongoing longitudinal study, we assessed digital media habits using the Smartphone Addiction Scale (SAS) and Mobile Technology Engagement Scale (MTES); mental well-being using the Adolescent Wellbeing Scale, and sensitivity to social feedback using two combined self-report indices (Resistance to Peer Influence, Rejection Sensitivity) as well as brain activation profiles using a functional neuroimaging task that indexes reactivity to social feedback (Peer Affinity Task).
Results: Overall, the young adult users (ages 18-20) reported substantially higher digital media usage than did the younger sample (7-17 year-olds). While there were no direct correlations between social sensitivity and general digital media usage (as measured by the MTES) in either cohort, adults with lower social sensitivity scores reported significantly lower addiction-like digital media behavior (as measured by SAS, $r = 0.25$, $p = .004$) and more positive well-being ($r = 0.21$, $p = .017$). This relationship was not evident in the younger sample.
Discussion: This pattern of findings suggests that lower sensitivity to peer feedback might be a protective factor against developing unhealthy digital media habits and concomitant mental health problems as one progresses into young adulthood, when digital media usage has intensified. To corroborate this interpretation, we are currently probing the fMRI Peer Affinity Task data to explore whether brain regions associated with social and reward relevant processing exhibit heightened reactivity to social feedback among users who report greater digital media behavior, and whether this relationship emerges in an age-dependent manner that matches the pattern obtained for self-reports of social sensitivity.

SU111. NEURAL CORRELATES OF SOCIAL ACCEPTANCE AND REJECTION

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Background: Peer relationships are significant predictors of psychological well-being. Positive peer experiences, such as those that sustain one's sense of belonging, can buffer individuals from developing internalizing symptoms like depression or anxiety. In contrast, negative peer experiences, such as those that threaten a sense of belonging, can trigger significant distress and, if chronic, place individuals at risk of developing internalizing psychopathology. Despite the significant role of peer relationships in psychological well-being, the neural mechanisms subserving the processing of peer feedback are poorly understood, and even less is known about

these processes in cases of unexpected acceptance and rejection. The present study aims to evaluate the neural basis of peer acceptance and rejection in adolescence and early adulthood.

Methods: We recruited adolescents and young adults from the greater Boston area (84 participants aged 10-23). All participants underwent an fMRI reciprocal social evaluation task, exposing them to instances of acceptance and rejection from unfamiliar age-matched peers. Participants were instructed to predict whether peers would accept or reject them before receiving actual feedback from those peers (the social evaluative feedback rate was set at 50% acceptance and 50% rejection). Imaging data were preprocessed using fMRI Prep version 23.2.0, and whole-brain univariate analyses were modeled using SPM 12. Brain activation for peer acceptance trials were contrasted against peer rejection trials and corrected for multiple comparisons. Further, activation patterns of unexpected acceptance were contrasted against unexpected rejection to identify activation associated with updating social expectations.

Results: Peer acceptance was associated with greater activation in neural regions linked to mentalization and social rewards (e.g., dorsomedial prefrontal cortex, ventromedial prefrontal cortex, and striatum) than peer rejection. In contrast, peer rejection was associated with greater activation in neural religions linked to salience and visceromotor activation (e.g., anterior cingulate cortex, posterior insula) than peer acceptance. In terms of unexpected social feedback, unexpected peer acceptance was associated with greater activation in neural regions linked to social semantic processing (e.g, anterior temporal lobe and inferior frontal gyrus) than unexpected peer rejection. In contrast, unexpected peer rejection was associated with greater activation in neural regions linked to salience (e.g., sgACC, ACC) and default mode (e.g., posterior cingulate cortex, precuneus) systems than unexpected peer acceptance.

Discussion: Social acceptance prompted recruitment of regions associated with social reward and mentalization. These activation patterns were largely consistent in the case of unexpected acceptance, but with greater recruitment of regions involved in abstract processing, particularly processing of abstract social information. Unexpected acceptance therefore may require greater conceptual processing to make sense of novel social information. Peer rejection, on the other hand, recruited regions involved in the salience network. Again, these patterns were stronger in the case of unexpected rejection. Further, unexpected rejection was associated with both salience and default mode network activation, suggesting there may be social learning occurring as one receives input from peers (e.g., predictions from the ACC to the DMPFC). Future work will examine age-related differences in processing social feedback to better elucidate the developmental trajectories of these mechanisms.

SU112. WILL YOU LIKE ME? NEURAL ACTIVATION ASSOCIATED WITH PREDICTING SOCIAL FEEDBACK

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Background: We form first impressions of people rapidly, even before engaging with them. These predictions often shape how we choose to interact with others. For example, if you expect to be rejected by someone, you may be less likely to initiate a conversation with them. Predicting social feedback—whether you will be accepted or rejected by peers—is complex. Past research has indicated that the predicted outcome, i.e., acceptance or rejection, is associated with different patterns of neural activation. However, most studies investigate the prediction phase when cues

are first shown, which may overlook later processes involved in social predictions. In this study, we replicate and extend prior research on the neural basis of expected social feedback. Specifically, we investigated two phases of prediction: when first viewing an image of a peer and when explicitly indicating one's prediction about that peer. By disentangling if and how the underlying neural processes for these phases differ, we may gain a better understanding of, and better model, the mental processes involved in predicting social feedback in a normative population.

Methods: Eighty-five participants aged 10-23 were recruited from the greater Boston area and completed the First Impressions Task. Before the in-person fMRI visit, participants indicated how much they would like unfamiliar age-matched peers. During the study visit, participants were shown the same peers and asked to predict if that peer accepted or rejected them while undergoing fMRI. Imaging data were preprocessed using fMRI Prep version 23.2.0, and whole-brain univariate analyses were modeled using SPM 12. Brain activation for peer acceptance trials were contrasted against peer rejection trials and corrected for multiple comparisons.

Results: At cue onset, participants showed significantly greater activation in neural regions associated with visceromotor prediction and activation (e.g., bilateral anterior cingulate cortex, bilateral amygdala) and social cognitive functions such as mentalization (e.g., posterior cingulate cortex, right temporal parietal junction, anterior temporal lobe) when expecting to be accepted compared to rejected. In contrast, participants showed significantly greater activation in neural regions associated with the regulation of emotion and attention (e.g., bilateral ventrolateral prefrontal cortex, superior frontal gyrus) when expecting to be rejected compared to accepted. Activation when indicating predictions showed a different pattern. When participants expected acceptance compared to rejection they showed increased activation in neural regions associated with social information processing (default mode network, e.g., posterior superior temporal sulcus). However, participants showed increased activation in neural regions associated with social monitoring and predictions (e.g., right TPJ, dmPFC) while making judgements of expected rejection compared to acceptance

Discussion: Taken together, these results suggest that initial impressions when formulating expectations of being liked rely on neural regions associated with accessing social semantic information (e.g., anterior temporal lobe) and activating visceromotor sensations (e.g., anterior cingulate cortex). However, areas associated with processing of hedonic value and rewards are more active when formulating predictions of rejection. While awaiting feedback, we see the inverse; increased activation in the salience network was associated with anticipating rejection compared to acceptance. This may indicate that for a general population, predicting acceptance is the default, while predicting rejection may reflect other important factors like social standings.

SU113. CONNECTING SOCIAL COGNITION TO NEURAL ENGAGEMENT USING AUDITORY NARRATIVES: AN EEG INTER-SUBJECT CORRELATION STUDY

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Background: Engagement with narrative is key in a reader's enjoyment and comprehension of a text in educational and recreational settings, yet is often less studied than other reading processes. Examined across fields such as literary theory, neuroscience, and psychology using largely behavioral and physiological (e.g., self-report or heart rate) measures, understanding such a

complex topic requires interdisciplinary novel approaches. This study utilizes electroencephalography inter-subject correlation (EEG-ISC) to study engagement with naturalistic audio narratives. EEG-ISC is suggested to index brain states of narrative engagement or "emotionally laden attention". In previous work, EEG-ISC has been driven in audiovisual stimuli by features such as suspense; our study aims to see if solely speech-based stimuli can elicit similar effects on EEG-ISC.

Methods: This study examines 6 auditory stimuli, each 5 mins long and classified as social or non-social using LIWC, a linguistic analysis software. Social category texts had a generally higher percentage of social and cognitive vocabulary; non-social category texts had a higher proportion of perceptual and spatial vocabulary. Participants (18-35 years old and highly fluent in English) were assigned two excerpts from each category (counterbalanced). 128-channel EEG was recorded as participants listened to each stimulus one time. We present preliminary results based on 24 datasets with an average of 16 trials per stimulus.

EEG-ISC was calculated using an established pipeline, first using reliable components analysis (RCA) to compute optimized spatial filters (components) that summarize the most highly correlated activity across trials. ISC was then calculated on a per-stimulus, per-component basis as the correlation of each trial against all other trials. As is typical in the literature, we report the per-stimulus sums of the ISC values across the three maximally correlated components. We computed ISC across entire stimulus durations and in 5-sec windows advancing in 1-sec increments to explore how ISC varies across the time course of each narrative in response to moments in the narrative.

Results: The derived spatial components highlight auditory and non-auditory regions, similar to other EEG-ISC studies; for example, the first component represents auditory-oriented processing. Group-averaged ISC values were within expected ranges, with social texts ranging from 0.0331-0.0477 and non-social texts from 0.0386-0.0417. We then reviewed time-resolved ISC within category and per text. In the social texts, ISC peaks appear related to moments of change in the narrative, e.g., a young son's perspective on the first moment his mother shows interest in another man. In the non-social narratives, peaks appear related to an influx of specialized vocabulary, e.g., world-specific language in a science fiction story or non-English words in an expository text. Two texts also had ISC peaks at moments of "morality" in the text, e.g., when a character shared his opinion on work or during a cultural saying about sheep herd ownership.

Discussion: The EEG-ISC paradigm shows clear promise for both adult and developmental neuroscientific work given the wide range of applicable stimuli and sensitivity to narrative content. It facilitates ecologically valid investigations of narrative engagement with excerpted texts and potentially supports examinations of underlying neural processes. We have derived initial insights into relationships between EEG-ISC and narrative content in a set of auditory excerpts, providing a means to study how narrative content may drive engagement. Future work includes analyses of self-reports accompanying the present data; we also aim to use the current analytic approach with a new dataset (collected from approximately 40 7th- and 8th-grade students) to investigate the role of content knowledge on narrative engagement before and after classroom learning.

SU114. CAREGIVER-CHILD BRAIN SYNCHRONY PATTERNS AS CORRELATES OF CHILD INTERNALIZING AND EXTERNALIZING BEHAVIOR

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Background: Externalizing/internalizing behaviors are often precursors to psychopathologies (Compas et al., 2017). As behavioral markers may show great heterogeneity, exploring neural activity biomarkers may be promising for early problem detection. Beside single-brain studies and individual brain processes, caregiver-child interactions are also critical for children's regulatory process development. Here, we aim to explore how caregiver-child brain synchrony in the dorsolateral prefrontal cortex (dlPFC) and temporoparietal junction (TPJ) relates to child externalizing/internalizing behavior. The dlPFC is key to explicit emotion regulation (Etkin et al., 2013), while the TPJ is for making appropriate predictions and responses to the environment (Geng and Vossel, 2013). Reindl et al. (2018) revealed that greater functional near-infrared spectroscopy (fNIRS)-based brain synchrony in the frontopolar cortex, during cooperation, was associated with greater adult/child emotion regulation and others showed greater synchrony in the middle/inferior frontal gyrus to predicted greater decline in internalizing scores (Quiñones-Camacho et al., 2022). While PFC's involvement in emotion regulation and problematic behavior is often investigated, the TPJ's role is unclear.

Additionally, most studies focus on in-phase synchronization, but leading by one partner can result in lagged/anti-phase synchronization (Gvirts et al., 2023). A meta-analysis revealed that parents with better emotion regulation and parenting skills may have children with fewer behavioral problems (Zimmer-Gembeck et al., 2021). However, a study highlighted that parental instruction may lead to worse child regulation, potentially suggesting fewer behavioral difficulties in children who lead (Obradović et al., 2021). Yet others showed that leading in a cooperation task is evenly split between children and parents (Yarmolovsky and Geva, 2023).

Given that greater emotion regulation, predicts lower externalizing/internalizing behaviors (Cai et al., 2021) and correlates with greater interbrain synchrony, we hypothesized lower child externalizing/internalizing scores to be associated with caregiver-child neural synchrony. However, due to mixed findings in the literature, we have no specific hypotheses regarding how parent/child lead synchrony relates to externalizing/internalizing behavior.

Methods: We measured simultaneous brain (TPJ and dlPFC) activation in 40 child-caregiver dyads during cooperation, using NIRSport2 fNIRS system, and collected child behavioral scores through the Child Behavior Checklist (APA).

Results: After removing one outlier there was no overall relation between higher synchrony and lower behavioral problems ($p > .05$) However, a linear mixed model revealed externalizing ($F(15, 14501)=5.38$, $p < .001$) and internalizing ($F(15, 14501)=3.49$, $p < .001$) scores' association with different brain synchrony patterns. Externalizing behavior was associated with lower child TPJ – parent lTPJ synchrony, while internalizing behavior was associated with lower child rTPJ– parent lTPJ and higher child ldlPFC -parent lTPJ synchrony. We then compared synchrony at different lags within these three identified channels of interest, the lag analysis showed greater child-caregiver lTPJ synchrony (the channel associated with externalizing) when the child led the interaction by 3 seconds compared to when the child led by 6 seconds, $p=0.005$ or to phase, $p=0.045$. In the other areas, synchrony was not different across different lags or phases.

Discussion: While these findings are inconsistent with the literature on dlPFC the observed trends indicate caregiver lTPJ's involvement in synchrony patterns. Surprisingly there is more heterogeneity between child brain areas' contribution to synchrony patterns. Our results of the lag analysis in lTPJ might suggest that caregivers are more responsive to their children's lead during the puzzle task, but this responsiveness may be lower for children who have more externalizing behaviors.

SU115. NEURAL SIMILARITY DIFFERENTIALLY PREDICTS INTERACTION SUCCESS WITH PEERS AND NON-PEERS IN EARLY ADOLESCENCE

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Background: Navigating successful social interactions with peers and non-peers is a promoter of well-being for youth, including autistic youth who experience higher rates of social challenges than non-autistic peers. One factor that may contribute to social interaction success is neural similarity, the between-participant correlation of the time series of neural response to naturalistic video stimuli. Neural similarity, particularly in areas of the brain involved in social cognition and reward processing, is linked to one's experience of the social world such that less lonely and more popular individuals are more neurally similar. However, no work has yet examined links between neural similarity and day-to-day interaction success with peers and non-peers. Therefore, we evaluated relations between neural similarity and day-to-day interaction success measured through ecological momentary assessment (EMA).

Methods: Youth aged 11-14 (n=25 autistic, n=67 non-autistic; 33 female, 56 male, 3 non-binary) participated in a functional MRI scan in which they watched six video clips with social and non-social content. Afterwards, youth completed a ten-day EMA protocol during which they answered 4-5 prompts each day about how well their recent interactions went (interaction success) and who their interaction partners were (coded for peer and non-peer). To compute neural similarity, preprocessed neural signal was extracted for each participant from twelve functionally derived regions of interest (ROIs) involved in social cognition and reward processing. Time series for each ROI were correlated across all participants to derive correlation matrices, then the set of correlations involving each participant were averaged to yield one value of neural similarity to the group per participant per ROI. Multilevel models were constructed with EMA responses nested within participants. Interaction success was the outcome, and the predictors were neural similarity, whether the interaction was peer/non-peer, and the interaction term between those two predictors. Age, gender, and group (autistic/non-autistic) were included as covariates.

Results: Across the full sample of autistic and non-autistic youth, neural similarity in the left temporoparietal junction (lTPJ) and peer interaction status significantly interacted to predict interaction success (marginal after FDR correction across the twelve ROIs: (B=74.01, t(71.04)=2.76, p_raw=0.007, p_corrected=0.09)). Youth with higher neural similarity in lTPJ had a larger discrepancy in success between peer and non-peer interactions (1 SD above the mean; B=8.08, t(66.29)=5.05, $p < 0.001$) while youth with lower neural similarity in lTPJ had no significant difference in success between peer and non-peer interactions (1 SD below the mean; B=1.69, t(76.60)=1.00, p=0.32). Put another way, neural similarity in lTPJ positively predicted peer interaction success (B=15.47, t(80.08)=0.45, p=0.65) but negatively predicted non-peer interaction success (B=-58.54, t(84.09)=-1.72, p=0.09).

Discussion: These findings establish potential links between peer interaction success and neural similarity of social-cognitive processing in the lTPJ. As adolescence has been proposed as a time of brain and behavioral tuning towards peer interactions, these findings could provide a window into one neural correlate of this tuning by linking typicality of neural processing in a social-cognitive brain region, the lTPJ, to adolescents' increased enjoyment of peer interactions relative to non-peers. Future longitudinal work could strengthen this interpretation by directly linking the

developmental trajectory of the lTPJ to developmental changes in enjoyment of peer relative to non-peer interactions.

SU116. DEVELOPMENTAL CHANGES IN NEURAL INDICES OF COGNITIVE CONTROL AND AFFECTIVE PROCESSING

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Background: The neural circuitries supporting both attentional control and emotional processing are continually refined throughout childhood and adolescence. More specifically, evidence suggests a shift during development from a subcortically-driven “bottom-up" neural circuitry to more cortically driven “top-down” mechanisms governing neural processing when performing decision-making tasks. This includes how distracting affective stimuli are processed under conditions of increasing cognitive load. Consequently, we hypothesized that across development, we would see significant age-related alterations in how task irrelevant emotional stimuli are processed, with most of these changes found in the extended networks supporting attentional control and affective processing.

Methods: Sixty-six children aged 8-15 years-old (age =12.47 ± 2.31 years, 35 males) completed an emotional-faces distractor task while undergoing an fMRI scan. For this task, lines of various angles were presented on either side of the face, and participants were asked to indicate whether or not the lines were in a parallel orientation, ignoring the face. There were three conditions for the line orientation: a parallel (control), a perpendicular (easy), and a 45° slanted (difficult) condition. In addition to the lines, in the middle of the screen a picture of a face exhibited either a happy, fearful, or neutral expression for 200ms, which was rapidly replaced with a neutral face. We then examined whether there were age-related changes in patterns of functional brain activation by line orientation condition, emotion, and their interaction.

Results: Behaviorally, we found that there was a significant main effect of line orientation condition ($F= 6.744$, $p= .005$, $\eta p2= .054$) on accuracy during the task. No significant effects were found in relation to participants’ reaction time. Whole brain analyses indicated significant age-related changes in BOLD activity in extended brain networks supporting affective processing and attentional control. We saw overall increases in BOLD activity in the medial prefrontal cortex and the temporoparietal junction during the difficult (slanted) condition relative to other conditions (all ps uncorr $<$ .001) as a function of age. Conversely, we noted significant negative age effects in the right frontal eye fields, and in the medial prefrontal and posterior cingulate cortices in the easy (perpendicular) condition (all ps uncorr $<$ .001). We saw further nuanced patterns of age-related changes in BOLD activity across extended face processing and attentional control networks when considering specific Condition-by-Emotion interactions. For instance, when the distractor face exhibited a fearful expression, we found significant negative age effects in bilateral fusiform face area, dorsolateral prefrontal cortex, and inferior parietal cortex (all ps uncorr $<$ .001) as well as significant positive age effects in the right insula (all ps uncorr $<$ .001) during our difficult condition.

Discussion: Herein, we identified patterns of development in brain activity critical in maintaining attentional control in the face of distracting affective stimuli. We found evidence of differential activation of regions involved in more affective processing (i.e., bottom-up) versus cognitive

control (i.e., top-down) as a function of age, which may indicate greater capacity for processing the affective distractors during the task under conditions of high cognitive load among older youth. These data contribute to the growing literature exploring the maturational trajectories of complex cognitive-emotional processing systems during a critical period of development.

SU117. RELATIONS BETWEEN AUDITORY CHANGE-DETECTION AND VOCABULARY KNOWLEDGE DURING EARLY CHILDHOOD: AN ERP STUDY

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Background: Early childhood is a crucial period for vocabulary acquisition. Early vocabulary knowledge predicts subsequent achievement outcomes such as reading (Bleses et al., 2016), highlighting the importance of understanding its predictors. The ability to detect auditory changes is thought to be a child-level factor contributing to vocabulary growth due to its potential role in detecting speech patterns and language processing. Traditional measures of this ability require the production of an oral or physical response, such as tapping or counting, which are often not feasible with infants and young children. However, two Event-Related Potentials (ERPs) provide a window into children's neural mechanisms underlying the ability to discriminate sounds: the Mismatch Response (MMR) and the P3a from auditory oddball paradigms. The MMR is thought to reflect involuntary attention-switching to deviant sounds relative to standard sounds, whereas the P3a is thought to indicate an orienting response to novel sounds (Näätänen 1990, Escera et al., 1998). Previous research has linked both ERPs with aspects of language development. Attenuated MMR and P3a have been observed in children with language impairments relative to healthy controls (Uwer et al., 2002, Leppänen and Lyytinen, 1997), and higher MMR amplitude at 2 months has been linked to increased word fluency at 7 years (van Zuijen et al., 2013). Little is known about whether individual differences in MMR and P3a are associated with vocabulary knowledge in community samples. We examined whether MMR and P3a amplitude assessed at 9 months and 36 months are positively associated with vocabulary knowledge at 48 months.

Methods: Two hundred and ninety-one infants (54% female) and their parents (69% White, 16% Black, 7% Latinx, and 3% Asian) were recruited for a longitudinal study examining the role of early temperament on later development. Children completed a passive oddball task while wearing an EEG net at 9 and 36 months of age. MMR was calculated as the mean amplitude of neural responses to deviant sounds relative to standard sounds within a 100 to 300 ms window post-stimulus presentation. P3a response to a novel stimulus was calculated as the mean amplitude in the 100 to 400 ms window. At 9 months, 103 infants, and at 36 months, 112 children had sufficient ERP data. Vocabulary intelligence was assessed at 48 months via the vocabulary subscale of the Wechsler Preschool and Primary Scale of Intelligence (Wechsler, 2002).

Results: We conducted two linear regression models. The first examined whether MMR and P3a amplitude at 9 months were associated with vocabulary knowledge at 48 months. The second examined whether MMR and P3a amplitude at 36 months were associated with vocabulary knowledge at 48 months. Both models included child sex, maternal education, and race/ethnicity as covariates. Results showed that 9-month MMR amplitude, but not P3a amplitude, was positively associated with vocabulary scores at 48 months ($B = .32$, $p = .007$; $B = -.08$, $p = .392$, respectively).

At 36 months, P3a amplitude, but not MMR, was positively associated with vocabulary scores at 48 months (B = .32, p = .045; B = -.11, p = .628, respectively).
Discussion: Our results indicate that individual differences in young children's ability to detect auditory changes are associated with subsequent vocabulary knowledge. Specifically, we found that higher MMR amplitude at 9 months and P3a amplitude at 36 months were associated with higher vocabulary knowledge at 48 months. These findings highlight the importance of understanding when during development these ERP components may be associated with subsequent vocabulary knowledge. Our findings suggest that auditory processing may be a potential therapeutic target for early interventions aimed at promoting vocabulary development. Future research is needed to understand how these neural processes may interact with environmental factors, such as child-directed speech, to predict children's vocabulary development.

SU118. EARLY BRAIN CONNECTIVITY PATTERNS AND LANGUAGE SKILLS IN TYPICALLY DEVELOPING PRESCHOOLERS

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Background: Early childhood, typically referring to the first years of life spanning infancy, toddlerhood and preschool age, is a key period of postnatal brain maturation. It is also the stage in the human lifespan when many developmental skills are acquired, including receptive and expressive language skills, which enable children to form relationships and serve as foundational building blocks for the acquisition of academic and socioemotional competencies. At the same time, brain functional organization undergoes significant development, including emergence of functional asymmetry across hemispheres – a fundamental feature of human brain organization. Namely, leftward asymmetry of functional language networks has been identified as early as infancy, with age-related increases in leftward functional asymmetry linked with the development of language skills across childhood. The objective of the present study was to examine functional asymmetries within the language circuitry in typically developing preschoolers.
Methods: This study utilized functional MRI data acquired during natural sleep on a GE 3T MR750 scanner (two 6-minute runs, or 800 volumes), in combination with clinical and behavioral data collected from toddlers and preschoolers participating in the longitudinal SDSU Toddler MRI Project. The cohort (cross-sectional data only) included 38 TD children (17 female, 21 male) who were between 16 and 64 months of age (mean age 34.2±16.4 months) at their first study visit. A subset of 10 children (2 female, 8 male) returned for the second study visit (longitudinal data) when they were between 36 and 68 months of age (mean age 44.2±5.4 months). Developmental skills, including expressive and receptive language skills, were assessed with the Mullen Scales of Early Learning (MSEL). fMRI data was preprocessed using SPM12 and the conn toolbox. Functional connectivity between canonical regions implicated in language processing (bilateral superior temporal gyrus [STG], posterior superior temporal sulcus [pSTS], inferior frontal gyrus [IFG], and middle temporal gyrus [MTG]) were estimated with Fisher's z-transformed Pearson correlation coefficients calculated between the BOLD signal time courses from each region. Two indices of laterality (Asymmetry Index, AI) were calculated as interhemispheric FC (LR minus

RL language ROI connectivity) and intrahemispheric FC (LL minus RR language ROI connectivity). The effect of age on interhemispheric and intrahemispheric AI, while controlling for in-scanner head motion (RMSD), was tested with regression models.
Results: Results revealed a significant effect of age on intrahemispheric AI when controlling for RMSD ($F(2,37) = 3.88$, $p = 0.03$), with positive association between age and leftward intrahemispheric connectivity. No significant associations were found between age and interhemispheric asymmetry when controlling for RMSD. Additional analyses will explore the within-subject longitudinal trajectory of AI, and relationship with language skills.
Discussion: Our findings revealed that brain functional leftward lateralization continues to strengthen between the ages 1.5 and 5 years. Considering the malleability of the brain and behavior during the first years of life, gaining a better understanding of the emergence of brain functional asymmetry will help inform evidence-based early language interventions. This may lead to improved language and social outcomes for children with atypical language development, contributing to improved quality of life for both children and their families.

SU119. A RANDOMISED CONTROLLED TRIAL OF AN EMOTION-FOCUSED PARENTING INTERVENTION ALTERS EMOTION REGULATION NEURAL FUNCTION IN AT-RISK EARLY ADOLESCENT GIRLS

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Background: Early adolescence is a period of increased vulnerability to internalising problems. While previous studies have identified modifiable family and parenting factors as key intervention targets for improving adolescent internalising outcomes, less is known about their impact on adolescent brain function. Here, we examined whether an emotion-focused parenting intervention leads to changes in adolescent emotion regulation neural function and internalising symptoms in a randomised controlled trial.
Methods: Participants included 70 female adolescents with elevated internalising symptoms between 10-12 years old ($M = 11.5$, $SD = 0.77$), whose mothers were randomised to receive either an 8-week Tuning in to Teens (TINT) parenting intervention ($N = 34$) or waitlist control ($N = 36$). At baseline and 6-month follow-up, adolescents completed affect labelling and cognitive reappraisal tasks during functional magnetic resonance imaging. Adolescent internalising symptoms were measured using the Revised Children's Anxiety and Depression Scale.
Results: Adolescents in the TINT intervention group showed increased activation in the superior frontal gyrus during affect labelling, and decreased activation in the inferior frontal gyrus during cognitive reappraisal compared to adolescents in the control group. In addition, mother-reported adolescent internalising symptoms were significantly reduced in the intervention group.
Discussion: The results suggested that an emotion-focused parenting intervention can alter brain activity in regions supporting emotion regulation in early adolescent girls with elevated internalising symptoms. These findings highlight the importance of intervening with modifiable parenting behaviours to promote healthy brain function and mental health in at-risk youth.

SU120. NEONATAL BRAIN AGE MODELS IN PRETERM INFANTS

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Background: Preterm birth (< 37 weeks of pregnancy) is an important public health issue affecting > 10% of children worldwide. Among children born very preterm, < 32 weeks gestational age (GA), about ½ have disrupted neurodevelopment, including abnormalities in the white matter (WM), which can be characterized by magnetic resonance imaging (MRI). Our research team curated a clinical neonatal neuroimaging dataset to assess the development of WM connections in preterm infant brains. In this study, we aim to develop a model linking WM microstructure to the age at which the scan was obtained. In typically developing children, prediction of age, and specifically "brain age", is a commonly undertaken task in neuroimaging machine learning. Here, we ask whether features of WM microstructure relate to age, i.e., post-menstrual age at scan (PMA, age since conception), the sum of GA at birth and chronological age (CA, age since birth). These data may be diagnostic of overall brain health in infants born preterm.

Methods: Participants were children born < 32 weeks GA and had an MRI scan at near-term equivalent age. The clinical MRI protocol included single-shell diffusion-weighted magnetic resonance images in two phase-encoding directions (b=700s/mm2). The final dataset after quality control included scans collected from Jun 2016 to Jan 2022 (n=184), with mean GA at birth of 200 days (range: 161-223 days), mean PMA at scan of 259 days (range: 224-323 days), and mean CA at scan of 59 days (range: 3-157 days). Preprocessing, probabilistic tractography, and multidimensional analysis of informative features from tractometry were performed with open-source software libraries (QSIprep, pyAFQ and AFQ-Insight). We modeled fiber orientation distribution functions using constrained spherical deconvolution (CSD), and then extracted tract profiles of diffusion properties along the length of 24 tracts. Each tract was divided into 100 nodes, resulting in a feature space of 4800 features per subject utilizing both fractional anisotropy (FA) and mean diffusivity (MD). The GA, PMA at scan, and CA at scan were used as target variables. A lasso principal components regression with elastic net regularization was used to predict targets, with splits used to ensure independence of training and test sets. To evaluate model fit, we used a nested cross-validation procedure with 20% of the dataset held out for each batch, and predicted the age of held out subjects with fixed parameters based on the linear coefficients from the training set.

Results: Features in infant white matter microstructure explain significant variance in PMA at scan of these infants (R2=0.21). When decomposed into GA at birth and CA at scan, we observe that diffusion properties explain 15% of variance in CA and 2% of variance in GA, respectively. The Lasso PCR model had a mean α value of 17.1 (SD=13.1), with the model weights that were significantly different from 0 distributed over many different tracts and dMRI tissue properties (both FA and MD).

Discussion: Features of WM microstructure predicted PMA at scan, with better prediction of CA than GA. This finding likely relates to the timeline of WM development, where vulnerability of oligodendrocytes are maximal between PMA of 24 to 48 weeks. We replicate previous findings that weights are distributed throughout WM, indicating that many regions of WM change over time, even in the first months of life after preterm birth. Advantages of this data-driven approach include being able to utilize clinical scans collected under variable conditions, a continuously-maintained open-source preprocessing pipeline, and maximizing the use of neuroimaging data

available without the need for a priori feature engineering. Future research will consider whether WM microstructure relates to clinical status and developmental care during hospitalization. An accurate brain-age model for the neonatal brain holds potential for tracking the effects of neonatal care and predicting neurodevelopmental outcomes.

SU121. EVALUATING THE PSYCHOMETRIC PROPERTIES AND LONGITUDINAL TRAJECTORIES OF TASK-POSITIVE BRAIN NETWORK RESPONSES TO COGNITIVE DEMAND DURING THE N-BACK TASK

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Background: Recent empirical evidence suggests that flexible adaptation to cognitive demand in the "task-positive" frontoparietal and dorsal attention networks (FPN and DAN) is linked to more efficient cognitive performance (Weigard et al., 2024). Specifically, individuals with more efficient performance displayed higher task-positive network activation relative to less efficient individuals during high cognitive demand (2-back) and displayed lower activation during low cognitive demand (0-back). However, psychometric properties of these task-positive brain network activations remain unclear. We propose to examine the dimensionality, temporal stability, longitudinal trajectories, and construct validity of FPN and DAN responses to cognitive demand throughout early adulthood, a critical period of cognitive and neural development. The pre-registration of this analysis plan can be found on Open Science Framework at: https://doi.org/10.17605/OSF.IO/GH37Q

Methods: The proposed study will utilize data from a longitudinal sample (N=162) of participants from the Michigan Longitudinal Study, spanning the period of early adulthood (ages 18-25). Participants completed a spatial n-back task in the MRI scanner in which stimuli sequentially appeared at one of four spatial locations on the screen and, on each trial, participants had to indicate which spatial location was n spaces back in the sequence. There were four task conditions of increasing cognitive load in which n was equal to 0 (i.e., the spatial location currently presented on that trial), 1, 2, and 3 spaces back, respectively. Analyses will target Regions of Interest (ROIs) within task-positive brain networks that are active during n-back. Participants also completed a battery of self-report questionnaires, including the Youth and Adult Self Report forms, which assessed psychopathology and psychosocial functioning across several domains.

Results: Analysis Plan: Longitudinal principal components analysis and confirmatory factor analysis with nested model tests will be conducted to test the factor structure of task-positive network activation and evaluate the equivalence of this factor structure over time. Hierarchical linear modeling (HLM) will be used to examine temporal stability and growth trajectories of task-positive network neural activation. Correlations will be calculated to examine within-time associations between neural and behavioral measures of cognitive performance, including measures of performance at different levels of n-back load. Finally, psychopathology variables will be included in HLMs to examine associations with task-positive network neural activation, elucidating its construct validity across early adult development.

Discussion: Findings will shed light on the psychometric properties of task-positive brain network activation in response to cognitive demand. Specifically, the proposed study will reveal the longitudinal factor structure, growth trajectories, temporal stability, and construct validity of task-positive brain network activation during different conditions (high and low cognitive demand) of

the n-back task across a critical period of cognitive and neural development. Aims of the proposed study are consistent with calls to utilize well-validated psychometric methods to clarify key measurement properties of neuroscientific measures (Moriarity and Alloy, 2021; Paige et al., 2024) and findings may demonstrate how doing so with longitudinal data across critical maturational periods can improve measurement practices in developmental cognitive neuroscience.

SU122. NEURAL CORRELATES OF GIVING MAGNITUDE, TARGET, AND AUDIENCE DURING ADOLESCENCE: A LONGITUDINAL FMRI STUDY

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Background: Giving is vital for building and maintaining social relationships, a significant developmental task during adolescence. Despite its importance, there is limited understanding of how giving behaviors and their neural correlates evolve throughout adolescence.
Methods: This three-wave longitudinal fMRI study explores how adolescents' giving—differentiated by magnitude, social target (friend vs. unfamiliar peer), and peer presence (anonymous vs. audience)—develops across adolescence (ages 9–22 years; NT1 = 128; NT2 = 98; NT3 = 95).
Results: Our behavioral analysis using linear mixed models revealed a quadratic interaction effect among age, giving magnitude, and target. Older adolescents demonstrated a greater distinction between friends and unfamiliar peers when making small donations. In contrast, large donations peaked towards friends rather than unfamiliar peers during mid-adolescence. Neuroimaging results revealed that medial prefrontal cortex (mPFC) activation decreased with age. The insula showed a quadratic age effect, with activation peaking in mid-adolescence, particularly for giving to friends in the presence of an audience. Whole-brain analyses identified the left precuneus and right TPJ-IPL as involved in the friend versus unfamiliar other contrast across all timepoints. Finally, at the first and second timepoints, the precuneus demonstrated an interaction effect between target and donation size, showing higher activation for friends in the large giving condition and for unfamiliar peers in the small giving condition.
Discussion: These results provide valuable insights into the developmental trajectories of giving and its underlying neural mechanisms during adolescence, emphasizing the complex interplay between social context and neural activation in shaping giving behavior.

SU123. A STUDY OF THE RELATIONSHIP BETWEEN PRENATAL MATERNAL MELATONIN LEVELS, MENTAL HEALTH AND EARLY-LIFE OFFSPRING DEVELOPMENT

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Background: Prenatal maternal depression and anxiety have been associated with offspring development, including poorer social-emotional, motor, and language development (Rogers et al., 2020). However, current literature has not explored the role of melatonin as a possible mechanism influencing this relationship. Sleep disruptions are well-documented in mood disorders, yet how melatonin (which is critical to sleep onset and maintenance) is impacted in pregnancy in the

context of mood disorders and its role in offspring neurodevelopment is not understood. This study aimed to explore the relationship between maternal prenatal mental health symptoms, melatonin secretion, and early-offspring development among a sample of Latinx mother-infant dyads.

Methods: We explored the relationship between prenatal depression, anxiety, melatonin production during pregnancy, and offspring birth outcomes within 8 mothers and their infants (female n = 5, male n=3) enrolled in a pilot study of melatonin and stress in infancy. Salivary concentrations of N-acetyl-5-methoxytryptamine levels were assessed for one evening during the second or third trimester of pregnancy in which participants were asked to shield themselves from bright lights and collect a tube of saliva hourly until one hour past their bedtime. Participants had a mean age of 31.2 years (SD=4.3) and mean gestational age of 32.5 weeks (SD=7.4). Dim light melatonin onset (DLMO; time of the evening when melatonin is expected to increase calculated as 2 SDs added to the mean value of the first three consecutive low daytime points), phase delay (difference in time between average bedtime and DLMO), and area under the melatonin curve (AUC) were calculated. Pregnant persons self-reported their anxiety (via General Anxiety Disorder-7) and depression symptoms (via Edinburgh Postnatal Depression Scale). The Ages and Stages (ASQ) questionnaire was administered to assess early development of their children at 2 and 6 months of age. We utilized multiple linear regressions to explore associations.

Results: Pregnant persons who reported more symptoms of depression rated their offspring as having poorer fine motor development ($p=0.03$). Pregnant persons who reported more symptoms of anxiety rated their offspring as having poorer fine motor development at trend level ($p=0.07$). We did not find significant associations between anxiety and depression symptoms and the other ASQ categories or melatonin markers. Pregnant persons who had larger melatonin AUC (which indicated higher levels of melatonin secretion), rated their offspring as having greater problem-solving skills ($p=0.13$) at trend level. No significant associations between phase delay/DLMO and infant development were reported.

Discussion: This pilot study demonstrates preliminary associations between maternal mental health and poorer early offspring development as well as increased melatonin secretion associated with positive offspring developmental outcomes. Melatonin production has been associated with neurodevelopmental disorders that occur in infancy (Febesse et al., 2017) which highlights the importance of understanding the possible intergenerational effects of maternal melatonin production. However, we found limited evidence that demonstrates an association between variation in maternal melatonin levels and early infant development. These analyses suggest that possibly other prenatal factors may have a larger impact on early infant development, including disruptions in sleep, which although often seen in mood disorders, are not always present and were not included in the present analyses. This pilot study consisted of preliminary analyses that focused on development within the first 6 months of birth. Further studies are needed to assess longitudinal neurodevelopmental outcomes that may be associated with maternal melatonin levels.

SU124. LONGITUDINAL CHANGES IN HUMAN PUBERTAL DEVELOPMENT LACK ADRENAL AND GONADAL DISCRIMINANT VALIDITY

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Background: Experimental animal and human clinical endocrinology research have dissociated pubertal development into adrenal processes driven by hormones such as DHEA, and gonadal processes driven by hormones such as testosterone, estradiol, and progesterone. Increased precision in pubertal measurement may distinguish between adrenal and gonadal maturation using self-report measures of perceived pubertal development in humans, or latent adrenal and gonadal variables using self-report in conjunction with hormonal measurements. Low reliability of adrenal and gonadal maturation scores in studies of normative human pubertal development has often been attributed to collinearity, small or non-representative samples, insufficient statistical power, as well as lack of longitudinal data, biomarkers, or standardized measures.

Methods: The present research aims to test the internal reliability and longitudinal stability of the adrenal and gonadal subscores of puberty, computed using items from the commonly used self-report Pubertal Development Scale (PDS) and Sexual Maturation Scale (SMS) line drawings, and salivary measurements of testosterone, DHEA, estradiol, and progesterone. We use the large, longitudinal, sociodemographically diverse Human Connectome Project in Development (HCPD) sample (N = 1,304, 50% male, ages 5-21, three-wave longitudinal n = 254). All analyses had at least 1,554 observations from at least 1,167 unique participants. We tested discriminant validity of adrenal and gonadal maturation scores by: 1) comparing the internal reliability of adrenal and gonadal scores against overall puberty scores; 2) testing whether adrenal and gonadal hormones correlate more strongly with their respective subscores; 3) confirmatory factor analysis testing one- against two-factor solutions to pubertal self-report items; 4) exploratory factor analysis testing the latent factor structure of all pubertal and hormonal measurements.

Results: Using generalized additive mixed-effects models, we characterized nonlinear increases, rates of change, and sex differences in perceived pubertal development and salivary hormones. We additionally calculated within-subject longitudinal change scores, and demonstrated that while a composite metric of the PDS and SMS has high internal reliability ($\alpha = .92$), adrenal ($\alpha = .74$) and gonadal ($\alpha = .79$) subscores were less reliable. Compared to pubertal self-report measures, salivary hormones display much higher variability and did not differentiate across adrenal and gonadal axes. Specifically, adrenal scores were not more highly correlated with DHEA ($r = .56$) than gonadal hormones (r's = .12 - .73); gonadal scores in females were not more highly correlated with estradiol ($r = .45$) than testosterone ($r = .47$) or DHEA ($r = .58$); and, lastly, testosterone was not more highly correlated with gonadal scores ($r = .72$) than adrenal scores ($r = .73$) in males. Confirmatory factor analysis found that adrenal and gonadal processes were not significantly dissociable; two factors did not outperform a one-factor solution to self-reported pubertal development ($p = .554$). Exploratory factor analysis including salivary hormones alongside pubertal self-report items supported a two-factor solution ($R2 = .585$, $p < .001$), however, the two factors distinguished method factors for self-report vs. hormones rather than adrenal vs. gonadal axes.

Discussion: Taken together, the large HCPD dataset did not yield discriminant validity between the adrenal and gonadal axes of puberty. While adrenal and gonadal processes are dissociable in experimental and clinical research, common convenience-based measures used in research on normative human development (short self-report questionnaires and salivary hormones) may not have sufficient sensitivity to differentiate these axes. Future research designs, if interested in dissociating adrenal and gonadal processes, should maximize sensitivity to specific mechanisms of pubertal change.

SU125. TEASING APART THE RELATIONSHIPS BETWEEN CHILDHOOD ADVERSITY AND ADOLESCENT MENTAL HEALTH AND NEURODEVELOPMENT: A MULTIVARIATE INVESTIGATION

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Background: Most children and adolescents in the United States experience at least one form of adversity, which is known to increase risk for mental illness. Several conceptual models propose how adversity influences biology and behavior, and neural development has been proposed as one key mechanism through which such experience is biologically embedded. Despite many investigations into the relationships between adversity, neural development, and mental health, less is known about how operational choices of these constructs impact results.
Methods: Using a multivariate approach (inter-subject representational similarity analysis), this study evaluates both the cumulative risk model and the dimensional model of psychopathology as operational frameworks to capture the effect of adversity on longitudinal trajectories of mental health symptoms in adolescence and assess whether neurodevelopment mediates that relationship. Participants from the Transitions in Adolescent Girls study who have three to five waves of high-quality structural magnetic resonance imaging scans (n = 111) were included. Neurodevelopment is represented by volumetric changes in the amygdala and hippocampus and cortical thinning in the rostral anterior cingulate cortex, medial orbitofrontal cortex, rostral middle frontal cortex, and superior parietal cortex.
Results: Thus far we have established that both theoretical models of adversity provide useful frameworks for capturing similarity amongst adolescents in their neurodevelopmental changes, although a dimensional model explains slightly more variance in those trajectories. As expected, similarity in adverse experiences is also related to similarity in internalizing symptoms throughout adolescence. By Flux Congress, we will extend this work to test whether neurodevelopmental similarities partially mediates the effect of adversity on mental health symptoms.
Discussion: This study extends previous efforts to determine how operational definitions of adversity affect our understanding of brain growth and mental health problems that commonly occur in adolescence.

SU126. EXPLORING THE RELATIONSHIP BETWEEN BRAIN FUNCTIONAL AND STRUCTURAL CHANGES IN PREMATURITY: AN EEG-MRI STUDY

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Background: Prematurity is linked to various neurodevelopmental disorders, but the underlying early brain alterations are still poorly understood. It is therefore essential to characterize early impairments at the structural and functional levels to propose diagnostic and prognostic markers allowing to evaluate rehabilitation programs with the aim to improve neurodevelopmental outcome.

Our goal was to investigate the relationships between functional and structural markers of brain development in premature-born infants by integrating EEG and MRI information at term equivalent age. Through this, we aimed to better understand associations with perinatal risk factors, including gestational age at birth and sex.

Methods: Forty-one preterm infants with a mean gestational age (GA) at birth of 27.1±1.7 weeks underwent MRI and EEG exams on the same day (post-menstrual age PMA: from to

39 to 42w). 3T-MRI T2-weighted images were acquired in three slice planes and reconstructed with a super-resolution of 0.8mm (NiftyMIC tool). Images were segmented into different compartments (iBEAT and DrawEM tools: Fig 1a; [1]), and White Matter volume was considered for further analysis. Resting-state EEG data were collected using a 128-channel net (EGI) at a sampling rate of 1kHz and were analyzed within active sleep for all infants (average duration ~ 6 minutes). The temporal dynamics of EEG activity were characterized by parsing it into 7 "microstates" (Figure 1c) [2,3]. We selected three microstates, based on their duration sensitivity in capturing aspects of brain dysmaturation when comparing premature-born and full-term infants [3]. Using a regression linear model, we related the interindividual variability in microstate duration and WM volume, while accounting for some perinatal risk factors (i.e. GA at birth, sex; [3]) and PMA at MRI/EEG.

Results: In addition to a significant effect of GA at birth and to a lesser extent sex on the duration of all 3 microstates [3] (Figure 1d) and on WM volume (Figure 1b), we observed some association between these functional and structural measures: longer duration residuals (after correcting for PMA) were related to higher WM volume residuals (Figure 1e).

Figure 1. Summary of methodology and analyses. (a) Coronal view showing segmentation of supratentorial white matter in red and capsules in yellow. (b) Boxplot displaying the WM volumes a function of GA at birth, categorized into three groups: G1: 24w < GA≤26w, G2: 26w < GA≤28w, G3with: 28 < GA≤32w (lower volumes in G1). (c) Graphical representation of microstates (MS). (d) Boxplot analyzing the duration of an exampled microstate (MS4) across the specified GA groups (shorter durations in G3). (e) Linear regression model between the residuals (after correcting for PMA at MRI/EEG) of MS4duration and WM volume

Discussion: These preliminary findings suggest a relationship between the development of resting state EEG microstate activity and MRI measures of WM growth. Specifically, higher

WM volume correlated with extended microstate duration, suggesting a slower neuronal impulse conduction. This highlights the potential of multimodal investigations to characterize the interindividual variability of brain development in premature-born infants. To gain a deeper insight into WM development and its implications for functional brain maturation, further analyses are planned to include complementary measures of WM maturation, provided by diffusion MRI.

SU127. ASSOCIATIONS BETWEEN THE AREA DEPRIVATION INDEX AND RESTING STATE EEG ACTIVITY IN 12-MONTH INFANTS

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Background: Family socioeconomic status (SES), encompassing parental educational attainment and family income, is associated with individual differences in children's brain activity within the first year of life. Resting electroencephalography (EEG) is a common method in which to measure young children's brain activity. Prior studies that have examined developmental differences in resting EEG have found that as typically developing children grow, there is a decrease in lower frequency (e.g., theta) power and an increase in higher frequency power (e.g., alpha, beta and gamma; Marshall et al., 2002). Moreover, family socioeconomic disadvantage has been associated with more lower-frequency (theta) and less higher-frequency (alpha, beta and gamma) power in the first year of life (Pierce et al., 2019; Sandre et al., 2024; Tomalski et al., 2013), suggesting that family socioeconomic circumstances are associated with differences in children's developing brain activity. However, much of this research has focused on socioeconomic circumstances within a child's family, and not within their neighborhood. Yet, neighborhood socioeconomic circumstances, such as access to high quality early childhood education (Wei et al., 2021), access to healthy food (Black et al., 2012; Chilton et al., 2007) and green spaces (Hazlehurst et al., 2024; Towe-Goodman et al., 2024), are strongly associated with differences in children's development and health. Nonetheless, emerging evidence suggests that neighborhood socioeconomic deprivation is associated with less higher-frequency power in young children (Elansary et al., 2024).

Methods: To extend these findings, the current study examined whether neighborhood socioeconomic disadvantage is associated with lower (i.e., theta) and higher-frequency (i.e., alpha, beta and gamma) EEG power in 12-month-old infants. The data for this study come from 113 mother-infant dyads who were recruited for an ongoing longitudinal study examining the links among socioeconomic factors, children's experiences, and brain and behavioral development over the first three years of life. The analytic sample includes 78 12-month-old infants who had both usable resting-state EEG data, and data regarding their neighborhood SES. Resting EEG data was collected from these infants and preprocessed using the MADE pipeline (Debnath et al., 2020), decomposing the data into the following frequency bands: theta (3-5 Hz), alpha (6-9 Hz), beta (13-19 Hz), and gamma (21-45 Hz). Neighborhood SES was measured using the Area Deprivation Index (ADI), which uses participant addresses to examine the overall income, education, employment, and housing quality of a neighborhood (Kind and Buckingham, 2018). Neighborhoods are given a state decile score, which ranges from 1-10 and compares the neighborhood to other neighborhoods in the state, or a national percentile score, which ranges from 1-100 and ranks the neighborhood relative to other neighborhoods in the country. A higher ADI score indicates more neighborhood deprivation.

Results: We hypothesized that higher levels of neighborhood deprivation would be associated with more lower-frequency power (theta) and less higher-frequency power (alpha, beta and gamma). Multiple linear regression analyses were conducted to examine the relationship between participant ADI score and EEG power in each frequency band, controlling for child age, child sex, family income-to-needs, and parental education. Results: indicated that, counter to expectations, higher neighborhood deprivation, indexed by higher national percentile scores, was marginally associated with more high-frequency gamma ($\beta = .19$, $p = .09$).

Discussion: Altogether, this work contributes to the scientific understanding of how environmental factors, such as neighborhoods, contribute to the development of brain activity in infants.

SU128. POLYGENIC RISK UNDERLIES OVERALL PSYCHOPATHOLOGY AND PERSONALIZED FUNCTIONAL BRAIN NETWORK TOPOGRAPHY IN ABCD

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Background: A critical question in developmental neuroscience is how genetic risk influences functional brain networks and psychopathology in early adolescence. A recent multivariate genome-wide association study found two genetic factors, F1 and F2, that explain the majority of genetic variability associated with transdiagnostic psychopathology in adulthood. F1 encapsulates subclinical psychiatric symptoms, major depression, and bipolar II disorder and F2 captures schizophrenia, schizoaffective disorder, and bipolar I disorder. Additionally, emerging evidence has suggested the biological importance of a latent overall factor, or p-factor, that quantifies an individual's generalized psychiatric symptom burden. However, it is unclear how F1 and F2 are related to p-factor during adolescence, and how these variables are reflected in functional brain networks.

Methods: In this study, we used personalized functional networks (PFNs)—which capture individual variation in functional network topography that is otherwise ignored by standard analyses based on group atlases—to elucidate how these genetic factors relate to overall psychopathology and functional brain networks in the baseline sample of the Adolescent Brain Cognitive Development (ABCD) Study (N=11,873, ages 9-10). Each participant's fMRI time series was decomposed through spatially constrained non-negative matrix factorization, resulting in a PFN loading matrix of 17 networks across 59,412 cortical vertices. A bifactor model of 125 mental health indicators was used to derive p-factor scores, and polygenic risk scores (PRS) of F1 and F2 were derived in a European ancestry subsample (N=3,982) using continuous shrinkage priors (PRS-CS).

Results: P-factor was found to be heritable based on twin analyses ($h^2=0.53$, $p < 0.001$). Furthermore, the polygenic risk score of F1 (PRS-F1) was found to be significantly correlated to p-factor ($r=0.12$, $p < 0.001$), although the polygenic risk score of F2 (PRS-F2) was not. PFN topography was also found to be heritable (51.14% of vertices pFDR < 0.05, mean $h^2=0.31$) and was robustly related to interindividual differences in p-factor (Discovery: $r=0.12$, $p < 0.001$; Replication: $r=0.12$, $p < 0.001$), PRS-F1 (Discovery: $r=0.05$, $p=0.019$; Replication $r=0.07$, $p=0.0013$), and PRS-F2 (Discovery: $r=0.08$, $p < 0.001$; Replication: $r=0.08$, $p < 0.001$). The relationship between functional networks and clinical/genetic risk was largely driven by interindividual differences in the topography of multimodal association networks. The cortical regions and network topography driving these multivariate PFN associations converged between p-factor and PRS-F1, yet diverged between p-factor and PRS-F2.

Discussion: Our results expand upon prior literature, showing that personalized functional network topography has a genetic basis and is related to overall psychopathology in early adolescence. Specifically, we provide novel evidence that two psychiatric polygenic risk scores,

one that manifests clinically during early adolescence (PRS-F1) and one that has yet to (PRS-F2), are both reflected in personalized functional topography during this stage of development.

SU129. SCEREBELLAR CONTRIBUTIONS TO SOCIAL LEARNING IN ADOLESCENCE

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Background: While the cerebellum critically supports motor function, emerging neuroimaging evidence shows its involvement in a variety of non-motor functions. Across domains, the cerebellum seems to play an important role in facilitating learning, with cerebellar anterior lobe contributing to motor learning and cerebellar posterior lobe (CPL) contributing to learning in cognitive domains (Stoodley and Schmahmann, 2010). The cerebellar internal forward model (Ramnani, 2006) proposes that the operation of the cerebellum comprises an iterative process of error reduction. According to this account, the cerebellum generates predictions of the command and encodes and sends the discrepancy between predicted and actual consequence, i.e., prediction error signals (PEs), to various cortical regions. While a number of studies (Van Overwalle et al., 2014) have pointed to the role of the cerebellum in social information processing, its specific role in social learning remains unclear. Compared to adults, adolescents demonstrate greater social motivation, visible in greater susceptibility to social influence and rejection. Neural development during adolescence, particularly in the cerebellum and its connected cortical regions like the medial prefrontal cortex (mPFC) plays a crucial role in shaping behavior (Stoodley, 2016). Adolescents (versus adults) are more sensitive to PEs across social learning paradigms and exhibit lower learning rates, which Results: in slower PE updating (Rosenblau et al., 2018). Given the cerebellum's role in prediction, we hypothesize that cerebellum is important for encoding PEs in adolescence. As the cerebellum matures at the onset of adolescence (Tiemeier et al., 2010), while the mPFC develops into adulthood (Steinberg, 2008), its role in PE encoding may be more significant in adolescents than in adults.

Methods: This functional magnetic resonance imaging (fMRI) study examined the role of the CPL in social learning of typically developing adolescents (preliminary sample: N = 14, 8 - 17 years old, 8 females). Participants inferred the preferences of two peers in two scan runs. Each peer was introduced with a short vignette before rating their preferences for 60 food and activity items in each run (120 total). They then received feedback about the peer's actual preferences. PEs were conceptualized as the difference between participants' ratings and the feedback, and learning was defined as reductions in PEs over time. We predicted that CPL and mPFC activity would scale with PEs and that connectivity between these two regions would scale with the magnitude of learning, i.e. decreasing PEs over time. fMRI data was collected in a 3T Siemens Magnetom Prisma and preprocessed with the fMRIPrep pipeline (Esteban et al., 2019). For cerebellar analysis, the cerebellum was registered to a standard cerebellar template (Diedrichsen, 2006). PEs were used as parametric regressors and a linear mixed effects model (Woolrich et al., 2004) was conducted to investigate how cerebellar activity was modulated by PEs. Results for preliminary analyses are reported at an uncorrected threshold of $z = 2.3$ and $p < .01$.

Results: As hypothesized, our preliminary analyses revealed that PEs scaled with activity in the left Crus II and mPFC, regions that support social cognition and are densely connected.

Discussion: In a next step, we will corroborate the involvement of these regions by using our preregistered regions of interest analyses (CPL: lobule VI, Crus I, and Crus II) and whole brain analyses with our total preregistered sample (N = 32 - 48). In line with our hypotheses about the role of CPL - mPFC connectivity in social learning, we will perform task-based functional connectivity analyses and relate to the magnitude of social learning. Our preliminary findings highlight the role of CPL and mPFC in encoding PEs in social learning and enhance our understanding of social learning processes in adolescence. This study is supported by the National Institute of Mental Health (R01MH116252).

SU130. DATA-DRIVEN COGNITIVE AND NEUROIMAGING CLUSTERS IN PERSISTENT DYSLEXIA

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Background: Dyslexia is a neurodevelopmental disorder characterized by difficulties in reading despite adequate intelligence and education. While its cognitive and neurobiological bases have been extensively studied, the relationship between specific cognitive profiles and brain structure remains unclear. This study aims to identify the cognitive and correspondent neuroanatomical signatures of dyslexia in a well-characterized cohort of children with persistent dyslexia resistant to intervention. We hypothesize that deviation from typical neurodevelopment in specific brain regions will be associated with corresponding performance on cognitive measures, providing insight into subtypes of dyslexia.

Methods: Participants included 97 children with dyslexia ages 8-14 (M=11, SD=1.8) who received a comprehensive battery of neuropsychological, academic, and language tests and MRI at the UCSF Dyslexia Center. We performed hierarchical clustering of the cognitive scores identifying 4 partially independent clusters (correlations between r=0.15-0.34). For each cluster we generated a composite score and assigned a cognitive domain label based on the common theme among the tasks: Reading and Phonological Processing, Verbal Fluency and Working Memory, Visual-spatial and Mathematical Reasoning, and Processing Speed and Executive Function. For each cluster we hypothesized a group of brain ROIs predicted to be most implicated for the domain based on previous literature. Structural T1w MRI data was processed with FreeSurfer, extracting cortical thickness and area parcellated by the Destrieux atlas. To identify atypical structural deviations that are associated with cognitive profiles in dyslexia, we utilized a normative model based on neuroimaging data from 82 sites (N=58,836; ages 2–100) to generate deviation scores for each region metric accounting for age, gender, and site effects. To examine relationships between cognitive scores and brain deviation scores, we implemented a mixed-effects linear model for each brain metric, including fixed effects for each composite score and a random effect for subject ID. To quantify the association between the cognitive scores and brain regions, we averaged the beta value for each group of ROIs across each cognitive composite.

Results: Results for cortical thickness displayed more distinct associations that largely aligned with our hypotheses. Thickness of the left middle frontal, superior frontal, supramarginal, and fusiform gyri were strongly associated with the Visual-spatial and Mathematical Reasoning composite, followed by the Reading and Phonological Processing composite. Thickness of the

left inferior frontal gyrus, precentral gyrus, and the precentral sulcus showed clear associations with the corresponding Verbal Fluency and Working Memory composite as we predicted, followed by the Reading and Phonological Processing composite. Thickness of the bilateral intraparietal sulcus and superior parietal lobule, predicted to be associated with Visual-spatial and Mathematical Reasoning, were strongly associated with the Processing Speed and Executive Function composite. Aligning with our hypothesis, thickness of the bilateral middle frontal and superior frontal gyri were most strongly associated with the Processing Speed and Executive Function composite. Cortical area showed mixed associations without clearly interpretable relationships.

Discussion: This study reveals distinct associations between cognitive profiles and deviations from typical cortical thickness development in children with dyslexia, partially aligning with our hypotheses. The findings highlight the importance of visual-spatial, mathematical reasoning, and executive function abilities in dyslexia, beyond traditional reading measures. Our results suggest heterogeneity in dyslexia manifestations, emphasizing the need for personalized assessment and intervention. Future research should focus on identifying dyslexia subtypes based on cognitive profiles and their corresponding neurodevelopmental trajectories.

SU131. HOW TODDLER IRRITABILITY RELATES TO EEG DATA QUALITY AND ERP MISMATCH NEGATIVITY AMPLITUDE

Aldair Acosta Juarez*[1], Ananya Mittal[1], Serena K. Mon[1], Lauren S. Wakschlag[1], Elizabeth S. Norton[1]

[1]Northwestern University**Background:** Expressions of irritability are extremely common in toddlerhood and have both typical (e.g., having a mild temper tantrum when hungry and tired) and atypical (e.g., having many explosive tantrums per day or hurting others during a tantrum) manifestations (Wakschlag et al., 2015). Atypical expressions of irritability are among the earliest and strongest predictors of later psychopathology. Therefore, understanding the neural correlates of irritability in toddlers could improve our understanding of the course and predictors of psychopathology. However, neuroimaging research with toddlers, particularly highly irritable children, poses substantial challenges, and it is unknown whether irritable behaviors could negatively impact data quality, potentially affecting or masking the presence of neural indicators of interest. The auditory ERP mismatch negativity (MMN), a pre-attentive neural measure that doesn't require the child's attention, and has been linked to a variety of neurodevelopmental disorders (e.g., dyslexia, schizophrenia; Norton et al., 2022). The early MMN amplitude was enhanced in adolescents with high behavioral inhibition and anxiety (Reeb-Sutherland et al., 2009) but has rarely been studied in toddlers at risk for psychopathology. Here, our first objective was to identify whether toddlers' irritability (per parent report) was associated with EEG data quality measures (number of Interpolated Channels, Usable MMN Trials, and HAPPE Data Quality). Our second objective was to explore whether irritability was related to the MMN mean amplitude, as seen in older children.

Methods: The current analyses included n=80 toddlers, age 24-32 months, who participated in the broader longitudinal When to Worry study, which oversampled for high irritability and for language delay. Irritability was assessed via the Multidimensional Assessment Profiles-Temper Loss scale (MAPS-TL), a validated parent survey that presents questions on an objective frequency scale. MMN to speech syllables (85% standard "da", 15% deviant "ba") was collected with a 32-channel BioSemi ActiveTwo system. Preprocessing was completed in the

HAPPILEE/HAPPE+ER processing pipeline (Monachino et al., 2022) and we derived the data quality measure from HAPPE (representing similarity between the pre-and post-processed data). MMN analysis focused on literature-defined early (100-200 ms temporal) and late (300-600 ms frontal) MMN mean amplitudes.

Results: In terms of data quality, a Spearman partial correlation controlling for sex, revealed no significant correlations between irritability scores and any of the EEG data quality measures (ps > 0.34; interpolated channels; r=0.04, usable MMN trials; r=-0.08, HAPPE data quality; r=-0.11,) indicating that data quality did not differ meaningfully by child irritability. In relation to MMN mean amplitude, we found a significant negative correlation between irritability scores and the early MMN (r=-0.23, $p < 0.05$), where high irritability scores are associated with a more negative (greater) MMN mean amplitude.

Discussion: These results suggest that the MMN can be used to reliably assess young children's neural responses across a spectrum of irritability; this is ideal as a very similar paradigm is in use in the national HEALthy Brain and Child Development study. Further, our data suggest that irritability in very young children shows differences similar to those seen in adolescents. Early MMN amplitude may reflect features such as increased sensitivity to novelty at the early stages of cognitive processing.

SU132. THE IMPACT OF ESTIMATED EXPRESSION OF THE WILLIAMS SYNDROME GENE GTF2I ON DEVELOPMENTAL TRAJECTORIES OF MYELINATION IN TYPICALLY DEVELOPING CHILDREN AND ADOLESCENTS

Caroline Raymond*[1], J. Shane Kippenhan[1], Tiffany A. Nash[1], Michael D. Gregory[1], Anna G. Kelemen[1], Ariana S. Chavannes[1], Madeline H. Garvey[1], Philip D. Kohn[1], Daniel P. Eisenberg[1], Shau-Ming Wei[1], Karen F. Berman[1]

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Background: Myelination of neurons in the brain is necessary for proper nerve conduction and is a complex, yet critical, neurodevelopmental process. Myelin consists of a protective fatty sheath that insulates neuronal axons and facilitates saltatory conduction to speed the propagation of action potentials. Multiple genetic factors have been linked to the process of myelination and may contribute to differences in the developmental trajectories of cognitive abilities and social behaviors. One important example occurs in Williams Syndrome (WS), a rare genetic neurodevelopmental disorder, characterized by alterations in myelination and by increased social drive (often termed "hypersociability"). WS is caused by a hemideletion of ~26 genes at the 7q11.23 chromosomal locus, and postmortem samples from individuals with WS show decreased myelination in frontal cortex. Additionally, in mice, selective deletion of the GTF2I gene, a general transcription factor that is one of the 26 genes hemideleted in WS, reduces myelination of forebrain excitatory neurons. Since myelination of the brain increases throughout neurodevelopment, we sought to examine whether estimated GTF2I expression impacts the developmental trajectories of myelination in vivo from childhood to early adulthood in typically developing participants (TDs) studied with longitudinal MRI.

Methods: mcDESPOT scans were longitudinally collected on a GE 3T MR750 scanner and were used to generate voxelwise, quantitative myelin water fraction (MWF) maps for 134 TD children (423 cumulative visits, age range 5-22 years, mean=12.9+/-3.0; 68 males). mcDESPOT imaging includes an irSPGR image, 8 flip angles of an SPGR image, and 8 flip angles of SSFP images at

phases 0° and 180°, which were processed with the QUIT pipeline, warped into a study-specific MNI template, and smoothed at 8mm FWHM. The resulting MWF maps yield a quantitative measure of myelin content per voxel that allowed for longitudinal and between-subject comparisons. Estimates of cortical GTF2I expression were imputed based on the Genotype Tissue Expression (GTEx) project cis-expression quantitative trait locus data for SNPs within +/- 1Mb of the transcription start site using SNP information derived from each participant's peripheral blood samples. Mixed-effects penalized-spline modeling was used to test for interactions between GTF2I expression scores and developmental trajectories of MWF, controlling for sex and genetic ancestry-related components. Results were thresholded at $p < 0.001$, uncorrected.

Results: We found that there was an interaction between participants' estimated GTF2I expression values and the developmental trajectories of MWF in three distinct brain regions: the right forceps major, left anterior thalamic radiation, and left uncinate fasciculus. Higher estimated GTF2I expression values were associated with greater myelin content throughout development in these three regions, whereas lower estimated GTF2I expression values were associated with an earlier peak in myelination in late adolescence.

Discussion: We found that myelin development in white matter is affected by genetically-predicted GTF2I expression levels in white matter tracts connecting regions previously shown to have structural and functional anomalies in WS and to have relevance for the behavioral phenotypes in the syndrome, including the intraparietal sulcus (forceps major) and anterior insula (uncinate fasciculus). These results provide evidence of a GTF2I-based neurogenetic mechanism that is important in the structural and functional organization of the developing brain. Future analyses will explore the effects of estimated GTF2I expression on social behavior across development as measured by the Multidimensional Personality Questionnaire.

SU133. SPATIOTEMPORAL VARIATION IN WHITE-MATTER DEVELOPMENT ACROSS EARLY CHILDHOOD: AN ALONG-TRACT FIXEL-BASED ANALYSIS STUDY.

Mervynderjeet Singh*[1], Dennis Dimond[1], Ryann Tansey[1], Kirk Graff[1], Christiane S. Rohr[1], Deborah Dewey[1], Catherine Lebel[1], Signe Bray[1]

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Background: Longitudinal diffusion-weighted imaging (DWI) studies have characterized spatiotemporal variation in white matter (WM) development during childhood, with sensorimotor tracts maturing faster compared to association tracts, which exhibit more protracted trajectories (Dimond et al., 2020; Lebel et al., 2019; Reynolds et al., 2019). However, this work has investigated effects at the whole-tract level, perhaps obscuring important anatomical variation. Indeed, WM properties show a high degree of variability within a given tract (Colby et al., 2012). As such, there has been increasing focus on applying along-tract approaches to quantify localized effects with greater specificity (Shirazi et al., 2021). Here, we employed an along-tract analysis approach to investigate whether there are spatial maturational gradients within tracts, across early childhood.

Methods: DWI data (2.5mm3; b=2000s/mm2; directions=45, b0=3) were acquired from 133 typically developing children aged 4-7 years (F/M=76/57). Children were scanned on a 3T GE MRI system, with 63 participants returning for 12-month follow-ups. DWI preprocessing included

eddy current distortion and within-volume motion correction (via slice outlier interpolation; Andersson et al., 2016). WM fibre orientation directions (FODs) were estimated using Single-shell 3-Tissue Constrained Spherical Deconvolution (SS3T-CSD; Dhollander and Connelly, 2016) and probabilistic tractography was performed to generate group-level tracts. Three major WM tracts that were spatially oriented along the anterior-posterior (inferior fronto-occipital tract; IFO; superior longitudinal fasciculus-I; SLF-I), and superior-inferior (corticospinal tract; CST) axes were chosen. Tracts were partitioned lengthwise into 20 segments, and fixel-based analysis (FBA) was applied to extract average measures of fibre density (FD) and fibre cross-section (FC) from each segment (Dhollander et al., 2021; Raffelt et al., 2017). These were entered into linear mixed-effects models to examine age-related trajectories, adjusting for sex, handedness, total brain volume and total number of motion-corrupted slices. Rates-of-change were plotted for each segment and compared against whole-tract rates of change.
Results: Among tracts, faster rates of change were found for the CST, whilst the SLF-I and IFOF had a more protracted (i.e., slower) maturational profile, supporting prior evidence of sensorimotor tracts maturing earlier compared to association tracts. Along-tract analysis of age-related FD and FC maturation did not show posterior-to-anterior (IFO, SLF-I) or inferior-to-superior (CST) developmental gradients across segments.
Discussion: Our preliminary findings suggest that the observed spatiotemporal developmental patterns seen in prior work at the whole-tract level are not reflected at the within-tract level.

Poster Session III
Monday, September 30
1:15 p.m. – 2:45 p.m.

M1. THE EFFECT OF TIME AND THE SEASONS ON RESTING-STATE FUNCTIONAL CONNECTIVITY IN YOUTH

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Background: Adolescence is a unique period of the lifespan, in which cognitive phenotypes exhibit a protracted maturation and many forms of psychopathology first emerge. It is also a time in the lifespan characterized by continuing maturation of functional circuits. Many studies focus on environmental and genetic contributions to the development of the brain and behavior. However, the timing in which brain and behavior are measured is often overlooked. Recent evidence suggests that short (within day) and long (seasonality) time scales may influence brain connectivity and behavioral outcomes. This study aims to characterize the effect of time-of-day and seasonality on youth resting-state functional connectivity.

Methods: Resting-state functional connectivity (RSFC) data from the Adolescent Brain and Cognitive Development study (ABCD) was segmented into predefined Discovery and Replication sets (nDiscovery = 2,316, nReplication = 2,247). Within each dataset, individual RSFC data from both sets were grouped into Morning (8AM to 12PM scans) Discovery, Evening (4PM to 7PM scans) Discovery (nMorning = 989, nEvening = 476), Morning Replication, and Evening Replication (nMorning = 925, nEvening = 464) sets. We contrasted the group averaged morning scans with the group averaged evening scans and quantified the reproducibility of whole brain morning vs. evening scans in the Replications set. The Discovery and Replication sets were also segmented according to the seasons at the time of scanning. Winter (nDiscovery = 489, nReplication = 483) was defined as November 1st to January 31st, Spring (nDiscovery = 555, nReplication = 604) was February 1st to April 30th, Summer (nDiscovery = 682, nReplication = 592) was May 1st to July 31st, and Fall (nDiscovery = 521, nReplication = 524) was August 1st to October 31st.
Results: Significant differences between morning and evening brain maps were observed primarily within and between visual and somatomotor networks, with greater connectivity observed in the morning grouping (visual: $\Delta r = 0.03$, $p < 0.05$; motor $\Delta r = 0.02$, $p = 0.02$). This time-of-day effect in RSFC resembled previous patterns of day-to-day variability within individuals, as well as norepinephrine terminal projections, suggesting a potential arousal-related effect. Whole brain differences were found to replicate across Discovery and Replication data sets ($r = 0.43$, $p < 0.001$). Additionally, a one-way ANOVA revealed no statistically significant difference in the average RSFC between the four seasons for the Discovery ($F(3, 221108) = 0.41$, $p = 0.7448$) and Replication ($F(3, 221108) = 0.43$, $p = 0.7331$) sets. The difference in average RSFC for winter and summer did not replicate between the Discovery and Replication sets ($r = 0.0429$).
Discussion: Reproducible differences in time-of-day effects suggest that scan time may be an important factor to model in between-person links between brain and behavior. Notably, these same differences were not observed across the months of the year, suggesting within-day RSFC fluctuations may play a more important role than longer time-scale seasonality effects. In the future, a more fine-grained approach to seasonality is needed to look at RSFC differences between specific regions of interest rather than the entire brain. Future studies have the potential to determine the presence of similar differences in activity across varying time scales.

M2. NEURAL MECHANISMS OF SENSORY REACTIVITY AND REGULATION IN YOUTH WITH EARLY CAREGIVING ADVERSITY

Megan Banchik*[1], Adriana Mendez-Leal[1], Melis Çakar[1], Audra Langley[1], Jill Waterman[1], Nim Tottenham[2], Shulamite Green[1]

[1]University of California, Los Angeles, [2]Columbia University

Background: Sensory over-responsivity (SOR) is a heightened, extended, or disproportionate reaction to sensory stimuli that causes significant impairments in day-to-day functioning. SOR is prevalent across a range of neurodevelopmental populations, including children who have experienced early caregiver-related adversity (ECA; Méndez Leal et al., 2022). Despite its prevalence, SOR is understudied in ECA compared to other clinical groups, such as autism. Understanding the neural mechanisms of SOR in children with ECA is crucial for understanding

the distinct or shared presentation of SOR across populations and for developing targeted interventions tailored to specific populations.

Methods: This study compared 26 children with ECA, ages 8-18 years, to 26 age- and sex-matched non-adopted, typically-developing controls (NAC). During functional MRI (fMRI), participants experienced six blocks of simultaneous mildly aversive tactile (scratchy fabric rubbed on the inner wrist) and auditory (white noise) stimuli. Between-group analyses were performed at a threshold of $Z=2.7$, $p < .05$. Parents completed the Sensory Processing 3-Dimensions Inventory (SP3-D) inventory to report on their child's SOR symptoms. SOR scores were entered as regressors into a bottom-up whole-brain analysis to investigate how SOR relates to brain responses. Finally, functional connectivity during the aversive sensory stimulation was examined using a psychophysiological interaction (PPI) analysis with regions of interest (postcentral gyrus, DLPFC, and ventromedial thalamus) as seeds ($Z=2.3$ $p < .05$).

Results: Compared to NAC, the ECA group showed hyperactivation during sensory stimuli in the postcentral gyrus. In the ECA group, lower SOR corresponded to increased activation in the thalamus, precuneus, precentral gyrus, and prefrontal cortex. PPI analyses demonstrated that the ECA group showed negative connectivity of all three seed regions with sensory processing regions (e.g., auditory and visual cortices). Additionally, the ventromedial thalamus showed negative connectivity with several frontal regions (precentral, inferior frontal, and middle frontal gyri).

Discussion: The ECA group demonstrated neural hyperactivity during aversive sensory stimulation, which has been seen in other groups with elevated SOR; however, here, it was confined to the sensorimotor cortex compared to the broad activation typically seen in other groups (Cummings et al., 2024.; Green et al., 2015). In the ECA group, increased neural activity corresponded to lower SOR in sensory regulation-related regions (i.e., thalamus and prefrontal regions), a pattern that differs from other groups that tend to show increased brain activation with higher SOR. This unique pattern could indicate compensatory mechanisms at play, so we examined functional connectivity within these regions. Negative functional connectivity between the postcentral gyrus and sensory regions might indicate more differentiation between sensory networks which may be compensatory in this group compared to children with autism, who show decreased differentiation of sensory networks associated with SOR (e.g., Green et al., 2019). Further, the negative functional connectivity with prefrontal regions and thalamus found here has previously been shown to contribute to resilience to SOR (Green et al. 2019; Green et al., 2017). In this group, negative functional connectivity between prefrontal regions, thalamus, and sensory cortices suggests that the prefrontal cortex and thalamus contribute to down-regulating irrelevant sensory regions and modulating appropriate sensory responses. Together, results suggest that while children with ECA are at higher risk for SOR than the non-adopted population, they may have developed compensatory mechanisms that help regulate neural over-reactivity to sensory stimulation and may shed light on neural mechanisms implicated in resilience to SOR.

M3. THE IMPACT OF FUNCTIONAL NETWORK CONSTRUCTION PARAMETERS ON COGNITIVE OUTCOME PREDICTION IN CHILDREN AND ADOLESCENTS WITH CONGENITAL HEART DISEASE

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Background: The application of network science principles has enhanced our understanding of the human brain's structure and function. The choice between weighted and binary networks when constructing network matrices has significant implications for downstream network metrics and interpretation. Weighted networks directly capture raw correlation values between nodes, resulting in larger and more complex networks. Conversely, binary networks simplify network architecture by representing connections as either present or absent, but at the cost of losing continuous information. Each approach has trade-offs. Despite an abundance of applied network analyses in brain imaging, there is no consensus on appropriate or optimal construction methods nor threshold choice. Here we perform graph analysis on a congenital heart disease cohort and matched controls to explore how varying network construction and threshold selection Methods: affect executive function (EF) outcome prediction.

Methods: A dataset of 125 resting state fMRIs were collected from 77 controls and 48 CHD patients. Patient scans were preprocessed according to published motion correction and quality-control guidelines (Power et al., 2014). Segmentation utilized the AALv3 atlas.

After preprocessing, average intensity values were computed for each brain region per timepoint, followed by Pearson correlation calculations between pairs of brain regions. Resulting patient-specific NxN matrices were used to construct adjacency matrices, using weighted and binary approaches (absolute and proportional thresholding). An iterative approach was adopted for binarization threshold selection, ranging from 0 to 1 with a step size of 0.05.

A comprehensive set of 14 network measures was computed. Global metrics included global efficiency, assortativity, density, modularity, transitivity, and small-worldness. Regional metrics were local efficiency, nodal efficiency, clustering coefficient, node betweenness, degree, eigenvector centrality, and participation coefficient. All metrics were calculated per patient network across all thresholds.

We applied a regression model for each patient to predict their neurocognitive test outcome score. Models were built on each threshold separately, as well as on the average of network metrics across several thresholds. To account for multiple corrections we report results with a coefficient for the interaction term between CHD and network metric having a p-value < 0.001.

Results: Prior to binarization, we saw no significant difference in the average functional connectivity values between CHD and control groups. No significant differences in global connectivity were measured across all thresholds and weighted networks. Significant differences in local connectivity metrics were observed within cohorts across different thresholds. Notably, the small-world σ exhibited a decreasing trend as the network density increased. Weighted networks showed 5 significant metrics. Averaged absolute and proportional networks showed 4 and 14 significant metrics respectively. Measures from the averaged networks closely mirrored those observed at each individual threshold. However, some metrics appeared significantly only at specific thresholds, suggesting potential spurious findings. Moreover, the Results: observed across average network values closely aligned with Results: significant across several individual thresholds.

Discussion: We identified robust structural regions significantly associated with EF cognitive measures across several graph construction methods. However, while some findings overlapped between methods, some methods yielded uniquely associated regions. This variability allows for a comprehensive examination of network differences, helping differentiate true signal from spurious findings. We suggest future studies explore multiple thresholds, as well as weighted and binarized techniques, in order to increase reproducibility and transparency when applying graph metrics to functional connectivity analysis.

M4. DYNAMIC FUNCTIONAL CONNECTIVITY OF THE DEFAULT MODE AND FRONTO-PARIETAL NETWORKS IN YOUTH WITH ADHD

Hope Peterson-Sockwell*[1], Heather Shappell[2], Jessica Cohen[1]

[1]University of North Carolina at Chapel Hill, [2]Wake Forest University School of Medicine

Background: ADHD is the most commonly diagnosed disorder in children, hallmarked by developmentally inappropriate symptoms of inattention, hyperactivity, and impulsivity. An indicator of poor attention in youth with ADHD is variable response speed during cognitive tasks. The neural mechanisms underlying this variability, and thus inattention, remain unclear. One candidate mechanism is disruptions to dynamic interaction patterns between the default mode network (DMN), thought to underlie internally-oriented processing, and the fronto-parietal network (FPN), thought to underlie task-relevant control processes. Studies have documented differences between typically developing (TD) youth and youth with ADHD in both the DMN and the FPN, as well as in how they interact. Current hypotheses posit that inattention lapses in ADHD may be explained by reduced DMN deactivation during engagement in cognitive tasks. The current proposed analyses will implement dynamic functional connectivity (dFC) Methods: to assess how dynamic interactions within and between the DMN and the FPN are altered in youth with ADHD and relate to inattention.

Methods: This sample includes 100 youth with ADHD and 50 TD youth (10-12 years). BOLD MRI was collected from all participants during a go/no-go task (GNG), and standard image processing steps will be completed using fmriprep on GNG fMRI time series data. Processed time series will be extracted from regions classified as belonging to the DMN and FPN according to a functional brain atlas (Seitzman et al, 2020). Task performance will be assessed by tau, a response time variability metric derived from the exponential-Gaussian distributional model of response times sensitive to infrequent yet extremely slow response times that are indicative of lapses in attention. A hidden semi-Markov model (HSMM) will be utilized to assess dFC during performance of the GNG by characterizing the temporal sequence of brain states constructed from time series. Dwell time (how long an individual remains in a given brain state) and transition probabilities (how likely an individual is to transition from a given brain state to another) will be calculated for each network state separately for the TD and ADHD groups, and differences between groups will be assessed with permutation testing (Simpson et al, 2013). Additionally, mixed model for multitask brain network regression framework capable of combining continuous covariates and brain network features will be implemented to determine the relationship between tau, dwell time, and transition probabilities (Tomlinson et al, 2023).

Results: Identification of between four and six network states are anticipated in this sample, as these have previously been observed as the optimal number of brain states for youth with ADHD (Shappell et al, 2021). Based on previous analyses that have demonstrated longer dwell time and lower transition probabilities for networks states marked by high DMN connectivity in youth with ADHD during the resting state, we hypothesize in this analysis that youth with ADHD will exhibit a greater probability of transitioning into connectivity states in which the DMN is dominant, and longer dwell time within DMN-dominated states than TD youth during the GNG task. TD youth are hypothesized to more uniformly fluctuate between DMN and FP dominated connectivity states. Participants with ADHD are anticipated to perform worse than TD subjects on the GNG task, captured as greater tau values. Finally, we hypothesize that increased tau will be associated with

longer dwell time in DMN-dominant network states and with higher probability of transiting into DMN-dominant states.
Discussion: Hypothesized results would substantiate the claim that inattention symptoms in ADHD may be due to individuals becoming "stuck" in DMN activation, resulting in internally-focused thought (i.e., mind wandering) rather than task-relevant attention.

M5. BEHAVIORAL INHIBITION AND ASSOCIATED NEURAL CONNECTIVITY DURING THE PRESCHOOL YEARS

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Background: Behavioral Inhibition (BI), defined as fearfulness and wariness in response to novel stimuli, is estimated to be present in 15-20% of preschool-aged children. BI during the preschool years is associated with heightened risk for anxiety disorders in adolescence. Prior work suggests that observed behavioral measures of BI may be associated with differences at the neural level during adolescence, specifically within the lateral prefrontal cortex (LPFC) and the temporoparietal junction (TPJ). These regions are part of a larger ventral attention network (VAN) involved in shifting attention, updating goals, and mentalizing. However, little work has examined whether these neural differences are present during the preschool years when BI is first observable.
Methods: 60 children between the ages of 3 and 5 years old (53% girls, 47% boys) engaged in two paradigms from the preschool version of LAB-Tab, the Risk Room and Stranger Approach paradigms, which are designed to elicit wariness in BI children. In the Risk Room paradigm, children are left to explore with a set of unfamiliar and/or adventurous toys (e.g., balance beam, trampoline, etc.). In the Stranger Approach paradigm, children are expected to interact with an unfamiliar, adult experimenter. Near infrared spectroscopy (NIRS) data were collected during the Stranger Approach paradigm, and BI was coded observationally by an established coding system from the Risk Room paradigm ("observed BI").
Results: Higher observed BI during Risk Room was associated with weaker connectivity between the right temporoparietal junction (TPJ) and the left lateral prefrontal cortex (PFC) ($t=-2.71$, $p=0.009$), left anterior medial PFC ($t=-2.85$, $p=0.006$), and the left TPJ ($t=-2.75$, $p=0.008$) during Stranger Approach. Higher observed BI during Risk Room was also associated with stronger connectivity between the left TPJ and right lateral PFC ($t=3.16$, $p=0.003$) during Stranger Approach.
Discussion: Findings provide a neural basis for inhibited behavior in preschool age children. BI children may have a more difficult time shifting goals and attention to support a positive social interaction in the presence of a stranger and may require greater effort to understand others' intentions and regulate their own emotions in the presence of a stranger.

M6. STRUCTURE-FUNCTION COUPLING AND PSYCHOPATHOLOGY IN A TRANSDIAGNOSTIC SAMPLE OF YOUTH

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Background: Resting-state functional neuroimaging (rs-fMRI) has been used to identify a variety of functional networks (Lee et al., 2023). Connectivity within and between these networks has been shown to associate with psychopathology in youth (Hoy et al., 2023) and provides insights into communication pathways within the brain. Functional communication is supported by the structural connectome (Baum et al., 2020), the anatomical network of axonal fiber bundles. Correlation between the structural network and interregional functional connectivity is referred to as structure-function coupling. Previous literature has demonstrated an association between structure-function coupling and psychopathology in adulthood (Jiang et al. 2020; Zhou et al., 2023). However, the relationship between coupling and transdiagnostic youth psychopathology remains unclear. Here, we examine structure-function coupling and its association with psychopathology in a transdiagnostic sample of youth.

Methods: N=72 (50% male, Mage = 13.31, SD = 2.73) youth completed rs-fMRI and diffusion imaging within one month of each other. The sample included youth with a primary diagnosis of an anxiety disorder, attention deficit/hyperactivity disorder, disruptive mood dysregulation disorder, major depressive disorder or healthy volunteers. Youth and caregivers rated the participants' irritability using the Affective Reactivity Index (ARI), and anxiety using the Screen for Child Anxiety Related Disorders (SCARED). Bifactor analyses, a latent variable approach, quantified unique and shared variances of psychopathology symptoms. A Negative Affectivity factor was outputted, reflecting commonality among all items and indicated levels of co-occurring symptoms, as well as 3 'domain-specific' factors, reflecting variance not accounted for by the negative affectivity factor: irritability (parent-reported), irritability (youth-reported), and anxiety. Diffusion and rs-fMRI data were preprocessed, and structural and functional connectomes were computed using a parcellation scheme combining the Schaefer-Yeo atlas (200 parcels, 7 networks; Schaefer et al., 2018) and Choi striatal parcellation (Choi et al., 2012). Coupling was computed as the correlation between structural and functional connectivity between each pair of nodes. Within- and between- network coupling was calculated for each network. Regression models investigated associations between each coupling measure and psychopathology factor, controlling for age and sex, and multiple testing using Bonferroni correction.

Results: Increased coupling between the DMN and control network demonstrated associations with negative affectivity (B=3.62, p=0.0005). Additionally, higher parent-reported child irritability scores were associated with decreased coupling between the dorsal and ventral attention networks (B=-3.92, p=0.0016).

Discussion: Structure-function coupling is understood to develop over adolescence and associate with cognitive outcomes (Baum et al., 2020). Our analysis demonstrates associations between shared and unique variances of psychopathology and coupling between structure and function during rest. Further work should explore coupling using task fMRI and across development to progress understanding of coupling in relation to youth psychopathology and determine if there are any disorder-specific alterations.

M7. STABILITY OF RESTING-STATE FUNCTIONAL CONNECTOME OVER YEARS PREDICTS ATTENTION IN YOUTH.

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Background: The ability to sustain attention is vital to nearly every aspect of daily life. Yet, overall attentional abilities differ greatly between individuals and changes across the lifespan. Moderate-to-severe persistent impairments in attention are characteristic in attention-deficit/hyperactivity disorder (ADHD). Youth with ADHD face higher risks of poor school performance and premature death. Whole-brain functional connectivity (FC) has been used to predict individual differences in processes including attention (Rosenberg et al, 2016). These FC patterns are reliable and unique at an individual level. Recent work by Corriveau and colleagues has shown that the stability of functional connectomes during task and rest can be used as markers of cognitive performance, such that adults who perform better on sustained attention tasks have more stable functional connectivity patterns across minutes and days. Cross-sectional studies have shown that youth connectomes become increasingly stable and distinct with age and that youth with increased general psychopathology show a marked delay in connectome distinctiveness compared to healthy individuals (Kaufmann et al, 2017). However, it is unclear whether within-subject stability across years is related to clinical symptoms or attention function across development.

Methods: Here, we investigated whether FC stability within individuals across years can serve as a developmental marker of inattention indexed by Child Behavior Checklist DSM5-oriented Attention-deficit/Hyperactivity symptom (CBCL-ADH) scores and 0-back task performance. Using the Adolescent Brain Cognitive Development (ABCD) Study, FC matrices for Baseline (age 9-10) and Year 2 Follow Up (age 11-12) were calculated for each usable resting-state fMRI run (mean frame-to-frame head displacement < 0.2 mm). Whole-brain and network-level stability were calculated within individuals (N = 1109) by calculating the Pearson correlation between resting-state FC patterns at age 9-10 and age 11-12 for the same participant. Raw CBCL-ADH scores were averaged across three consecutive collected years from age 9-12. Task performance was averaged between two imaging timepoints. A linear mixed-effects model was fit to examine the relationship between CBCL-ADH scores or 0-back performance and within-subject brain network stability, while controlling for head motion at each year, sex, age, and site.

Results: The standardized beta coefficients revealed significant associations between attention function and functional connectome stability, suggesting that youth with more stable connectomes have lower average ADHD symptoms ($\beta = -0.12$, $p < 0.05$) and better sustained attention task performance ($\beta = 0.11$, $p < 0.05$). Network-level analysis demonstrated that higher within-network stability in the medial frontal, frontoparietal, motor, and visual association networks—but not the default mode, subcortical-cerebellum, visual I, visual II networks—are significantly associated with lower mean ADHD symptoms in youth. Higher stability across years within the medial frontal, frontoparietal, and default mode network significantly predicted average 0-back performance.

Discussion: Youth with more stable patterns of functional brain organization at rest from age 9-10 to 11-12 show better sustained attention task performance and lower attention-related clinical symptoms. The findings are consistent with cross-sectional work demonstrating that greater FC stability is associated with better attentional performance in adults and that FC stabilization is delayed in youth with clinical diagnoses.They also align with the idea that features of the pediatric functional connectome predict clinically relevant cognitive performance across time at the individual level. We speculate that the same processes that support the stability of the connectome support sustained attention function in development. Future research could reveal the trajectory of connectome stability as it is related to attentional development.

M8. MOTOR PERFORMANCE AND FUNCTIONAL CONNECTIVITY BETWEEN MOTOR AND ATTENTION-MODULATING NEURAL NETWORKS IN ADOLESCENTS CLINICALLY RECOVERED FROM CONCUSSION AND CONTROLS

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Background: Adolescents clinically recovered from concussion (mTBI) continue to show subtle deficits in motor performance, which may contribute to increased risk for reinjury and repeat concussion. Previous work has found a relationship between functional connectivity (motor and attention network synchrony) and performance on an out-of-scanner subtle motor examination. We examined whether this association persisted with an in-scanner finger tapping motor task.

Methods: Our sample consisted of 56 adolescents ages 10-17 (M_age=13.77, SD=2.55, Male=50%), of which 19 were within 6 weeks from their clinical recovery from a concussion (mTBI group), and 37 were typically-developing, never-concussed participants (control group).

Participants underwent a functional MRI scan consisting of a 9-minute finger tapping motor task and a 6.5-minute resting state scan. During the motor task, participants tapped their fingers to their thumb in sequence for 8 blocks of 45 seconds each (with 20 seconds of rest between blocks). Finger tapping performance was evaluated by the number of errors (out-of-sequence taps).

Low motion functional MRI data (task and rest) were concatenated, and functional connectivity between the somatomotor (SomMot) network and the dorsal attention (DAN) and default model (DMN) networks were calculated using the Schaefer-Yeo 7-Network atlas (M_scan time=14.47mins, SD=2.57, M_framewise displacement=0.32mm, SD=0.25).

Associations between demographic variables (age, sex, race, group, maternal education, advanced sport participation status) and finger tapping and connectivity were examined. The relationships between finger tapping errors and connectivity were analyzed using Spearman correlations with the whole sample and separately by group. We also ran multiple linear regressions to investigate the interaction between group (mTBI vs. control) and connectivity (separate models for SomMot-DAN and SomMot-DMN) on finger tapping performance, controlling for age, due to age being significantly associated with connectivity and errors.

Results: Among demographic factors, only age was significantly related to finger tapping errors (ρ=–0.42, p=0.001) and SomMot-DMN connectivity (ρ=–0.28, p=0.039), such that errors and connectivity decreased with age.

Finger tapping errors were significantly correlated with both SomMot-DAN (ρ=0.29, p=0.03) and SomMot-DMN (ρ=0.32, p=0.015) connectivity, such that greater synchrony was associated with more errors. These relationships persisted in the control group (for errors with SomMot-DAN, ρ=0.39, p=0.016; with SomMot-DMN, ρ=0.43, p=0.009), but not among mTBI participants (all $p > 0.9$). However, in the multiple linear regressions controlling for age, there were only significant main effects of age and connectivity on finger tapping performance (all $p < 0.05$). The interaction between connectivity and group approached significance in both models (p=0.105 for SomMot-DAN*group, p=0.088 for SomMot-DMN*group).

Discussion: There was a significant association between motor accuracy on an in-scanner finger tapping task and functional connectivity between SomMot-DAN and SomMot-DMN, which may have been driven by a relationship in Control participants but not in those recently recovered from a concussion. Our findings align with previous work which found that more synchrony between motor regions and DAN and DMN was associated with worse performance on an out-of-scanner motor task designed to detect subtle motor deficits.

Longitudinal studies are needed to understand how brain connectivity and motor performance change after clinical recovery from concussion. Furthermore, task-related fMRI analyses can identify differentially activated regions in recently-concussed adolescents performing a motor task compared to their never-concussed peers. These lines of work would further our understanding of which brain regions and networks influence subtle motor performance, a domain known to show lasting deficits even after clinical recovery from concussion.

M9. CANONICAL NEURODEVELOPMENTAL TRAJECTORIES OF STRUCTURAL AND FUNCTIONAL MANIFOLDS**

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Background: Organisational gradients refer to a continuous low-dimensional embedding of brain regions, grouped based on similarity to an independent variable. These gradients can quantify core organisational principles of complex systems like the human brain.

Methods: Taking a developmental approach and leveraging longitudinal and cross-sectional data from two multi-modal neuroimaging datasets, spanning the full neurotypical-neurodivergent continuum, we charted the organisational variability of structural (N = 887) and functional (N = 728) gradients, across childhood and adolescence (6-19 years old).

Results: Across datasets, despite differing phenotypes, we observe similar structural and functional gradients, indicating universal principles of brain organisation. By modelling developmental trajectories as non-linear splines, we show that structural and functional gradients are established early in life, exhibit statistically sensitive periods, persist throughout childhood and adolescence, and are refined across development, indicating universality. Specifically, structural gradients gradually contract in low-dimensional space as networks become more integrated, whilst the functional manifold expands, indexing functional specialisation. Coupling of these gradients follows a unimodal-association axis and varies across individuals, with developmental effects concentrated in late-developing plastic higher-order networks. Finally, we mapped structure-function coupling onto dimensions of psychopathology and cognition and demonstrate that coupling is a robust predictor of dimensions of cognition, such as working memory, but not psychopathology.

Discussion: In summary, using a big data multi-cohort approach, we demonstrate universal axes of structural and functional brain organisation, with structural integration and functional segregation across youth. These are established early in life, and refined through development. Individual differences in the alignment of structural and functional axes predicts dimensions of behaviour, specifically working memory, across development and phenotypes.

****Flash Talk**

M10. DIFFERENCES IN FRONTOLIMBIC CONNECTIVITY IN ADOLESCENTS WITH PRENATAL CANNABIS EXPOSURE: A LONGITUDINAL ANALYSIS FROM THE ABCD STUDY

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Background: Prenatal cannabis exposure (PCE) continues to increase against the Background: of increasing social acceptance and legalization of recreational use across the US. Emerging evidence suggests PCE is associated with altered hippocampal connectivity in the fetus, an area rich in cannabinoid receptors during fetal development. Additionally, reports using the Adolescent Brain Child Development Study data demonstrate decreased fractional anisotropy (FA) in the bilateral fornix in 9-10 year olds with PCE. Although decades of research suggest correlations between PCE and neurobehavioral differences in offspring, pregnant individuals continue to express uncertainty about the potential harm posed by prenatal cannabis use. Further, there remains a lack of evidence of the mechanisms by which PCE impacts later behavior. Thus, continued efforts to understand the longitudinal effects of PCE are imperative. The objective of this study is to assess longitudinal associations between PCE and neural connectivity in the frontolimbic white matter tracts.

Methods: To account for unmeasured ways those who use cannabis during pregnancy and those who do not may differ, we chose a case-control study design with 2 control groups. Those in the exposure (PCE) group included all participants with PCE after the knowledge of pregnancy. Both controls were matched on age, sex, parental education and income. The first control group was also matched on prenatal tobacco and alcohol exposure; the second had no prenatal drug exposure. FA of the frontolimbic white matter tracts (fornix, anterior thalamic radiations, parahippocampal cingulum, and uncinate) was compared across the baseline and 2 year time points using linear mixed effects regression. Covariates included parental psychopathology, measured by the ASEBA total problems score, age, sex, puberty as well as sex*puberty interaction. The inclusion of non-linear age terms, and adolescent substance use were evaluated. Site and MRI ID were included as random effects. All results include false discovery rate correction.

Results: Two hundred twenty-four ABCD participants (3%) were exposed to prenatal cannabis after the knowledge of pregnancy. Of this PCE group, the average age at baseline is 118 months (9.8 years), 57% are female, 25% had concurrent prenatal alcohol exposure and, 49% had concurrent tobacco exposure. Control groups were well matched across the intended variables across both time points. Age range across both time points was broad (107 -163 months), and mean age at 2 year follow up was 143 months (11.9 years). In longitudinal analyses of the 8 ROIs, the bilateral fornix demonstrated significantly lower FA in those with PCE compared to both control groups in uncorrected analyses. After FDR correction, FA differences in the left fornix remained statistically significantly. Visualization of model-predicted FA demonstrate decreased FA over time in all comparison groups with the PCE group having lower FA at each age. There were no differences in FA in the other frontolimbic tracts.

Discussion: These data suggest that PCE is associated with sustained differences in the white matter integrity of the fornix compared to those who have no prenatal exposures and those who have only alcohol/tobacco exposure. The difference in FA compared to controls is consistent across the age range included in the study, suggesting the impact of PCE is likely to be first realized prior to age 9. Prior studies indicate the fornix is one of the first white matter tracts to reach peak FA in adolescence prior to decreasing into adulthood. Therefore, this pattern could represent an

advanced maturation or advanced aging mechanism in those children with PCE. Alternatively, it could represent a prenatally programmed difference in development of this structure. Further studies of early childhood would aid in understanding the full developmental trajectory and the impact of PCE on fornix development.

M11. FUNCTIONAL CONNECTIVITY BETWEEN THE NUCLEUS ACCUMBENS AND AMYGDALA UNDERLIES AVOIDANCE LEARNING DURING ADOLESCENCE: IMPLICATIONS FOR DEVELOPMENTAL PSYCHOPATHOLOGY

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Background: Reward and threat processes work closely together to support adaptive learning during development. Adolescence is associated with increasing approach behavior (e.g., novelty-seeking, risk-taking) but often also coincides with emerging anxiety and depression symptoms, which are characterized heightened avoidance behavior. Peaking engagement of the nucleus accumbens (NAcc) during adolescence, often studied in reward paradigms, may also relate to threat mechanisms of adolescent psychopathology.
Methods: 47 typically developing adolescents (9.9 to 22.9 years) completed an aversive learning task during functional magnetic resonance imaging, wherein visual cues were paired with either an aversive sound or no sound. Task blocks involved an escapable negatively reinforced stimulus (CS+r), the same stimulus without reinforcement (CS+nr), or a stimulus that was never reinforced (CS-). Parent-reported internalizing symptoms were measured using Revised Child Anxiety and Depression Scales.
Results: Functional connectivity between the NAcc and amygdala differentiated the stimuli (p=.013), such that connectivity increased for the reinforced stimulus (CS+r) but decreased for the nonreinforced stimuli (CS+nr, CS-). Adolescents with greater symptoms tended to exhibit heightened functional connectivity for the CS- (p=.037).
Discussion: Adolescents show heightened NAcc-amygdala functional connectivity during escape from threat. Higher anxiety and depression symptoms were associated with elevated NAcc-amygdala connectivity during safety, which may reflect poor safety versus threat discrimination.

M12. STATISTICAL PROPERTIES OF FCMRI ENRICHMENT ANALYSIS

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Background: Brain-behavior association studies are important for exploring underlying neurobiology and phenotypic variability. Brain-wide approaches to these are often needed for

behaviors and ages without well understood functional correlates. Mass univariate testing on functional connectivity MRI (fcMRI) data suffers from difficulty achieving experiment-wide significance. Adapted from genomics, enrichment analysis provides a method for decreasing dimensionality and increasing statistical power. Enrichment analysis has been useful in analyses exploring autism-relevant behaviors, such as joint attention (Eggbrecht 2017), repetitive behaviors (McKinnon 2019), and motor development (Marrus 2018). However, there has not yet been an examination of the robustness or statistical power of this method for fcMRI data, which is vital for designing well-powered future brain-wide association studies (BWAS).

Methods: We estimate the statistical power of enrichment analysis for detecting correlations between fcMRI and behavior for various network-pairs, sample sizes, and correlation effect sizes. We compare the statistical power of enrichment analysis to that of comparable univariate analysis. We assess the robustness of permutation testing for significance assessment.

Enrichment analysis consists of mass univariate screening over functional connections between regions-of-interest (ROI) pairs, followed by synthesizing the screening statistics within a network-pair into an enrichment statistic. Statistical significance is computed through permutation testing.

We generated simulated connectivity/behavioral data using resting-state fcMRI and behavioral data from school-aged participants of the Infant Brain Imaging Study (IBIS), a longitudinal study of brain and behavior development in infants at high- and low-familial likelihood for ASD. There were 144 subjects (92 high-likelihood) with behavior data, and 121 subjects (78 high-likelihood) with fcMRI data. ROIs and network labels are derived from the 300ROISet atlas (Seitzman 2020).

To determine the robustness of permutation testing for significance assessment, we computed the false positive rate for enrichment analysis on simulated datasets using thresholds determined by permutation testing for a target significance (p=1e-4).

To estimate statistical power, we applied enrichment analysis to data simulated with a similar covariance structure as the observed data plus an embedded connectivity/behavior effect. We compared the statistical power of enrichment analysis to univariate analysis, for a variety of network-pairs, effect sizes and SDs, and sample sizes.

Results: Enrichment analysis outperforms univariate analysis in most instances, though it was not suitable for smaller network-pairs (< 50 ROI-pars). Permutation testing for significance assessment appears robust. The observed false positive rate using the significance cutoffs derived from permutation testing, using a target of p=1e-4 was 0.9e-4 (SD 0.3e-4)

Discussion: To lay the groundwork for future fcMRI enrichment analysis studies, we validated the robustness of permutation testing for significance assessment and established Methods: for conducting power analyses. We've shown that enrichment analysis is well-powered at sample sizes that are under-powered for univariate analysis, enabling well-powered BWAS. More work is needed to expand enrichment analysis to smaller network-pairs, and to extrapolate from power at the network-pair level to brain-wide power.

M13. ASSOCIATIONS BETWEEN ADOLESCENTS' EXPERIENCE OF VICTIMIZATION AND WHITE MATTER CONNECTIVITY

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Background: Youth victimization encompasses a broad domain of exposure to violence, crime, bullying, and abuse. Heterogeneity in the experience of victimization could differentially shape children's white matter connectivity implicated in emotional processes. Previous literature has predominantly focused on abuse and neglect in children's rearing environments and cumulative evidence highlights specific white matter tracts—such as the left anterior thalamic radiation (ATR), bilateral fornix, inferior longitudinal fasciculus (ILF), inferior fronto-occipital fasciculus (IFOF), and the corpus callosum (CC)—as significantly associated with child maltreatment. This study extends existing research by considering a broader range of victimization experiences, including within the home, school, and community environments, and their associations with white matter connectivity.
Methods: Participants were 2,420 youth aged 9 to 15 years (47.32% girls) from the Social Development substudy of the Adolescent Brain Cognitive Development (ABCD) Study. We first conducted exploratory factor analysis (EFA) of the Juvenile Victimization Questionnaire (JVQ) to identify domains of victimization experiences. Next, we conducted linear mixed effects models in 1,418 participants with neuroimaging data to assess associations between victimization and fractional anisotropy (FA) in the left and right hemispheres of the ATR, fornix, ILF, IFOF, respectively, and the CC. Models accounted for nesting (families within sites within MRI scanners) and were adjusted for age, sex, household income, and parental education.
Results: EFA of the JVQ consistently identified three factors across scree plot, parallel analysis, and very simple structure after dropping five items with low loadings or conceptual misalignment: (1) direct physical violence exposure, (2) indirect exposure to violence, and (3) peer bullying. Linear mixed effect models indicated significant associations between the frequency of direct physical violence exposure (but not indirect exposure or peer bullying) and lower FA in the right IFL, right IFOF, and the CC, after adjusting for covariates and Bonferroni correction.
Discussion: We confirmed previous evidence of associations between maltreatment and white matter connectivity in a large sample of youth. Extending previous research to specific domains of victimization, we found that more frequent experiences of direct physical violence were associated with a lower FA in key white matter tracts implicated in emotional processes. The ILF serves as a ventral associative tract that facilitates dynamic communication between visual regions and the amygdala and hippocampus. The amygdala and hippocampus in turn provide modulatory feedback to the occipital lobe to augment emotionally relevant information in early visual stimuli. The IFOF links ventral occipital and posterior temporal-basal regions to the frontal lobe, which is implicated in the top-down regulation of sensory input. Both the ILF and IFOF play a critical role in recognizing and integrating facial expressions with emotional responses. This visual-emotional circuitry is crucial in detecting and responding to threats. Altered white matter connectivity in fronto-amygdala-occipital pathways could underlie difficulties integrating visual input and regulating cognitive or emotional responses among youth who have experienced direct physical violence. Lastly, the CC is the brain's most significant commissural pathway. Altered WM connectivity could indicate a disrupted exchange of information between the brain's hemispheres, essential for advanced emotional and cognitive functions.

M14. CHILDREN WITH FAMILIAL HISTORY OF DYSLEXIA EXHIBIT FUNCTIONAL BRAIN DIFFERENCES: A META-ANALYSIS OF FMRI STUDIES

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Background: Dyslexia is a heritable and highly prevalent neurocognitive condition, affecting approximately 20% of the population. Structural and functional MRI studies have suggested that individuals with a family history of dyslexia display disruptions to a core network of left lateralized, language related brain regions. While several studies have investigated the neurobiological origin of these brain differences, findings remain somewhat inconsistent. This meta-analysis synthesizes functional brain differences in pre- and emerging-readers with a familial history of dyslexia (FHD+) relative to those without a family history of dyslexia (FHD-).
Methods: A systematic literature search of PubMed, SCOPUS, and Web of Science was conducted in February 2024 to identify primary research studies using whole-brain, functional MRI (fMRI) during reading and language tasks in 4-11-year-olds with and without a family history of dyslexia. Using the PRISMA Framework, two raters independently screened 1,448 studies for eligibility. Using the meta-analytic tool GingerALE 3.0.2, ten studies were analyzed using a voxel-level threshold of $p < 0.001$ (uncorrected) and a cluster threshold ≥ 150 mm3.
Results: Two separate analyses were run in GingerALE. Results of the FHD- > FHD+ contrast identified significant clusters ($p < 0.001$) in primary visual cortex [18, -86, 8], caudate [16, 8, 16], superior temporal sulcus [52, -16, -16], primary auditory cortex [-34, -30, 20], left cerebellum [-26, -78, -28], and primary motor cortex [54, -6, 20]. Results of the FHD+ > FHD- contrast identified one significant cluster ($p < 0.001$) in dorsolateral prefrontal cortex [38, 32, 22].
Discussion: We conducted a systematic literature search and then performed a quantitative meta-analysis of research studies (n = 10) examining functional brain differences in pre- and emerging-readers with and without a family history of dyslexia. Results of this meta-analysis suggest that children with a familial history of dyslexia exhibit decreased activation in brain regions responsible for sensorimotor processing, and increased levels of brain activity in the dorsolateral prefrontal cortex during reading and language tasks relative to their FHD- peers. These findings suggest that reduced engagement of brain regions responsible for sensorimotor integration and compensation via executive control processes may be key features of reading and language differences in children with a family history of dyslexia.

M15. EXPLORING NEURAL CORRELATES OF METACOGNITIVE MONITORING IN LIFE SCIENCE THROUGH A LONGITUDINAL MIXED METHODS: STUDY

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Background: Metacognition refers to the ability to monitor and control one's own cognitive processes, including planning, monitoring, and evaluating one's understanding and performance (Flavell, 1979; Lai, 2011). One branch of metacognition is metacognitive calibration, which pertains to the accuracy with which individuals assess their own knowledge and understanding (Pieschl, 2009). Increased autonomous learning among undergraduate life science students plays a particular role in effective metacognitive calibration and self-monitoring. For example, metacognitively aware students may proficiently detect biological errors in models and evaluate the models more accurately than students who are less metacognitively aware. Additionally, regions of the prefrontal cortex (PFC)—particularly the anterior PFC (aPFC), dorsolateral prefrontal cortex (dlPFC), and anterior cingulate cortex (ACC)—are implicated in metacognitive processes such as error detection and cognitive control (Baird et al., 2013; Fleming et al., 2012; Fleming and Dolan, 2012). This interconnected network of brain regions underscores the

complexity of metacognition and suggests its potential as a predictor for academic success (Fleming and Dolan, 2012).

Methods: Despite the recognized importance of metacognition in STEM education, longitudinal studies exploring the stability of metacognitive monitoring and error detection are conspicuously scarce. This void in the literature hampers our comprehension of the developmental trajectory of these cognitive processes and their enduring impact on STEM education outcomes. Therefore, our explanatory convergent mixed methods study aims to address the gap in the longitudinal research on metacognitive calibration in STEM education by investigating how students' self-monitoring and error detection abilities develop over time, particularly in the life sciences. In this study, 50 participants viewed and evaluated a series of biology models and determined whether each model contained an error while, concurrently, rating their confidence in their responses for each model. One year later, a subset of 44 participants from timepoint 1 returned for a follow-up interview session in which they were instructed to view and evaluate biological models and systems and explain their understanding of the model structures and relationships to ascertain their level of content knowledge. This longitudinal study will enable us to draw accurate inferences about students' neural and behavioral performances, helping us to understand the metacognitive skills needed to evaluate biology models and to determine the stability of students' metacognitive monitoring over a year.

Results: We will investigate how students' neural responses from timepoint 1 are linked to their longer-term metacognitive abilities, offering a holistic understanding of metacognitive calibration within STEM education. We hypothesize that students will demonstrate an observable increase in metacognitive skills as they engage with biological models over a year. We also expect increased self-awareness and refined self-monitoring mechanisms to manifest in timepoint 2 relative to timepoint 1, reflecting a heightened ability to assess and regulate cognitive processes over time. Furthermore, findings may reveal that the neural correlates of metacognition from timepoint 1 can predict behavioral performance at timepoint 2. Such changes are likely to align with students' enhanced proficiency in error detection and adjustment of metacognitive strategies.

Discussion: In general, our study bridges the gap in longitudinal research on metacognitive calibration in life sciences education and offers a comprehensive exploration of students' neural responses, metacognitive monitoring, and knowledge retention. Our study contributes meaningfully to the broader discourse on metacognition in STEM education, offering practical implications for instructional strategies to promote student achievement in STEM disciplines.

M16. EXPLORING BEHAVIORAL AND NEURAL CORRELATES OF SOCIAL INFLUENCE WITHIN DIGITAL CONTEXTS

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Background: Adolescence is characterized by increased sensitivity to social contexts and greater susceptibility to social influence, particularly from peers. The development of rapidly changing social media platforms with unique affordances have altered how adolescent social interactions occur in the modern age. Social media's near-constant accessibility and quantifiable feedback metrics (i.e. likes, followers, etc.) which arrive at variable reinforcement schedules may be augmenting the value of peer feedback thereby prompting greater social influence behaviors

among users. Simultaneously, adolescents experience significant neurobiological changes including heightened sensitivity to social rewards which may further impact how youth perceive and react to digital social influences. The present study aims to examine how adolescents respond to peer influence on a novel, ecologically valid fMRI task co-designed with a youth advisory board to replicate the features of a digital media platform.

Methods: Adolescent participants (N = 49, Mage = 16.96, SDage = 0.54, boys = 49.0%, girls = 46.9%, nonbinary = 4.1%, Black = 32.7%, Latinx = 32.7%, White = 30.6%, Multiracial = 4.1%) were asked to rate images of ostensible peers on a simulated social media platform every day for two weeks. Subsequently, they completed a social media fMRI task during which they were shown the same images they saw during the two-week period, this time accompanied by the rating of an ostensible high, average, or low status peer, and asked to re-rate the image. The ratings of the peers were manipulated to either differ from the participants' original rating (i.e., social influence trial) or be the same (i.e., no influence trial). Data is currently being co-analyzed and co-interpreted with an adolescent researcher via a cyclical and iterative process.

Results: Preliminary analysis revealed that adolescents changed their ratings significantly more on influence trials, than on noninfluence trials ($f(1) = 4.36$, $p = 0.038$). However, peer influence did not differ based on peer status ($f(2) = 0.17$, $p = 0.843$) suggesting that adolescents are experiencing digital social influence but this may not be primarily driven by peers' status. Next, we will explore the neural correlates of digital social influence by examining functional connectivity with a ventral striatum seed region and regions of interest within social cognitive (mPFC, TPJ/pSTS) and cognitive control (lPFC) during influence and noninfluence trials. Given prior literature, we predict greater activation within reward related brain regions will be coupled with activation of social cognition and cognitive control brain regions more strongly in influence trials compared to noninfluence trials.

Discussion: This study integrates youth voices into developmental neuroscience research to increase our understanding of how adolescent social influence behaviors may be taking place in digital contexts and contribute to our growing knowledge regarding the impact of social media on the developing brain.

M17. ON THE MATURATION OF CORTICAL BODY REPRESENTATIONS IN THE FIRST MONTHS AFTER BIRTH

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Background: The primary somatosensory cortex (SI) plays a major role in our ability to perceive and use our body to interact with our environment (e.g., locomotion, grasping) and others (e.g., speech, writing). Since the seminal work of Penfield and Boldrey (1937), the last thirty years of sensorimotor research focused primarily on its functional characterisation in adult individuals. However, recent studies comparing individuals who lost a hand at different developmental stages (Hahamy et al, 2017) re-emphasised the crucial role of early development in determining sensorimotor organisation, large-scale plastic changes being observed after atypical development. Interestingly, recent work revealed the presence of distributed representational content throughout

the adult SI (Muret et al, 2022), with the ability to decode actions performed by a body part (e.g., foot) in remote parts of SI (e.g., face region). This normally hidden activity could explain the atypical organisation observed in previous studies. However, very little is known about how SI maps and their representational content evolve in the first months after term birth. Only a handful of neuroimaging studies reported the existence of proto-maps in preterm neonates and 7mo infants (Meltzoff et al, 2018; Dall'Orso et al, 2018).

Methods: We aimed to address this gap by scanning (3T functional MRI) typically-developing full-term infants at 1 month (n=13 out of 21 included) and 3 months of age (n=15 out of 22 included). Whenever possible infants took part in both sessions (n=9 out of 18 tested on both sessions). All infants received soft tactile stimulation on 3 body parts (i.e., the cheek, hand and foot) on the right side, during EPI functional imaging (Multiband, acceleration factor = 2, TR = 2.2s, TE = 40ms, resolution: 2x2x2mm). A block design with 8s of stimulation interleaved with 7s of rest was used. An anatomical axial T2-weighted image was acquired to obtain the detailed anatomy of each infant's brain (GRAPPA, acceleration factor 2, TR = 4.2s, TE = 149ms, resolution: 0.8x0.8x2mm). Infants were naturally asleep during recording. A variable number of data was collected for each infant depending on their sleep duration (6 to 24 blocks per condition). Three regions of interest in each hemisphere (supposed to house respectively the representation of the leg, hand and face) defined based on anatomical landmarks were used to perform classical univariate fMRI analyses (i.e., selectivity profiles, winner-takes-all maps, group maps) but also multivariate analyses allowing to quantify representational content.

Results: Preliminary univariate group maps obtained from 11 1- and 3-mo infants confirmed the expected topographical organisation with the feet represented most medially and the face most laterally. Further analyses will aim to quantify individual's profiles of i) univariate selectivity and ii) multivariate representational content across regions of interest, hemispheres and age.

Discussion: This unique dataset combined with state-of-the-art analyses will provide the first evidence of the development of body representations in the first months of life.

M18. HEMISPHERIC ASYMMETRY IN CHILDREN WITH ADHD AND ANGER OUTBURSTS: THE PUTATIVE ROLE OF PARIETAL REGIONS

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Background: There has long been an understanding that while the brain's anatomical structures are symmetrical across hemispheres, the functions of these regions and their activity level at rest are often asymmetric. Research primarily conducted using resting electroencephalogram (EEG) suggests that such asymmetry may be associated with specific emotions (Davidson, 1993; Heller, 1990, 1993). Prominent theories suggest that greater left prefrontal brain activity is associated with positive affect and approach motivational tendencies, while greater right prefrontal activity is associated with negative affect and withdrawal tendencies. The emotion of anger poses a unique challenge to this, as it is a negatively valenced emotion involving approach motivation. Many studies have found that greater left-than-right frontal activity is associated with anger (Harmon-Jones and Allen, 1998; Harmon-Jones and Sigelman, 2001; Stewart et al., 2008). In addition to theories involving prefrontal regions, research suggests that asymmetry in parietal brain areas may be associated with emotionality. Specifically, lower right-than-left parietal activity has been associated with depression and low arousal (Bruder et al., 1997; Stewart et al., 2011). The present

study aimed to examine cortical asymmetry in children exhibiting a range of anger in the form of severe temper outbursts. Because EEG studies of asymmetry associated with anger have shown that greater left-than-right activity is associated with anger, it was hypothesized that participants with such outbursts would show greater left-sided frontal asymmetry than those without. Further, since anger is a high-arousal emotion, it was hypothesized that participants in the temper outburst group would show greater right-than-left parietal activity.

Methods: Participants were 160 children (ages 5-9) from an NIMH-funded study recruited across three groups: children with severe temper outbursts and Attention-Deficit/ Hyperactivity Disorder (ADHD), children with Attention-Deficit/ Hyperactivity Disorder (ADHD) but without temper outbursts, and a healthy control group. Parents completed interviews and questionnaire measures of their child's emotions and behaviors. Resting-state functional magnetic resonance imaging (fMRI) scans were obtained for all participants.

Hemispheric asymmetry was assessed using fractional amplitude of low-frequency fluctuation (fALFF). Studies conducted on hemispheric asymmetry in anger have largely relied on EEG data; however, recent studies suggest that hemispheric asymmetry can be examined using fALFF as a measure of spontaneous brain activity (He et al., 2022; Liu et al., 2022; Romeo et al., 2022; Zou et al., 2008). The study relied on fALFF because it is comparable to resting-state EEG (Morys et al., 2020).

Results: Regions in the frontal and parietal areas were isolated, and a measure of asymmetry was calculated ([L-R]/L+R]) based on previous studies (Morys et al., 2020). Preliminary analysis of variance Results: between groups showed no significant differences for any frontal regions. Significant differences were found between groups for parietal regions. Further examination using mixed analysis of variance showed that the difference between groups in the parietal region was mostly due to a reduction in asymmetry in the ADHD and temper outburst groups compared to the control group.

Discussion: While these findings do not support the study hypotheses, additional analyses are currently being conducted to further dissociate emotional (anger) and behavioral (ADHD) symptoms and their associations with fALFF asymmetry. This is the first study to examine hemispheric asymmetry using fALFF in a child sample in relation to ADHD and associated emotions and has the potential to inform future work. In such, further analysis will also help to understand the relationship between EEG and fALFF and whether they are capturing the same functional phenomena.

M19. BOLD SIGNAL VARIABILITY AND BRAIN DYNAMICS ASSOCIATED WITH ANXIETY SYMPTOMS ACROSS THE LIFESPAN

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Background: Anxiety disorder (AD) is the most prevalent mental health disorder from childhood to adulthood [1], with symptoms typically appearing around age 11 [2] and ranging from subclinical to full-blown symptoms. Pediatric and adolescent anxiety predicts adulthood anxiety [3]. Recent neuroimaging literature suggests links between brain signal variability (BSV) and psychiatric disorders [4]. Despite BSV's significantly greater predictive power compared to conventional mean signal-based approaches and promising initial evidence for its measurement

reliability [5], no study to date has explored the relationship between BSV and anxiety symptoms across the lifespan. The current study used root mean square successive difference (rMSSD) to quantify BSV by calculating the variability between successive time points of the BOLD signal [6]. Gaining insights into age-related changes in BSV and its correlation with anxiety symptoms is imperative for identifying neural markers of anxiety at early stages.

Objective:

To examine the associations between BSV and anxiety symptoms, with the aim to identify neural markers of anxiety across the lifespan.

Methods: We analyzed resting-state fMRI data from 601 subjects in the Enhanced Nathan Kline Institute Rockland Sample [7]. Participants completed self-report measures and a structured clinical interview (DSM-IV-TR Axis I Disorders—Non-Patient Edition). Inclusion criteria were the availability of neuroimaging and behavioral data and resting-state fMRI data with head motion < 0.5 mm. Our final analysis included 575 participants (60% female), aged 8 - 85 years. Anxiety levels were assessed using the Multidimensional Anxiety Scale for Children (MASC) for those under 18 and the State-Trait Anxiety Index (STAI-trait) for adults.

The fMRI data preprocessing involved removing the initial five frames, despiking, realignment, normalization, and smoothing (6 mm FWHM). Additionally, ICA-FIX [8] was applied followed by nuisance regression, motion correction, and bandpass filtering (0.01–0.10 Hz).

Time series data were normalized to z-statistics before calculating voxel-wise rMSSD. Ordinary least squares regression in FSL analyzed subject-level rMSSD maps as dependent variables and anxiety scores as the independent variable, controlling for covariates such as linear age, sex, and head motion. Additional analyses controlled for quadratic age and explored interaction effects between anxiety and linear age and anxiety and quadratic age.

Results: Accounting for both linear and quadratic age effects revealed a positive association (voxel-wise uncorrected, $z = 2.3$ and 3.3; cluster-wise corrected, $p < 0.05$) between linear anxiety scores and BSV across various brain regions. These regions include the pre-central (PrCG) and post-central gyrus (PoCG), insula, medial temporal gyrus, and opercular cortex. Additionally, an interaction effect between anxiety and linear age in the lingual gyrus suggested increased BSV with age among individuals with higher anxiety, while an inverted U-curve relationship was observed in anxiety x quadratic age interaction effects in the PrCG, PoCG, paracingulate gyrus, and anterior cingulate gyrus as compared to individuals with mid- and low-anxiety. The categorization of anxiety scores was solely for visualization purposes.

Discussion: Our study uncovers intricate associations between anxiety and BSV across the lifespan, emphasizing the dynamic interplay among anxiety, age, and neural dynamics. We found a significant association between BSV and anxiety in brain regions associated with sensorimotor, salience, default mode, and cingulo-opercular networks. These brain areas may reflect symptoms like heightened bodily sensitivity, altered interoceptive processing, emotional dysregulation, and difficulty processing external information [9–13]. These findings emphasize the importance of considering developmental factors to understand the neurobiology underlying anxiety symptoms.

M20. CHARACTERIZING THE DEVELOPMENTAL TRAJECTORY OF TWITCHING DURING NON-REM SLEEP IN HUMAN INFANTS

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Background: Twitches are brief discrete movements that are characteristic of rapid eye movement (REM) sleep. These movements are generated by the brainstem and provide sensory feedback to sensorimotor structures throughout the brain, thereby contributing to the development of somatotopic maps and internal models. Recently, our lab made the surprising discovery that twitches also occur during non-REM sleep in human infants, beginning around 3 months of age, with the rate of non-REM twitching increasing over the next few months (Sokoloff et al., Current Biology, 2021). In addition, we found that the emergence of non-REM twitching occurs just after the emergence of sleep spindles over the sensorimotor strip and that individual twitches occur in synchrony with these sleep spindles. Spindles are associated with neural plasticity, suggesting that non-REM twitching may have a unique role in sensorimotor development. However, because we did not investigate infants over 6 months of age, we do not know the trajectory of non-REM twitching beyond that age. Specifically, does twitching continue to increase, level off, or decline? Understanding this trajectory and its timing could provide valuable insight into the neural substrates of motor control across early infancy. Preliminary data from our lab suggests that non-REM twitching is still present in children up to at least 30 months of age. However, data from this study did not use EEG to investigate the brain activity occurring during these twitches.
Methods: In the present study, we will investigate twitching during daytime naps in the sleep lab in children 0.5 to 4 years of age. An EEG sensor cap sized to the circumference of the child's head will be used. Eye movements will be measured using two EOG electrodes placed near the child's eyes. Cortical EEG is recorded continuously using the EGI 32-channel HydroCel geodesic sensor net connected to a Net Amps 200 Amplifier. EEG and EOG data will be acquired at 1000 samples/s. A video camera and infrared light will provide a frontal view of the child to record the movements of the face, head, and limbs. Infrared video data will be recorded at 30 frames/s. Recordings will continue for as long as the child remains asleep.
Results: Twitches will be scored by two independent raters using methods previously developed (Sokoloff et al., 2021). First, wake periods, startles and arousal will be identified and only periods of sleep will be scored for twitches. Next, coders will score the data in multiple passes to identify twitches of the face, head, left and right leg, and left and right arm. When coders disagree, they will independently review the videos around the periods of disagreement and, when necessary, rescore the video before calculating a final inter-rater reliability statistic (Cohen's Kappa). Finally, coders will jointly make a final pass through the data record and all remaining discrepancies will be resolved by mutual agreement. EEG and EOG will be used to characterize sleep states following the AASM sleep scoring criteria. Sleep spindles with we identified during non-REM sleep using an automated detection algorithm (Sokoloff et al., 2021). We will use a linear mixed-effects model with age as a continuous variable to quantify the developmental trajectory of twitch rate in non-REM and REM sleep. Lastly, we will analyze the probability of sleep spindles occurring in relation a twitch. For each electrode we will calculate the probability that a sleep spindle occurred in a window of ± 20 s around a twitch.
Discussion: Investigating the typical developmental trajectory of spindles, twitching, and their coupling will help us better understand their role in sleep-dependent motor development.

M21. DOES FAMILIAL RISK OF DYSCALCULIA OR/AND DYSLEXIA IMPACT BRAIN ACTIVITY DURING A NUMERICAL MAGNITUDE COMPARISON TASK IN KINDERGARTENERS?

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Background: Previous research has consistently shown that familial risk of dyslexia (FHR+) is an early indicator of children's reading and brain development. However, little is known about the role of familial risk of dyscalculia (FHM+) in children's math and brain development. Furthermore, despite the high co-occurrence of reading and math difficulties, we do not know if and how familial risk of dyslexia (FHR+) affects children's math processing. Therefore, the goal of this study was to examine whether familial risk of dyslexia or dyscalculia affected children's behavioral and brain activation during a fundamental math skill task (i.e., numerical magnitude comparison) as early as kindergarten age. Addressing this question not only helps us understand the underlying mechanism of high co-occurrence of dyslexia and dyscalculia, but it can also inform parents and educators on whether additional math supports are needed for children with different familial risks prior to formal math education.

Methods: Seventy-six kindergarteners (42 female, mean age = 6.08, age range = [5.11, 6.85], age SD = 0.43) were included in this study. Of this cohort, 43 children had no familial risk of dyscalculia (FHM-) and 33 children had familial risk of dyscalculia (FHM+). In addition, 37 children had no familial risk of dyslexia (FHR-) and 39 children had familial risk of dyslexia (FHR+). All children completed an fMRI matching task with both a number matching condition, where children were asked to judge whether the non-symbolic dots and the symbolic digit matched in their quantity, and a shape matching condition, where children were asked to judge whether two shapes were identical. Children's brain activity for the basic numerical magnitude processing was extracted using the contrast of number > shape conditions. In addition to the fMRI task, children were also assessed with standardized testing including phonological awareness, working memory, and math skills.

Results: We observed that although children with a familial risk of dyscalculia (FHM+) showed lower math skills as measured by a standardized testing, including math concepts and calculation, they did not show significant behavioral or brain activation differences during the fMRI matching task. Additionally, we observed that although children with a familial risk of dyslexia (FHR+) showed lower phonological awareness as measured by a standardized testing, they did not show significant behavioral or brain activation differences during the fMRI matching task. The null brain findings on basic numerical magnitude processing were based on a stringent pre-registered threshold (voxel-wise $p < .0001$ and cluster-wise $p < .05$ FWE-corrected). However, when using a more lenient threshold (voxel-wise $p < 0.005$ and cluster-wise $k > 60$), we observed that children with a familial risk of dyscalculia (FHM+) showed less activation in the right parietal lobe and MTG than children without a familial risk of dyscalculia (FHM-). In addition, children with a familial risk of dyslexia (FHR+) showed less activation in the left parietal lobe than children without a familial risk of dyslexia (FHR-).

Discussion: Our Results: confirm that familial risk status negatively affects children's math (i.e., math concept and calculation) and pre-reading (i.e., phonological) skills as early as kindergarten age. More importantly, our findings suggest that brain activity during basic numerical magnitude processing is likely impacted by both familial risk of dyslexia and dyscalculia through different brain hemispheres. However, given the lenient threshold used and relatively small sample size, additional future studies are needed to replicate our observed effects.

M23. NEURAL AND COMMUNICATION PROFILES IN GROUPS AT ELEVATED RISK FOR ASD AND DD

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Background: Neural and communication profiles of children with Autism Spectrum Disorder (ASD) are very heterogeneous potentially due differences in etiology. One of the factors that can contribute to this variability is different risk factors for developing ASD. For example, language/communication skills differ between autistic children who had familial-risk for ASD compared to those with no family history of ASD. However, almost nothing is known about the neural processing of social-communication information prior to diagnosis in infants with ASD outcomes with different risk-status.

The goal of this study is to investigate EEG neural activity in 6- and 12-month infants with an elevated-risk for ASD compared to those with typical-likelihood, as well as a subset of infants from both groups who were diagnosed with ASD as toddlers. EEG responses were recorded during viewing of video stimuli with social and nonsocial contents. Second, we investigate how EEG responses are related to social-communication skills measured in a clinical assessment.

Methods: We include 118 6-months-old infants (56 elevated-risk, ER; 62 typical-likelihood-risk, TLR) and 128 12-months-old infants (73 ER, 55 TLR). ER infants had either an older sibling with ASD or were born low birth weight. Typical-likelihood infants did not have any family members with ASD and were born at expected weight and gestational age. High density EEG was recorded while infants viewed video a social condition (women singing nursery rhymes) and a Nonsocial condition (dynamic toys). Power spectral density (PSD) values were calculated for 8 channels based on 10-20 system for delta (3–3.99Hz), theta (4–5.99Hz), alpha (6–12.99Hz), beta (13–29.99Hz), low gamma (35–54.99Hz), and high gamma (65–79.99Hz) frequency bands. Social and communication skills were measured with Vineland Adaptive Behavior Scales at 36 months.

Results: First, we fitted linear mixed-effect models with EEG power as dependent variable, age (6 vs. 12 months), condition (social vs. nonsocial), and group (ER vs. TLR) as main effects and the interactions between them for each electrode and each frequency band. For delta and theta bands, we revealed a significant main effect of condition: higher power was found to the social compared to nonsocial condition. For alpha, beta and low gamma, there was a main effect of age: 12-months-old infant had higher power that 6-month-olds. For high gamma, there was a main effect of group: the ER group had elevated high gamma power than the TLR group. Second, at 36 months infants were diagnosed with ASD and/or DD or typical development (TD). We created three groups: TLR+TD, TLR+ASD, and ER+ASD. We found that ER+ASD differed from TLR+TD group in high gamma with elevated power and lower Vineland subscores. The TLR+ASD group differed from TLR+TD group in high gamma but did not differ in Vineland scores. Third, we used correlations to assess if elevated high gamma power was related to Vineland subscores (p-values set to be significant at < 0.0007). Elevated gamma was associated with lower communication skills (5 electrodes), daily living skills (1 electrode) and socialization skills (1 electrode).

Discussion: Early EEG high-frequency based responses differ in infants based on risk for ASD, including in those with similar autistic outcomes.

M24. HIPPOCAMPAL VOLUME AND REORIENTATION STRATEGY DURING EARLY CHILDHOOD

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Background: Spatial reorientation is the ability to re-establish one's sense of direction after becoming lost or disoriented. Data from animal models and human adults suggests that the hippocampus is one of several cortical structures supporting efficient reorientation. The hippocampus may support reorienting behavior by maintaining representations of one's environment informed by salient geometric details and landmarks. Spatial reorientation paradigms are ideal for measuring spatial cue use, as success requires efficiently combining geometric and featural cues. Additionally, errors indicate which cue an individual primarily depends on to guide their reorientation. The left anterior hippocampus has been associated with individual differences in reorienting strategies in adults. However, few studies have examined the neurobiological correlates of reorientation in early childhood. The ages of four- to six-years old are marked by significant structural changes in the anterior hippocampus and refinement in children's reorientation strategies. The present study aims to characterize how individual differences in anterior hippocampal volume correlate with children's strategies on an age-appropriate spatial reorientation task.

Methods: A sample of 42 typically-developing children (23 females) completed an eight-trial reorientation task and T1-weighted structural MRI protocol. Prior to analysis, the hippocampus of each participant was manually traced. The uncal apex was used to delineate between the anterior and posterior hippocampus. Separate multiple regression analyses were performed with left anterior hippocampal volume predicting children's landmark, geometry, and combined cue usage on the reorientation task. Each model included children's age, biological sex, and intracranial volume as a covariate. In addition, the interaction between left anterior hippocampal volume and participant sex was included in each model as some data from adults suggests that structural differences in the hippocampus are associated with sex differences in spatial skills.

Results: After controlling for age, gender, and intracranial volume, individual differences in left anterior hippocampal volume were positively associated with children's geometry (β=0.84,p= .016) and combined cue (β=0.93,p= .037) strategy usage. However, the interaction between left anterior hippocampal volume and participant sex was not significant in the geometric (β= -0.79,p= .08) or combined cue strategy model (β=-0.75,p= .194). Left anterior hippocampal volume (β=0.21,p= .587) and its interaction with participant sex (β=0.05,p= .919) were not significantly associated with children's landmark strategy usage.

Discussion: These results indicate that children with greater left anterior hippocampal volume were significantly more likely to use geometric cues to guide their reorienting behavior. The significant association between left anterior hippocampal volume and combined strategy engagement may reflect an increased likelihood of encoding geometric cues in addition to landmarks. Unlike previous studies with adult samples, we did not observe a significant sex difference in hippocampal volume or reorienting strategies. These Results: highlight the importance of hippocampal structure in characterizing individual differences in children's spatial development.

M25. PRENATAL PSYCHOSOCIAL DETERMINANTS OF NEONATAL BRAIN STRUCTURE: EXPLORING MICROSTRUCTURAL AND VOLUMETRIC ALTERATION RELATED TO THE LIMBIC SYSTEM USING STRUCTURAL EQUATION MODELING

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Background: In the present study, we use data from a sample of N = 174 neonates from the FinnBrain Birth Cohort Study to investigate how prenatal parental psychosocial factors—such as maternal and paternal emotional distress, quality of life, resilience, and attachment styles—affect neonatal brain development. Our objectives are twofold: to identify prenatal psychosocial risk and protective factors and to explore how these factors interact with neonatal brain structures (i.e., amygdala, hippocampus) and frontolimbic white matter tracts relevant for emotion regulation. We hypothesize that increased prenatal psychosocial protective factors correlate with larger intracranial volume, smaller amygdala volumes, larger hippocampal volumes, higher global and local fractional anisotropy (FA), and lower mean diffusivity (MD). The mean age of the neonates at scan was 26.66 days (SD = 7.77, range = 11-54 days).

Methods: Neonates were scanned with a Siemens Magnetom Verio 3T scanner. The imaging protocol consisted of a 60-minute session, including a PD-T2-TSE sequence with a Repetition Time (TR) of 12,070 ms and effective Echo Times (TE) of 13 ms and 102 ms for PD-weighted and T2-weighted images respectively. Additionally, a sagittal 3D T1-weighted MPRAGE sequence was employed, featuring isotropic voxels of 1.0 mm^3, a TR of 1900 ms, a TE of 3.26 ms, and an inversion time (TI) of 900 ms. We conduct exploratory factor analysis of 8 psychosocial questionnaires (EPDS, WHOQoL-8, SCL-90/Anxiety, PRAQ-R2, CD-RISC, PBI, SOC, and ECR-R) completed at gestational weeks 14, 24, and/or 34 to identify latent factors. We then employ structural equation modeling to assess how these factors are related to the neonatal brain structures relevant for emotion regulation, specifically focusing on intracranial volume, amygdala-, and hippocampal volumes, and white matter integrity globally and within specific tracts.

Results: The study is pre-registered (https://osf.io/pkbju), and the psychosocial scales meet the assumption checks described in the registration. We ran some assumption checks including histograms for multivariate normality, scatterplots for predictor-outcome linearity, and correlation matrix for checking multicollinearity among predictors. Next we conduct exploratory factor analysis and structural equation modeling. More detailed results are presented in the congress.

Discussion: Our study has the potential to uncover the interplay of risk and protective mechanisms in determining structural brain development of regions relevant to emotion regulation at the point of early development with minimal postnatal influence. This study offers a novel approach to prenatal research by examining a broad range of environmental factors, both positive and negative. It highlights new pathways for addressing vulnerabilities that may lead to psychopathologies, thereby informing prenatal care and public health strategies.

M26. NETWORK CONTROLLABILITY OF THE FETAL STRUCTURAL CONNECTOME

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Background: The brain rapidly develops during the fetal period. The structural connectome has hallmark properties that support efficient brain dynamics by birth. Using ex-utero preterm infants as a model for normative fetal development, similar patterns appear over the third trimester. Yet, little work has investigated the structural connectome in in-utero fetuses using advanced approaches, like network control theory (NCT). We investigated the controllability of structural connectomes from 234 fetuses, 192 preterm infants, and 450 term infants from the developmental Human Connectome Project.

Methods: Diffusion-weighted data underwent standard preprocessing. Structural connectomes were created with the 90-node infant atlas. We used NCT to calculate node and edge average controllability (AC). AC is the ability to drive the brain toward nearby states. We asked several questions. First, we created trajectories for whole-brain AC from 20.86 to 45.14 weeks postmenstrual age (PMA). Second, we compared whole-brain AC between fetuses and preterm infants at the same PMA. Third, we tested whether fetuses and infants share similar developmental patterns in edge AC. A predictive model of PMA trained with edge AC from the fetal connectome and tested on the neonatal connectomes. We repeated this modeling by training on neonates and testing on fetuses. All analyses controlled for motion, head volume, sex, and network strength.

Results: First, across the perinatal period, AC exhibited a u-shaped pattern ($r=0.60$, $p < 0.001$). It decreased until 35.08 weeks PMA and increased afterward. Second, fetuses showed weaker AC than preterm infants at the same PMA. The greatest difference ($t=-5.85$, $p < 0.001$) between fetuses and preterm infants happens at 35 weeks PMA—the same PMA as the minimum of the u-shaped trajectory. Third, predicted models of PMA trained on fetal edge AC generalized to the neonatal connectome ($r=0.86$, $p < 0.001$, mean absolute error [MAE] = 4.11 weeks). Likewise, models created from neonatal data generalized to fetal data ($r=0.83$, $p < 0.001$, MAE=2.02 weeks).

Discussion: Our study characterizes AC in the fetal period. AC develops in a continuous pattern during the perinatal period. In-utero fetuses demonstrate weaker average controllability than ex-utero preterm infants. Despite these differences, maturation patterns across the connectome are similar enough for predictive models of PMA to generalize between fetuses and neonates.

M27. SLEEP DYSFUNCTION AND REGIONAL BRAIN VOLUME: A COMPARITIVE STUDY BETWEEN CHILDREN WITH AND WITHOUT AUTISM

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Background: Sleep plays a critical role in various brain functions. Sleep difficulties affect 25-40% of typically developing (TD) children and adolescents but are more pronounced in those with autism spectrum disorder (ASD), affecting 50-80%. This study investigated brain-behavior associations by examining the relationship between sleep difficulties and brain region volumes, comparing children with ASD to their TD peers.

Methods: A total of 612 children (215 ASD, 397 TD) between the ages of 8-12 years were included for analysis, with all behavioral and neuroimaging data gathered at a single site (Kennedy Krieger Institute). ASD diagnosis was based on the Autism Diagnostic Observation Schedule (ADOS) or ADOS-2 and on either the Kiddie Schedule for Affective Disorders and Schizophrenia or Diagnostic Interview for Children and Adolescents. Sleep difficulties were assessed using the parent-reported Children's Sleep Habits Questionnaire (CSHQ) and compared between diagnostic groups using ANCOVA, controlling for age. Brain regions linked to sleep in prior studies, including the caudate, putamen, thalamus, amygdala, insula, and hippocampus, were selected. Volumes for these brain regions were derived at 3T from high-resolution T1-weighted images using MRICloud, a web-based cloud platform, and FreeSurfer. Multivariable linear regression models, adjusted for age and total cerebral volume, analyzed the associations among regional brain volume, total CSHQ score, diagnosis, and their interaction.
Results: Using a standard cutoff CSHQ total score of 41, 61.68% of children with ASD, compared to 26.45% of TD children, met criteria for clinically significant sleep dysfunction ($\chi 2=72.11$, $p < 0.001$). Total and subscale CSHQ scores were significantly higher (greater dysfunction) in the ASD group, with p-values ranging from < 0.001 to 0.023. While the main effect of diagnosis on the left hippocampal volume was not statistically significant, significant effects were observed for the total CSHQ score ($\beta=-5.03$, $p=0.046$) and the interaction between total CSHQ score and diagnosis ($\beta=7.91$, $p=0.021$). Post-hoc analysis showed that each unit increase in total CSHQ score was associated with a significant decrease in left hippocampal volume in TD children (95% CI: -9.97 to -0.09). In contrast, in the ASD children, each unit increase in total CSHQ score was associated with an increase in the hippocampal volume, though this was not statistically significant (95% CI: -1.70 to 7.45). No significant findings were noted in other brain regions.
Discussion: Greater sleep difficulties were reported in children with ASD compared to their TD peers. Although the left hippocampal volume was significantly associated with the total CSHQ score, differential links of sleep with hippocampal volume were observed between groups, with more adverse effects noted in TD children. While research on the brain-behavior associations of sleep in children with ASD is limited, findings from TD adult studies indicate a similar trend, where poorer self-reported sleep is associated with decreased hippocampal volume.

M28. THE EFFECT OF SOCIOECONOMIC DISADVANTAGE ON LONGITUDINAL GROWTH OF HIPPOCAMPAL SUBREGION AND SUBFIELD VOLUMES IN THE ADOLESCENT BRAIN COGNITIVE DEVELOPMENT (ABCD) SM STUDY

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Background: The hippocampus plays an essential role in memory and learning (Kim et al., 2015) and is comprised of distinct subregions (i.e., anterior and posterior) and subfields (i.e., CA1, CA3, CA4/DG) which have been shown to differentially contribute to memory function in children (Tamnes et al., 2018) and adults (Shing et al., 2011). Given the high density of glucocorticoid receptors, the hippocampus is particularly sensitive to chronic stressors. Indeed, past cross-sectional research with the ABCD dataset suggests socioeconomic disadvantage is associated with smaller hippocampal subregion and subfield volumes in children (Botdorf et al., 2022). However, to-date, no studies have examined the effect of socioeconomic disadvantage on the development

of hippocampal subregion and subfield volumes longitudinally. Therefore, the proposed study, utilizes the ABCD Study dataset to investigate this effect in a large, diverse sample of children.

Methods: The study used data from the 5.1 dataset of the ABCD Study. The 5.1 data release includes structural MRIs completed at baseline (ages 9-10, mean age 9.9 years, n=11,867) and during the year 2 follow-up (ages 11-12, mean age 11.9 years, n=7,752). Subjects were removed from the analysis if one or both scans did not pass the quality control measure (521 total scans, 323 subjects, n=7,429) or if they did not have a scan at both baseline and year 2 (206 subjects, n=7,223). Freesurfer v7.4.1 was used to segment hippocampal subregions and subfields. The anterior hippocampal subregion was measured using the hippocampal head volume, and the posterior hippocampal volume was comprised of the body and tail volumes. The FS360 parcellation that includes CA1, CA3 CA4, DG, (CA4 and DG were combined) and the subiculum was used to segment the hippocampal subfields. The Area Deprivation Index (ADI), comprised of 17 socioeconomic variables, was used to assess socioeconomic disadvantage. In preliminary analyses (n=401), linear mixed-effects (LME) models were conducted to test relations between socioeconomic disadvantage and year 2 hippocampal subregion and subfield volume using the R lme4 and lmerTest package. Covariates included baseline hippocampal subregion and subfield volume, intracranial volume (ICV), sex assigned at birth, child's age in months, and time between the two MRI scans (in months). Random effect of scanner ID was also included in each model.

Results: For hippocampal subregions, LME models demonstrated a significant effect of socioeconomic disadvantage for the anterior ($b = -5.99$, $SEb = 1.98$, $t = -3.1$, $p = 0.007$) and posterior subregion volumes ($b = -5.31$, $SEb = 1.97$, $t = -2.69$, $p = 0.01$), such that greater socioeconomic disadvantage at baseline predicted smaller anterior and posterior hippocampal subregions at year 2. Regarding hippocampal subfields, LME models demonstrated a significant effect of socioeconomic disadvantage for the CA1 volume ($b = -2.54$, $SEb = 0.81$, $t = -3.13$, $p = 0.007$), such that greater socioeconomic disadvantage predicted smaller CA1 subfield volume at year 2. All p values reported are adjusted for multiple comparison corrections (FDR value $< .05$; Benjamini-Hochberg). No significant effect was found for the CA3, CA4/DG, or subiculum.

Discussion: These findings build upon previous cross-sectional research showing associations between socioeconomic disadvantage and smaller anterior and CA1 volumes in the ABCD study sample (Botdorf et al., 2022). Results: of this study provide a greater understanding of how socioeconomic disadvantage impacts growth of hippocampal subregions and subfields across development and has implications for cognitive development encompassing learning and memory processes. Further, given hippocampal subregion and subfield volumes are not provided in the publicly available ABCD dataset, this study will provide a wealth of data for future research examining biological and other environmental influences on hippocampal subregion and subfield volumes over time.

M29. THE TRANSCRIPTOMIC CORTICAL ALTERATIONS IN PROFOUND HEARING LOSS

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Background: Hearing loss has a profound effect on speech/language development in children which elicits functional deficits and has been linked to Alzheimer's disease (Ralli et al., 2019); nevertheless, little is known concerning structural-genetic reorganization. Studies of bilateral deaf

individuals have revealed increased gray matter and decreased white matter in Heschl's gyrus (Emmory et al., 2003; Smith et al., 2011), superior temporal gyrus white matter deficits (Shibata, 2007), and cortical thinning (Li et al., 2012). Our objective is to assess the effect of profound HL using MRI volume-based morphometry, shape metrics, and transcriptomics.

Methods: 42 children (n = 18 bilateral, prelingual) or unilateral hearing loss (left n= 10, right n= 14, prelingual) participated with 43 age and sex-matched controls (range 6 months to 18 years). Children were a homogeneous group having profound sensorineural hearing loss (≈ 90 dB) bilaterally or unilaterally. Structural MRI three-dimensional sagittal T1-weighted MP-RAGE sequences assessed volume and shape metrics using a segmentation pipeline. Structural images were used to calculate Yakovlevian torque. Brain-segmented labels from the MRICloud T1-Multiatlas were used to calculate the LDDMM across the HL groups against the Normal group. Additionally, AHBA was used to map gene expression to specific structures of the Desikan-Killiany atlas. A PLS analysis was performed to find which gene's expression levels explain better the volume of the structures across the brain. Selected genes were then entered into the Metascape platform to perform a gene enrichment analysis. Enriched genes were used to generate gene clusters based on their function.

Results: The analysis of global torque angles across different hearing loss groups revealed varying degrees of rotational asymmetry in the brain. The Bilateral group showed a global torque of 3.44° towards the left hemisphere. The Left group exhibited a global torque of 2.3° towards the left hemisphere. The Right group had a global torque of 6.45° towards the left hemisphere. Finally, the Normal Group displayed a left torque angle of 1.11°.

LDDMM analysis compared the three HL groups against the Normal group assessing the non-linear transformations needed to fit 8 structures to the Normal group template. For the Bilateral group left hemisphere, the mean deformation was: -0.4835. The Left group's left hemisphere presented a mean deformation of -0.2955. The Right group's left hemisphere had a mean deformation of -0.2801. On the other hand, for the Bilateral group left hemisphere, the mean deformation was -0.4365. The Left group's left hemisphere presented a mean deformation of -0.2527. The Right group's left hemisphere had a mean deformation of -0.3094.

PLS analysis was implemented to uncover latent variables elucidating the covariance between gene expression patterns and neuroimaging phenotypes. The findings highlight significant pathways in the left hemisphere of the bilateral group, such as immune response regulation and neuronal system development, and pathways related to ADHD and Autism in the left hemisphere of the right group. Similar enrichments are observed in the right hemisphere of the bilateral group, with additional processes.

Discussion: The present results support the idea that sensorial deprivation has an important effect on the structural development of the brain. As expected, bilateral hearing loss has a structural manifestation in both hemispheres, being less prominent in the right hemisphere of the brain. Even though we were expecting a shift in the Yakovlevian torque for the Right HL group, this change was not presented, indicating that other factors aside from sensorial stimulation are involved in determining the hemispherical torque. The finding of a correlation between the structural changes and ontogenetic pathways related to ADHD and Autism indicates that there is an important relationship between the structure and the cognitive development of our sample.

M30. UNRAVELING THE UNIQUE CONTRIBUTIONS OF PUBERTAL STATUS AND HORMONES TO WHITE MATTER TRACT DEVELOPMENT

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Background: Puberty, a time with heightened risk for developing psychopathology, is associated with changes in hormone levels that influence white matter development. Specifically, white matter microstructure is related to both physical markers of pubertal development and pubertal hormones. However, it remains unclear how pubertal status and pubertal hormones uniquely contribute to white matter microstructure development. An understanding of how different aspects of puberty uniquely impact white matter microstructure development will aid in understanding mechanisms of psychopathology risk. We studied these relationships in the Human Connectome Project in Development cross-sectional cohort.

Methods: Participants included 1131 youth aged 5–21 years old. The Pubertal Development and Sexual Maturation scales measured pubertal status. A z-scored average pubertal composite score was calculated from these scales. DHEA, Testosterone, Estradiol, and Progesterone were measured from saliva samples. Fractional anisotropy (FA), radial diffusivity (RD), and axial diffusivity (AD) were calculated in 26 white matter tracts (bilateral tracts were averaged) from diffusion MRIs with TRACULA. Generalized additive models were used to examine relationships with pubertal measures. Models were compared to determine if the sequential addition of age, pubertal stage, and hormones resulted in better fitting models, determined by an AIC 2 units < simpler models, for FA development. The unique variance explained in each tract by each pubertal term was calculated with a partial R2. Tract endpoints on the cortical surface were ranked on the sensorimotor-association axis, and winning FA models were examined in the context of the S-A axis. It was investigated how much FA variance in each track was explained by RD and AD.

Results: Age was the best-fit model for 16 tracts with prefrontal, parietal, and temporal connections. The Pubertal Timing model was the best fit for the optic radiation and inferior longitudinal fasciculus. The DHEA model was best fit for the splenium, genu, and prefrontal body of the corpus callosum. The Estradiol model was the best fit for ventral cingulum bundle, extreme capsule, and uncinate fasciculus. The Full model was the best fit for the rostrum. The Sex model was the best fit for the middle cerebellar peduncle. Tracts best explained by the Age models were more related to association-related tracts, while those best fit by Pubertal Timing models were more related to sensorimotor-related tracts. Age explained the most unique variance for FA (Radj2 change: < 0.01-0.06) in most tracts. RD explained more variance in FA in all tracts (Radj2=0.89-0.59), compared to AD (Radj2=0.23-0.05).

Discussion: The Age model was the best fitting model for the majority of tracts, particularly those tracts that connect association cortices, while Pubertal Timing models best explained tracts associated with sensorimotor cortices. RD explained a much larger amount of the variance in FA than AD, suggesting that the FA changes are related to changes in myelination. Future work will investigate how these relate to the development of internalizing symptoms during adolescence.

M31. RELATIONSHIPS BETWEEN BRAIN STRUCTURE AND EXTERNALIZING PSYCHOPATHOLOGY IN PEDIATRIC POPULATION-BASED AND CLINICALLY-ASCERTAINED SAMPLES

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Background: Elevated externalizing behaviours in childhood predict development of various mental health disorders in adolescence. Typically, children exhibiting elevated externalizing symptoms also show emotion dysregulation and callous-unemotional (CU) traits. These three dimensions may confer to varying risk trajectories of developing an externalizing disorder. Understanding whether these dimensions feature shared or distinct neurobiological correlates can complement the exploration of risk trajectories by providing insight on brain-based predictors of clinical and treatment outcomes. Here, we examined whether baseline brain structure in frontolimbic/striatal regions would be related to externalizing symptoms, emotion dysregulation, and CU traits in a population-based sample. We then determined whether brain structure of these regions would be predictive of improved conduct problems following a 15-week psychosocial treatment intervention in a separate pilot sample of children with externalizing disorders.

Methods: We fit separate linear mixed-effect models in two datasets to examine the relationship between baseline brain structure (parcellated from the Desikan-Killiany Atlas) and externalizing psychopathology dimensions over time. Using the Adolescent Brain Cognitive Development (ABCD) Study (n=10,534,ages=9-11), we examined cross-sectional and longitudinal relationships between frontolimbic/striatal structures and externalizing symptoms, emotion dysregulation, and/or CU traits using various clinical measures to index these dimensions. Fixed effect covariates included sex, age, medication status, and household income. Random effects included family ID (for multiple siblings enrolled), site, and participant ID (for longitudinal models). Then, in a pilot sample of children with externalizing disorders(n=17,ages=9-12), we examined whether pre-treatment brain structure of frontal regions identified in ABCD were linked to reductions in conduct problems (derived from Strengths and Difficulties Questionnaire; SDQ) following psychosocial treatment. Fixed effect covariates included time, emotion dysregulation, ROI thickness, the interaction between these three variables, as well as conduct problems. Random effects included participant IDs.

Results: In ABCD, higher baseline CU traits were significantly associated with increased baseline cortical thickness in the right rostral middle frontal gyrus (β=0.027,pcor=0.03) and the left and right pars orbitalis (left:β=0.033,pcor=0.009;right:β=0.027,pcor=0.03). Greater baseline emotion dysregulation was significantly associated with baseline lower subcortical volume in the left caudate (β=-0.026,pcor=0.02), right amygdala (β=-0.027,pcor=0.02), left and right nucleus accumbens (left:β=-0.024, pcor=0.02;right:β=-0.037,pcor < 0.001). Lower baseline cortical thickness in the left pars triangularis (F(2, 20576)=6.94,pcor=0.014) and left rostral middle frontal gyrus (F(2, 20619)=6.33,pcor=0.014) moderated the trajectory of externalizing symptoms over time. In the pilot study, greater thickness in the left insula and right rostral anterior cingulate cortex was associated with reduced conduct problems following treatment (β=1.01-3.88,p < 0.01).

Discussion: Our first analysis revealed that while the frontolimbic/striatal networks are implicated in externalizing psychopathology across a pediatric population-based sample, each dimension and the time-point being measured may influence the pattern and trajectory of brain-behaviour relationships found. Our second analysis revealed that frontal cortical regions may be predictive of treatment outcome in children with externalizing disorders. Although the two analyses identified different regions within the frontal cortical network, the overall results of this study shows that regions in this network may be implicated in externalizing psychopathology across different pediatric samples.

M32. MEGA-ANALYSIS INVESTIGATION OF SUBCORTICAL BRAIN VOLUMES IN INFANTS (0-6 MONTHS) EXPOSED TO ANTENATAL MATERNAL DEPRESSION.

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Background: Given what is now known about the neuropsychological impact of antenatal maternal depression (AMD) exposure in young children, there is the need to identify the precise neurodevelopmental changes that occur in infants which further mediate poor mental health outcomes later observed in children following AMD exposure. Furthermore, the infant's brain is delicate, and its typical development can be altered by a multitude of adverse conditions, hence the need to isolate the impact of AMD on infants' brain limiting their interaction with postnatal factors that may compromise findings.

This study aims to address gaps in knowledge of the impact of AMD exposure on subcortical brain development in infants between age 0-6 months, and address shortcomings of previous studies in this area, including small samples, leading to inconsistent findings, and lack of socio-demographic diversity in the samples assessed. A further strength of this study is the inclusion of a relatively large number of cohorts from low- and middle-income countries (LMICs) where AMD is most prevalent. This will be achieved by pooling and analysing individual level clinical and neuroimaging data from 20 international cohorts from diverse populations. Furthermore, we will also use the large and diverse pooled cohort to investigate whether the impact of AMD exposure on subcortical brain development is moderated by infants' sex and maternal socioeconomic status.

Methods: The mega-analysis study aims to pool data of cohorts from study sites involved in the ENIGMA ORIGINs consortium, in Bangladesh, Canada, Finland, Singapore, South Africa, United Kingdom and United States of America. Twenty (20) cohorts have committed to contributing brain volume, AMD exposure and sociodemographic data. An estimated minimum sample of 1850 young infants (0-6 months old AMD exposed and unexposed control infants) will be analysed in at least a subset of the cohorts sample. Subcortical volume estimates for the Thalamus, Amygdala, Hippocampus, Caudate, Putamen, and Pallidum have been generated using protocols and pipelines developed and implemented at the University of North Carolina, USA for the ENIGMA-ORIGINs consortium. AMD exposure was determined with Edinburgh Postnatal Depression Scale – EPDS (aggregate score greater or equal to 13) and Beck's Depression Inventory – II – BDI - II (aggregate score greater or equal to 14) as well as other maternal depression assessment tools administered during pregnancy and before delivery. Minimally adjusted linear mixed-effect (LME) model will be used to predict subcortical volume changes due to AMD exposure while a fully adjusted LME model will be used to assess sex and socioeconomic factors' interaction with AMD exposure on subcortical brain volume changes. The LME models will account for infant age, sex, study sites, intracranial volume (ICV), gestational age at birth, and further for antenatal psychotropic substance and alcohol exposure, and birthweight where relevant data are available.

Results: It is expected that larger hippocampal and amygdala volumes will be associated with AMD exposure. These differences due to prenatal depression will be more pronounced in girls, particularly with respect to the hippocampus.
Discussion: Study Progress to date

·Completed Task

-Invitation of sites to contribute in the study.

-Data transfer agreement (DTA) with ENIGMA-ORIGIN consortium (data provider) and University of Cape Town (data receiver)

·In progress

-Processing and quality check of subcortical brain volume data

-Developing scripts for statistical data analysis.

-DTAs with some of the sites.

-Data transfers for some of the sites

·Planned

-Data analysis

-Result write-up

M33. WEIGHT INDICES AND BASAL GANGLIA MICROSTRUCTURE FROM CHILDHOOD TO EARLY ADOLESCENCE

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Background: Neuroinflammation in the basal ganglia both Results: from and exacerbates obesity in rodent models. In children, higher body mass index (BMI) has been cross-sectionally associated with greater basal ganglia cellularity, assessed via diffusion-weighted magnetic resonance imaging (dMRI) techniques. Preliminary longitudinal evidence suggests bidirectional links between nucleus accumbens development and weight gain, but it is unclear if this pattern extends to other regions in the basal ganglia.
Methods: Baseline and 2-year follow-up data from the Adolescent Brain Cognitive Development (ABCD) Study were utilized. Basal ganglia microstructure was characterized using the restriction spectrum imaging restricted normalized isotropic (RSI-RNI) index, a dMRI-derived metric that is thought to indirectly reflect glial and neuronal cell density. Longitudinal ComBat was used to harmonize RSI-RNI across scanners. The data were iteratively split into Discovery and Replication halves 100 times. In each half, we used cross-lagged panel models to examine the prospective associations between baseline BMI or waist circumference (WC) and 2-year RSI-RNI in bilateral caudate, putamen, pallidum, and nucleus accumbens, and vice versa. For each association, we assessed its exploratory replicability (ER; % of Discovery halves surviving false discovery rate-corrected $p <= 0.05$) and confirmatory replicability (CR; % of Replication halves surviving nominal $p <= 0.05$ and having consistent direction with the Discovery halves). Replicable Results: (ie, those with $>= 50\%$ ER and CR) were followed-up using linear mixed models with a time interaction term to examine potential trajectory differences. All analyses accounted for child sex,

pubertal development scores, handedness, race and ethnicity, parental education, intracranial and regional volumes, and head motion, and were nested by family.

Results: Complete data from 3709 children were included (mean [SD] baseline age, 9.9 [0.6] years; 1819 [49%] girls; 1533 [41%] non-White). Higher baseline BMI reliably predicted greater RSI-RNI across all eight basal ganglia regions at the 2-year follow-up (ER's > = 98%, CR's > = 93%, median β's > = 0.07). Further, higher baseline BMI was associated with significantly greater RSI-RNI increases over 2 years in the right caudate (β = 0.02, p = 0.02) and left pallidum (β = 0.01, p = 0.03). Similar results were observed with WC. Conversely, greater baseline RSI-RNI in the bilateral nucleus accumbens highly replicably predicted higher WC (but not BMI) at the 2-year follow-up (left, ER = 93%, CR = 90%, median β = 0.05; right, ER = 91%, CR = 88%, median β = 0.05) as well as significantly increased longitudinal WC gain (left, β = 0.01, p = 0.05; right β = 0.01, p = 0.01). No such associations were seen with other regions.

Discussion: In line with animal literature, these results suggest that obesity plausibly contributes to increased basal ganglia cellularity over time in children. Nucleus accumbens microstructure also appears to play a unique role in predicting WC gain in youth. Further research is needed to identify important mediators of the observed associations and to distinguish within- vs. between-person effects.

M34. EARLY WHITE MATTER MICROSTRUCTURE DEVELOPMENT IN INFANTS WITH DOWN SYNDROME, FIRST LOOK

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Background: Down syndrome (DS) is the most prevalent chromosomal disorder and a leading cause of intellectual disability, affecting approximately 1 in every 700 newborns. Despite its significant impact on brain development, research on the white matter (WM) microstructure in DS remains limited. Findings in older children and adults suggest widespread reductions in WM integrity. A single study in younger children aged 2 – 4 years showed lower Fractional Anisotropy (FA) in the bilateral uncinate (UNC) and right inferior longitudinal fasciculus (ILF). To our knowledge, there is no published study on WM microstructure in infants with DS. We believe that investigating WM maturation in infancy provides early insights into brain growth, offering a predictive framework for understanding DS brain development. Furthermore, current advancements in image acquisition and computational techniques enable us to obtain higher-quality brain images in infant scans, which historically posed significant challenges. In this study, we aim to get a first look into WM microstructure associations in DS compared to typically developing (TD) infants around 6 months of age by analyzing Diffusion Tensor Imaging (DTI) properties. This study establishes a baseline for further in-depth investigation.

Methods: We analyzed a cohort of 52 infants (DS=32, TD=20) between the ages of 5 and 9 months (M=6.25, SD=0.81). Based on previous findings in the Infant Brain Imaging Study (IBIS) done in school-age children between the ages of 7 and 12 years, we examined nine major WM fiber tracts: left ILF, right UNC, bilateral inferior fronto-occipital fasciculi (IFOF), right frontotemporal arcuate (arcuate FT), bilateral fornices, splenium and tapetum of the corpus callosum. Tract DTI fiber properties were extracted via semi-automated atlas-based tract profile processing including a strict quality control protocol. Statistical analysis was performed using general linear models in JMP 17 Pro by comparing DTI tract averages of FA, Radial Diffusivity (RD), and Axial Diffusivity (AD) between the DS and TD groups. Additionally, linear regression models were used to examine the relation between individual Vineland II domain standard scores obtained at 6 months of age and FA tract average within the DS group. All analyses were covaried by age-at-assessment in days, as well as scan-motion quantification (number of diffusion volumes with significant artifacts, and with captured head motion larger than 2mm). Bonferroni correction was applied for multiple comparisons.
Results: Compared to the TD group, the DS group exhibited lower FA, and higher RD in the bilateral IFOF, left ILF, and right arcuate FT, and lower FA in the right UNC. The findings among the infant DS group showed similar FA patterns to the previously studied school-age DS group (7-12 years old). Consistent with previous findings, the fornices showed higher AD in the right fornix, and higher AD and RD in the left fornix of the DS group. Further analysis showed that the fornices exhibited higher Mean Diffusivity (MD) bilaterally. No significant findings were observed in the two interhemispheric tracts: the tapetum and splenium. No significant associations were found between the DS group's Vineland II standard scores and FA values.
Discussion: Early evaluations reveal distinct patterns of delayed WM maturation and indications of decreased myelination in DS infants compared to TD infants. The lack of significant differences in the interhemispheric tracts is most likely due to the relatively small sample size. These findings mirror the WM microstructural changes observed in school-age children, potentially providing an early prediction of WM development in children with DS. Future analyses will incorporate comprehensive full tract evaluations and utilize multishell-diffusion Neurite Orientation Dispersion and Density Imaging (NODDI) models to enhance our understanding of these observations.

M35. PARALLELS BETWEEN DEVELOPMENT AND DEGENERATION

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Background: During infancy and childhood, the brain expands and grows nonuniformly. Sensorimotor areas important for vision and motion mature earliest, and association areas, including portions of the frontal, temporal, and parietal lobes, experience more protracted, later development. Due to the timing and length of the developmental windows for these association areas, these regions may be particularly vulnerable to environmental effects, such as poverty or preterm delivery. At the opposite end of the lifespan, patients in the early stages of Alzheimer's Disease (AD) first experience cortical atrophy in the medial temporal lobes. As the disease progresses, atrophy spreads to other key association cortices, with relative sparing of sensorimotor cortices. This suggests a "last in first out" paradigm. While development and aging research have

traditionally been siloed from each other, emerging evidence suggests that early life factors like childhood poverty may increase risk for AD decades later, highlighting the need for a developmental contextualization of the brain changes that occur in AD. Therefore, the goal of the current study is to examine the similarities in spatial patterns of cortical expansion in early life and cortical atrophy in the early stages of AD.

Methods: To measure cortical expansion in early life, 41 full-term children from the WUNDER cohort underwent a structural MRI scan at term-equivalent age and again at 9/10 years old. Infant T2-weighted images were obtained using a Siemens Trio 3T scanner and processed using the M-CRIB-S pipeline, and age 9/10 T1-weighted images were obtained using a Siemens Prisma 3T scanner and processed using Freesurfer. Maps of cortical expansion were calculated using the anatomically-constrained multimodal surface matching (aMSM) pipeline, an innovative technique that allows for optimized point-correspondence between two surfaces. Additionally, 13 elderly patients from the ADNI database received longitudinal MRI scans over a two-year period that were obtained using 3T scanners and processed using Freesurfer. At the time of the first scan, they were diagnosed with mild cognitive impairment, and at the second scan they were diagnosed with AD. aMSM was run on these subjects to create maps of cortical atrophy. Finally, our group average maps of cortical expansion and cortical atrophy were spatially compared to each other using permutation spin testing.

Results: Across the first ten years of life, cortical expansion primarily occurred in association cortices ($R=0.57$, $Pspin < .001$). During a two-year period of degeneration in patients that converted from mild cognitive impairment to AD, cortical atrophy occurred in the temporal lobe, medial parietal lobe, precuneus, and portions of the frontal lobe. These two group average maps of expansion and atrophy were then compared to each other using a permutation spin test ($R=-0.43$, $Pspin < .001$).

Discussion: The brain regions that experience tremendous cortical expansion in early life are also the first to atrophy in the early stages of AD. Given that the development of these regions is particularly vulnerable to environmental factors, including low birthweight, prematurity, and poverty in childhood, and emerging research has shown these same factors can increase rates of AD in later life, it is possible that healthy and pathological aging may be influenced by early neurodevelopment. Additional research is needed to determine the social and genetic factors that influence these patterns of expansion and degeneration, as well as to explore how early life factors influence susceptibility to degenerative disease.

M36. INVESTIGATING THE ROLE OF MATERNAL DEPRESSION, PARENTING BEHAVIORS, AND CHILD WHITE MATTER VOLUME IN PRESCHOOLER PSYCHOPATHOLOGY SYMPTOMS

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Background: Maternal depression is associated with harsher parenting behaviors and greater child internalizing and externalizing symptoms at school age. Less maternal warmth is related to more disruptive behaviors in preschoolers. Harsh parenting behaviors in the first years of life also predict smaller white matter volume in school-aged children. White matter development influences critical cognitive and behavioral functions, such as emotion regulation, relevant to externalizing

symptomatology and thus is hypothesized to play a role in this risk trajectory. Longitudinal data are needed to understand when and through which parenting and neural mechanisms maternal depression influences child psychopathology.

Previous neuroimaging studies have focused on school-aged children and adolescents, so the present study investigates if the relationships of maternal depression to parenting, white matter volume, or early signs of psychopathology can be observed as young as ages 2 and 3 years. Using observational and neuroimaging data, we hypothesized that variation in parenting support would mediate the relationship between early maternal depression and toddler psychopathology and white matter volume, and that white matter volume would mediate the pathway of maternal depression to toddler psychopathology. More specifically, we hypothesized that greater maternal depression would predict greater toddler psychopathology, as well as non-supportive parenting behaviors and smaller white matter volume in toddlers, which would each in turn predict greater toddler psychopathology.

Methods: 220 mother-child dyads, oversampled for poverty exposure, were assessed each trimester, post-birth, and at ages 1, 2, and 3 years. Maternal depression was measured using the Edinburgh Postnatal Depression Scale during pregnancy and 4, 8, and 12 months postnatal. Supportive (sensitivity, positive regard) and non-supportive (intrusiveness, detachment, negative regard) parenting behaviors were coded by blind raters using Parent-Child Interaction Rating Scales. Child psychopathology symptoms were measured at year 2 (Infant-Toddler Social and Emotional Assessment) and 3 (Child Behavior Checklist). White matter data were acquired using a Siemens Prisma 3T scanner at years 2 and 3. The Melbourne Children's Regional Infant Brain Atlas Surface toolkit was used to generate anatomical volume segmentations, including white matter.

Results: Postnatal maternal depression (β=0.16, p=.01) predicted toddler externalizing symptoms (Mage=2.56 years), a finding that held when controlling for prenatal depression, maternal depression at ages 2 and 3, socioeconomic disadvantage, parenting, and child sex. Further, greater supportive parenting behaviors predicted fewer child internalizing symptoms (β=-.12, p=.05), a finding that held after accounting for socioeconomic disadvantage and child sex, age, and co-morbid externalizing symptoms. Surprisingly, maternal depression did not predict parenting behaviors after accounting for socioeconomic disadvantage. Contrary to our hypothesis, non-supportive parenting behaviors did not predict child white matter volume (β=1.20, p=.23), and white matter volume did not predict inattentive/hyperactivity symptoms, disruptive behavior, or total externalizing or internalizing symptoms (ps $>$ .31).

Discussion: Findings highlight the unique role of maternal depression during the first year of offspring life, which may be key in the intergenerational transmission of early psychopathology, though potentially not through parenting behaviors or white matter volume. Incorporating functional and structural connectivity data in future analyses may also elucidate the influences of maternal depression and behavior on toddler psychopathology symptoms.

M37. REPRODUCIBLE GRADIENTS OF MICROSTRUCTURAL DEVELOPMENT ALONG WHITE MATTER TRACTS IN YOUTH

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Background: White matter (WM) undergoes protracted microstructural changes in youth that refine communication between spatially distributed cortical regions critical for complex behavior. Post-mortem human and animal studies have shown posterior-to-anterior, inferior-to-superior, and central-to-peripheral maturational patterns of myelination. Work in animals has also revealed variation in myelin sheath thickness along an axon, which can profoundly impact neural transmission. However, the few human neuroimaging studies that have examined developmental variation along WM tracts are limited by small sample sizes and lack of a clear biological framework to interpret such variation. We propose that within-tract variation in developmental change is linked to the distinct roles of different parts of a tract, which come together to facilitate neural transmission. Here, we used two large-scale neuroimaging datasets (total N=1,786) to test the hypothesis that maturation of WM progresses systematically along tracts, with gradients of development reflecting adaptations that optimize neural communication between cortical regions.
Methods: We used diffusion MRI data from the Human Connectome Project: Development (HCP-D; N=569; ages 8-22) and Healthy Brain Network (HBN; N=1217; ages 5-22). All images were processed using QSIPrep 0.19.1. The QSIPrep reconstruction workflow included multi-tissue constrained spherical deconvolution and tractography using MRtrix3, followed by segmenting 22 major WM tracts using PyAFQ. Mean diffusivity (MD), which may be more sensitive to age-related changes than fractional anisotropy in this age window, was measured at 100 equidistant nodes along each tract. To model linear and non-linear associations between age and MD at each node, we fit generalized additive models, with age as a smooth term and sex and in-scanner motion as covariates. The age effect at each node was quantified by the change in adjusted R2 between a full model and reduced model with no age term. The relationship between age effect and position along a tract was evaluated using Pearson correlations.
Results: WM microstructure markedly varied along each tract, with portions of tracts deeper in WM having significantly lower MD than portions of each tract closer to tract endpoints. Though tract-averaged MD displayed overall decreases with age, we observed graded developmental changes within tracts. The magnitude of age effects showed a strong correlation with the relative position of a given node within its tract, indicating greater age-related decreases in MD closer to tract endpoints. This deep-to-superficial gradient of development was consistent across datasets in 18 total cortico-cortical tracts including bilateral arcuate fasciculus (HCPD: $r=0.90$, $pFDR < 0.0001$; HBN: $r=0.84$, $pFDR < 0.0001$), bilateral inferior longitudinal fasciculus (HCPD: $r=0.59$, $pFDR < 0.0001$; HBN: $r=0.81$, $pFDR < 0.0001$), bilateral superior longitudinal fasciculus (HCPD: $r=0.84$, $pFDR < 0.0001$; HBN: $r=0.96$, $pFDR < 0.0001$), and forceps minor (HCPD: $r=0.80$, $pFDR < 0.0001$; HBN: $r=0.91$, $pFDR < 0.0001$), with a mean correlation of 0.63 in HCP-D and 0.78 in HBN. Lastly, age effects increased from inferior to superior regions of bilateral corticospinal tract (HCPD: $r=0.72$, $pFDR < 0.0001$; HBN: $r=0.35$, $pFDR < 0.0001$).
Discussion: To our knowledge, this is the largest study of maturation along WM tracts from childhood to young adulthood. We delineate reproducible deep-to-superficial and inferior-to-superior gradients of WM development in two independent datasets. Deeper tract regions may myelinate earlier to reduce interference from crossing tracts carrying distinct neuronal signals, while regions near cortex may dynamically interact with cortical development. Further analyses

are necessary to investigate these hypotheses and to characterize the link between WM development and psychopathology. This work establishes the importance of studying spatial variation along WM tracts in understanding brain development and function.

M38. EXPOSURE TO OUTDOOR AIR POLLUTION RELATES TO AMYGDALA SUBREGION VOLUMES DURING EARLY ADOLESCENCE

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Background: Outdoor air pollution is a known neurotoxicant associated with widespread adverse neurophysiological and psychological health outcomes. The amygdala is a subcortical limbic structure composed of cytoarchitecturally and functionally distinct subregions. While a handful of studies have identified links between air pollution exposure and amygdala structure and function, the effects of pollutant exposure on heterogenous amygdala subregions—particularly in children and adolescents—remains poorly understood. In the current study, we examine relationships between outdoor air pollution exposure and amygdala subregion volumes in youths 9-10 years of age.

Methods: Cross-sectional data from 4,473 participants (55.4% male) enrolled in the Adolescent Brain Cognitive Development (ABCD) Study® were leveraged in our analyses. Using raw T1- and T2-weighted brain images collected on 3T Siemens MRI scanners, we segmented 9 distinct amygdala subregions using the high-resolution, in vivo probabilistic CIT168 atlas. From these segmentations, the relative proportion of each subregion volume to total hemispheric amygdala volume (relative volume fractions; RVFs) was quantified. Exposure to annual criteria pollutants and fine particulate matter (PM2.5) components were estimated for each child's primary residential address using an ensemble-based modeling approach. After adjusting for key sociodemographic and precision imaging-related variables, two separate multivariate, Partial Least Squares Correlation (PLSC) analyses (10,000 permutations; bootstrap ratio ≥ 2.5 [$p < 0.01$]) were then performed to identify latent variables representing relationships between exposure to 1) three criteria air pollutants (fine particulate matter [PM2.5], nitrogen dioxide [NO2], and ground-level ozone [O3]) and 2) 15 PM2.5 components (e.g., organic carbon, potassium, lead), and amygdala subregion RVFs.

Results: Across the two PLSC analyses, three significant latent variables were identified between air pollution exposure and amygdala substructure. Our first analysis identified one significant latent variable, which suggested that exposure to PM2.5 was the primary pollutant driving associations with overall subregion RVFs (percentage of variance explained = 82%). In our second analysis, two significant latent variables emerged. First, exposure to potassium and organic carbon was associated with subregion RVFs (percentage of variance explained = 30%). Next, exposure to PM2.5 components was associated with increased RVFs of the bilateral lateral nucleus (LA) and decreased RVFs of the bilateral basomedial nucleus (BM), right central nucleus (CEN), and left cortical and medial nuclei (CMN) (percentage of variance explained = 39%).

Discussion: We identified several relationships between outdoor air pollution and amygdala subregion RVFs, which varied across subregions. Our results suggest that exposure to PM2.5, specifically PM2.5 components likely stemming from sources of traffic and wood combustion, is

related to differences in amygdala apportionment, particularly expansion in lateral regions and reduction in medial regions. The LA, as part of the basolateral amygdala (BLA) complex, is central to the evaluation of the valence and social relevance of cortically processed inputs, and in turn to both positive and negative reinforcement learning. The BM serves as the connection between the LA and CEN and is essential for anxiety suppression. Taken together, these findings suggest that pollutant exposure may have downstream implications on regions of the amygdala necessary for healthy emotional regulation. This study provides novel insights into the impact of pollutant exposure on amygdala substructure during a critical period of brain development and identifies targets for future studies investigating the biological underpinnings of environmental neurotoxicity on the brain and behavior.

M39. ABNORMAL FETAL CORTICAL AREAL EXPANSION IS PREDICTIVE OF 2-YEAR NEURODEVELOPMENTAL OUTCOME IN CONGENITAL HEART DISEASE

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Background: The neurodevelopmental impairment observed in children with congenital heart disease (CHD) is thought to have in utero origins. We use longitudinal fetal MRI to normatively model growth trajectories of surface features in 30 gyral regions over the late second to third trimester. We estimate the deviance of each CHD fetus on the growth curve at two time points, then use linear regression to show that greater deviations from normative growth in utero are associated with worse neurodevelopmental (ND) outcome at 2 years old.

Methods: 292 in utero 3T T2-weighted brain MRI scans (20 – 39 weeks Gestational Age (GA)) were obtained (CHD = 135, Controls = 157). 76 participants were scanned twice, before and after 30 weeks GA. We segmented the brain, extracting the inner cortical plate boundary to reconstruct the surface. We aligned meshes to a 31 GA template, then parcellated the surface into 30 gyral regions, calculating the average sulcal depth, average absolute mean curvature and surface area in each region.

We use Gaussian Process Regression to normatively model surface metrics in the Controls, estimating a continuous standard error of the mean with GA. We calculated Z-scores for each fetus, representing the deviation from the expected mean for a given metric, accounting for GA and sex. We compared z-score distributions between first and second scans, and between CHD and Controls using a Kruskal-Wallis test, subtracting the difference between z-score means. We fit General Linear Models (GLM) to examine the effect of CHD and fetal GA on the relationship between z-scores and ND outcome at 2 years old, assessed with the Bayley Scales of Infant and Toddler Development, Third Edition.

Results: Prior to 30 weeks GA, CHD fetuses follow the normal growth trajectory for all surface metrics. However, after 30 weeks GA, we observe cortical areal expansion in fetuses with CHD deviates from the normative trajectory: we found significantly reduced z-scores in 13 cortical regions for surface area; 2 for sulcal depth and 0 for curvature. We investigated if there were differences between CHD physiologies, and also found z-scores differed between controls, single- and two-ventricle physiologies in specific brain regions, such as the pre and post central gyrus. Similarly, after 30 GW, within the CHD group, but not in the Controls, the lower z-scores were

significant predictors of worse Bayley standard scores, with motor scores having the most significant regional associations.
Discussion: While areal expansion is reduced in certain regions in CHD, the depth and curvature largely follow the normative growth trajectory, suggesting that despite the cardiovascular impairment, the mechanisms governing gyrification are operational. Our Results: support that increased metabolic demands of the third trimester perturb structural brain growth in CHD, manifesting as neurodevelopmental abnormalities at 2 years old.

M41. IMPACT OF GESTATIONAL AGE AT BIRTH AND EXTRA-UTERINE LIFE EXPERIENCE ON TACTILE SENSORY PROCESSING REGULATION: AN EEG STUDY IN PRETERM NEONATES

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Background: Prematurity increases the risks of later Neurodevelopmental Disorders (NDD), but we lack early vulnerability markers that would allow us to understand their emergence, thus limiting effective screening and interventions. Investigating sensory processing regulation appears promising: a key process in cognitive development is sensory prediction (SP), which regulates sensory processing via repetition suppression (RS) during non-relevant stimuli or amplification of responses during relevant stimuli. NDDs are associated with sensory deficits, particularly tactile ones. Altered tactile SP and RS abilities could constitute early mechanisms of cognitive deficits observed in autistic and attention disorders. This study examines SP and RS in preterm neonates in the tactile modality and the impact of prematurity level – and thus NDD risk – on these.
Methods: At 35 weeks of corrected Gestational Age (GA), we measured EEG evoked potentials in the brain activity of 62 preterm neonates born between 26 and 34 weeks GA during a tactile oddball-omission paradigm (290 vibrations of 200ms simulating a stroke on the forearm). The first and last 40 stimuli were identical (standards) and used to assess RS. Between these, stimuli organized in contiguous blocks (containing 5 standard stimuli, 1 deviant (reverse direction of vibration), and an omission, in a pseudo-random order) were presented. The number of painful experiences (medical procedures involving skin breach) were obtained from the patient's medical record on the day of measurement.
Results: A lower GA at birth and a higher number of painful care experiences during extra-uterine life in the NICU are both associated with greater SR in the somatosensory cortex (respectively $r=0.38$, $p=.002$ and $r=0.28$, $p=.02$), with an increase in activity amplitude during the omission of tactile stimulation, i.e. prediction (respectively $r=0.33$, $p=.008$ and $r=0.41$, $p=<.001$), and with a lower mismatch response (respectively $r=0.49$, $p<.001$ and $r=0.41$, $p=.001$).
Discussion: The degree of prematurity at birth and the experience of extra-uterine life have a significant impact on the modulation of tactile sensory processing in premature infants at near-term equivalent age. A larger proportion of extra-uterine experience for the same equivalent corrected GA is associated with prediction, as evidenced by activity during omission, yet a stronger suppression of all stimuli across the repetition, including deviants that yield no mismatch response. A larger proportion of in-utero time before measurement was associated with less suppression and a large mismatch response to deviants, which shows prediction processes despite no evidence of activity during omissions. In conclusion, all preterm neonates form predictions of tactile stimuli,

but how they regulate sensory processing based on these predictions depends on time spent in vs. out of the womb. These Results: could reflect a protective adaptation process to aversive stimuli in the NICU but could compromise subsequent sensory development and have implications for neurodevelopment. Recent integrative and cross-syndromic approaches suggest that deficits in top-down regulation of sensory processing would impair the development of attention, executive functions, and self-regulation, deficits that are central to NDD. To compare neonatal measures of somatosensory processing with neurodevelopmental outcomes at 2 years of age, all participants are enrolled in a follow-up cohort. If modulations in sensory processing are linked to later cognitive difficulties, it will allow us to use them as early markers of neurodevelopmental risk in these vulnerable patients and to design early prevention programs.

M42. AGE-RELATED NEURAL RESPONSES TO SENSORY STIMULI DURING REAPPRAISAL IN AUTISTIC CHILDREN

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Background: Autism spectrum disorder (ASD) is characterized by social communication challenges, repetitive behaviors, and sensory processing differences (Pitskel et al., 2014). Over half of autistic children experience sensory over-responsivity (SOR), or extreme negative responses to sensory stimuli (Baranek et al., 2006). However, interventions for SOR are limited. Reappraisal is a strategy that may be used to regulate an individual's emotional response to a stimulus by reinterpreting its meaning. In typically developing (TD) children, reappraisal activates frontal and parietal brain regions and increasing age predicts greater activation of prefrontal cortex (Silvers et al., 2017). Preliminary research suggests that, in autistic children, activation of prefrontal cortex may help regulate sensory responses (Green et al., 2019) and that prefrontal cortex activation during sensory stimulation increases with age (Cakar et al., 2023). However, the effects of interventions such as reappraisal on sensory regulation have not been studied. In this study, we examined neural activity in response to reappraisal in children with ASD compared to TD, and further investigated how age relates to neural responses in ASD youth.

Methods: Participants were 57 children aged 8-15 years with ASD (n=30) or TD (n=27). Participants were first trained in a reappraisal task adapted from the emotion regulation literature in which children are taught to view visual stimuli as near (i.e., without regulating emotions) or distant (i.e., reappraisal) (Silvers et al., 2017). Here, they were trained to either focus on how an aversive tactile stimulus makes them feel ("Feel" condition), or "report" on the stimuli and think about how they would describe it to someone else ("Report" condition). Participants then underwent fMRI while mildly aversive tactile stimuli (e.g., scratchy sweater, fake grass) were administered to their arm for 20 seconds at a time, with each block prompting them to "Feel" or "Report". Participants experienced 6 blocks of each condition, with the order counterbalanced across participants. FMRI analyses were performed at a threshold of $Z=2.3$, $p < .05$. Age was entered as a bottom-up regressor to examine within-group age correlations.

Results: For all participants, the Report condition resulted in more activation in executive functioning and higher-order sensory processing regions (i.e., superior frontal gyrus, paracingulate gyrus, and supplementary motor area), than in the Feel condition. For autistic children only, the Report condition resulted in less activation in somatosensory and visual cortical regions compared

to the Feel condition. Age was related to brain responses for the ASD group only: age was positively correlated with greater frontal orbital cortex activation in the Report condition as well as greater increases in medial prefrontal cortex (mPFC) in the Report compared to Feel conditions. Age was negatively correlated with activation in lateral occipital cortex in the Feel condition only. **Discussion:** Across groups, reappraisal led to upregulation of executive functioning and emotion regulation regions, suggesting that both groups effectively engaged in reappraisal to process their sensory experiences differently. In autistic youth, reappraisal also reduced activation in sensory and visual regions where overactivity has been shown to be associated with SOR in ASD, especially for pre-adolescent children (Cakar et al., 2023; Green et al., 2015; 2019). As autistic youth get older, they engage in greater activation of frontal regions, consistent with prior findings that older ASD youth are better able to engage prefrontal cortex to regulate sensory responses (Cakar et al., 2023). Younger ASD youth showed greater activation of visual regions during the Feel condition, but not during reappraisal. Results: suggest that reappraisal may be an effective way to help autistic children across ages regulate the overwhelming sensory experiences associated with SOR.

M43. CEREBELLAR INVOLVEMENT IN NEURAL PROCESSING OF SENSORY SIGNALS IN AUTISM

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Background: 1 in every 36 children in the US is diagnosed with Autism Spectrum Disorder (ASD), a complex neurodevelopmental disorder. More than 90% of ASD youth display atypical sensory processing. However, we currently lack a deep understanding of neural mechanisms that underlie these differences in sensory experiences, which is a barrier to generating evidence-based treatments for sensory challenges in ASD. Previous research on sensory over-responsivity (SOR; i.e., a common and particularly impairing sensory challenge) in ASD youth showed that more severe SOR is associated with over-activation and altered habituation of primary sensory regions and amygdala in autistic youth during aversive sensory experiences, implicating sensory-limbic atypicalities in sensory challenges in autism. However, a key sensorimotor region, the cerebellum, has been understudied in the context of sensory atypicalities in autism. Importantly, new research finds links between cerebellar functional connectivity at rest and SOR in autism (Cakar et al., 2023). Nevertheless, whether cerebellar responses during sensory stimulation differ in autism remains unclear. In this study, we aimed to characterize differences in cerebellar responsivity in ASD and typically developing (TD) youth during aversive sensory stimulation.
Methods: We collected functional magnetic resonance imaging (fMRI) data from 52 ASD (14F) and 41 TD (13F) youth (aged 8-18 years) while they completed a task comprising six 15-second blocks of mildly aversive auditory and tactile (on the left arm) stimuli, jointly presented. The search space was restricted to the cerebellum in analyses to assess cerebellar activation. Results: were cluster corrected for multiple comparisons at $p < 0.05$ and thresholded at $z > 2.3$.
Results: During sensory stimulation, ASD youth showed activation in bilateral sensorimotor and supramodal regions of the cerebellum (including Crus I and II) as well as deactivation clusters within the sensorimotor cerebellum and the vermis. TD youth similarly displayed activation in the

sensorimotor and supramodal cerebellum and deactivation in a wider region including the sensorimotor and supramodal cerebellum, the vermis, and lobule IX. In comparing the ASD and TD groups, we found that the ASD group showed more right lateralized (i.e., contralateral to tactile stimulation) cerebellar activity in the sensorimotor cerebellum, Crus I and II and lobule X.

Discussion: ASD and TD youth engage both the sensorimotor and supramodal cerebellar regions during sensory stimulation, indicating a cerebellum-wide involvement in sensory processing. The ASD group showed more cerebellar activation in the contralateral side to the arm experiencing tactile stimulation, suggesting atypical processing of sensory information in the cerebellum in autism. This finding is also consistent with previous research reporting a lack of inhibition in task-independent sensory networks in autism (e.g., Green et al., 2019). Further analyses for this study will investigate how cerebellar activity during sensory stimulation relates to neural habituation in sensory-limbic regions in ASD youth. Our current findings demonstrate the involvement of the cerebellum in sensory atypicalities in ASD and highlight that this brain region should be considered in sensory and ASD research.

M44. ASSOCIATIONS BETWEEN BRAIN AGING AND DIMENSIONS OF PSYCHOPATHOLOGY IN YOUTH EXPOSED TO NEIGHBORHOOD DISADVANTAGE

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Background: Adolescence is associated with heightened vulnerability to a variety of mental health problems, such as depression, anxiety, and aggression. Identifying the neurobiological underpinnings of psychiatric vulnerability during this developmental period can inform early risk identification and efforts for prevention. Theoretical models across multiple species postulate that deviations in the pace of brain
development may confer risk or resilience. Empirically, both accelerated and delayed brain maturation have been linked to both better and worse mental health, likely due to differences in samples, rates of psychopathology, and adversity exposure across studies. Consequently, additional research is required to characterize the association between the pace of brain development and mental health, especially (a) during adolescence, when psychiatric symptoms often emerge, (b) with respect to different dimensions of psychopathology and (c) among youth from disadvantaged communities, who may have a higher risk for stress exposure and the development of psychopathology.

Methods: This study tests how brain aging is associated with different dimensions of psychopathology in 600 twins (mean age = 14.72 years; 45.5% female; 79.67% white) from the Michigan Twin Neurogenetics Study (MTwiNS), a population-based sample of twins recruited from neighborhoods with above-average levels of poverty. We calculated brain age using an established algorithm trained and validated using structural MRI data in youth without psychiatric diagnoses (Drobinin et al., 2022). Chronological age was then subtracted from the model's brain age prediction to calculate the "brain age gap". Positive values are commonly interpreted as accelerated brain development, whereas negative values are commonly interpreted as delayed brain development. We used multi-informant (primary- and alternate-caregiver) reports on the Child Behavior Checklist and fit a bi-factor model to quantify (a) specific liability to externalizing

symptoms, (b) specific liability to internalizing symptoms, and (c) general liability for psychopathology (p-factor). We conducted multivariate regression analyses using maximum likelihood estimation with robust standard errors to predict mental health from brain age gap, controlling for twin clustering and other covariates. All three dimensions of psychopathology were entered simultaneously as outcome variables to account for their covariance.

Results: The bi-factor model showed acceptable fit (CFI = 0.91, TLI = 0.90, RMSEA = 0.03), as did the brain age model (correlation with actual age = .51, RMSE = 1.96, MAE = 1.59). Brain age gap was positively associated with the externalizing factor (β = 0.149, 95% CI [0.062, 0.237], p = .001), suggesting that adolescents with more advanced brain development had a greater propensity toward externalizing symptoms. However, this association was no longer significant after controlling for age, sex, race/ethnicity, household monthly income and parental education levels (β = 0.096, 95% CI [-0.019, 0.210], p = .103). Moreover, brain age gap was not significantly associated with the internalizing or p-factor dimensions in either the baseline or covariate-adjusted models (all p-values > .220).

Discussion: Our study provides preliminary evidence that a more protracted course of brain development may be beneficial for mental health - especially externalizing symptoms - although this relationship was not robust in this sample. Therefore, further research is needed to examine whether and how the pace of brain development is associated with mental health, especially in longitudinal samples exposed to adversity and disadvantage.

M45. INVESTIGATING THE NEURAL BASES OF LANGUAGE PROCESSING DURING A LIVE SOCIAL INTERACTION: A FNIRS STUDY OF NEUROTYPICAL AND AUTISTIC CHILDREN

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Background: To date, no studies have investigated how the brains of preschool-aged children process language during live social interactions, despite this being a sensitive period in language development. The present study examined the neural bases of live language processing in 20 neurotypical (NT) and 20 autistic (ASD) preschool-aged children. fNIRS was used to measure children's brain response during a live language condition (listened to story read by live experimenter) and a recorded language condition (listened to story played via audio recording). The study aims were to 1) compare the strength of brain response between conditions within groups, 2) compare the strength of brain response during each condition between groups, and 3) explore the associations between brain response and children's language skills within groups.

Methods: The sample included N=20 NT children (15 M, 5 F) and N=20 ASD children (17 M, 3 F), 3 to 6 years old. A TechEn CW7 fNIRS system (50 Hz, 690nm and 830nm) was used to measure children's brain function during two conditions – a live language condition and a recorded language condition. During the live language condition, children listened to a story read by a live experimenter. During the recorded language condition, children listened to a different story played via an audio recording. Stories were divided into 18 trials (10 seconds long), and a jittered fixation cross was presented in between trials (10 to 15 seconds long). The fNIRS cap bilaterally covered the inferior and middle frontal gyrus (IMFG), the superior and middle temporal gyrus (SMTG), and the temporal parietal junction (TPJ). Data were processed in Homer3 using standard procedures (Yücel et al., 2021), including channel pruning, spline SG motion artifact correction

(Jahani et al., 2018), low pass filtering, global signal regression, and GLM HRF estimation (Huppert, 2016). Average HbO concentration values from 0 to 10 seconds (trial length) were used for within-group and between-group analyses. Children's language skills were also measured using a standardized behavioral assessment (Preschool Language Scales; Zimmerman, Steiner, and Pond, 2011).

Results: Within the NT group, HbO was greater during the live language condition than the recorded language condition in the right TPJ ($t=3.085$, $p=.007$). Within the ASD group, the strength of brain response did not significantly differ between conditions ($ps \geq .093$). The ASD group showed greater brain response than the NT group during the recorded language condition in the right IMFG ($t=2.495$, $p=.017$). Language skills were positively correlated with brain response during the recorded language condition in the left SMTG for the NT group ($r=.645$, $p=.007$) and the left IMFG for the ASD group ($r=.624$, $p=.007$).

Discussion: Condition differences in the strength of right TPJ brain response suggest that NT children, but not ASD children, were engaged in social cognitive processes (e.g., joint attention, mentalizing) during the live language condition (Mundy, 2018; Krall et al., 2015). Group differences in the strength of right IMFG brain response align with previous findings of right hemisphere dominance during language processing in ASD (Herringshaw et al., 2016). Reduced left-lateralized brain response to language may help to explain why some ASD children experience challenges using and understanding language.

M46. A NEUROCOGNITIVE MODEL OF EARLY ONSET PERSISTENT AND DESISTANT ANTISOCIAL BEHAVIOR IN EARLY ADULTHOOD

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Background: It remains unclear which functional and neurobiological mechanisms are associated with persistent and desistant antisocial behavior in early adulthood.

Methods: We reviewed the empirical literature and propose a neurocognitive social information processing model for early onset persistent and desistant antisocial behavior in early adulthood, focusing on how young adults evaluate, act upon, monitor, and learn about their goals and self traits.

Results: Based on the reviewed literature, we propose that persistent antisocial behavior is characterized by domain-general impairments in self-relevant and goal-related information processing, regulation, and learning, which is accompanied by altered activity in fronto-limbic brain areas. We propose that desistant antisocial development is associated with more effortful information processing, regulation and learning, that possibly balances self-relevant goals and specific situational characteristics. The proposed framework advances insights by considering individual differences such as psychopathic personality traits, and specific emotional characteristics (e.g., valence of social cues), to further illuminate functional and neural mechanisms underlying heterogenous developmental pathways.

Discussion: Finally, we address important open questions and offer suggestions for future research to improve scientific knowledge on general and context-specific expression and development of antisocial behavior in early adulthood.

M47. AN EXPLORATION OF SEX DIFFERENCES IN SOCIAL ATTENTION IN AUTISTIC CHILDREN

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Background: Prior eye tracking studies have found that autistic children have different patterns of social attention compared to neurotypical children, with autistic children paying less attention to faces and the activities of others. Some evidence suggests boys and girls have different patterns of social attention, with autistic girls spending more time looking at social stimuli, though the evidence is limited and contradictory. Understanding whether there are sex differences in patterns of social attention could inform different types of supports for autistic children in social and school settings.

Methods: In this study, a naturalistic video displayed an actress with non-social and social stimuli to 94 children aged 42-95 months with autism spectrum disorder (girls N=25 (27%)). Gaze data were analyzed for the dyadic bid (DB) section where the actress speaks directly to the child, and for the whole video (all). Total time spent gazing at the media (Time on Media (DB), Time on Media (all)) were examined, along with the percentage of time spent gazing within pre-defined regions of interest (Time on Actress (DB), Time on Actress (all), Time on Face (DB), Time on Eyes (DB), and Time on Mouth (DB)). We utilized linear regressions to examine the association between gaze and sex while controlling for age and IQ. Additionally, we investigated how gaze and sex were moderated by the presence of autism-related behaviors as measured by the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2), the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), and the Repetitive Behavior Scale, Revised (RBS-R). We hypothesized that sex would moderate the relationship between social gaze and level of autism-related behaviors.

Results: When considering the association between gaze and sex, boys looked more at the video and actress than girls, as measured by the following variables: Time on Actress (DB), Time on Actress (all), Time on Media (DB) and Time on Media (all). Furthermore, when examining the interaction between gaze, sex, and autism-related behaviors, the opposite effect was observed, girls gazed longer than boys. We discovered that sex was moderating the relationship between gaze and autism-related behavior, specifically restrictive and repetitive behaviors (RRBs), as measured by DSM-5 Criteria B2 and ADOS RRB domain. For boys, fewer RRBs was associated with more time looking at the face and video, while for girls, more RRBs was associated with more time looking at the face and video.

Discussion: These results support previous findings that autistic boys and autistic girls have different patterns of social attention. Interestingly, the presence and amount of restrictive and repetitive behaviors affects the association between sex and eye gaze. RRBs, specifically routine-based behaviors, are characterized by adherence to routine, ritualistic patterns of verbal and nonverbal communication, resistance to change, and rigidity. For girls, these behaviors seem to lead to greater attention to the faces of others, as previous research has found that autistic girls focus more on the face than autistic boys. Further research can help to understand if these distinct sex differences are due solely to genetic differences or are products of socialization.

M48. IDENTIFICATION OF PROSPECTIVE PREDICTORS OF ALCOHOL INITIATION DURING EARLY ADOLESCENCE

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Background: Early alcohol initiation (EAI), use before the age of 16, is associated with negative, alcohol-related outcomes. Prospectively predicting those who are likely to initiate use early is key to delaying initiation to more developmentally appropriate ages. While previous work has identified numerous risk factors for EAI, the relative risk of each remains understudied. The current project addresses this gap by 1) prospectively predicting EAI using measures of inhibitory control, reward sensitivity, and contextual risk factors and 2) interrogating the relative importance of each domain.

Methods: This study leverages neuroimaging, neurocognitive task, and self-report survey data obtained from substance-naïve youth enrolled in the Adolescent Brain Cognitive Development (ABCD) Study® (n = 11,081). EAI was defined as the consumption of a full standard drink containing alcohol prior to turning 16-years-old (14 grams of absolute ethanol per drink). Propensity score matching was done to match alcohol initiators (n = 362) with demographically similar non-initiators at a 1:2 ratio (total n = 1,032, 49.3% female). Separate logistic regressions were conducted for variables measuring inhibition control, reward sensitivity, and contextual risk factors in classifying initiators from non-initiators within the matched sample. Hierarchical models were then conducted to determine if including multiple domains in a single model improved classification performance.

Inhibition control measures include dorsal lateral prefrontal cortex grey matter volume (GMV), anterior cingulate cortex GMV, performance on related neurocognitive tasks, and self-report surveys. Reward sensitivity measures include nucleus accumbens GMV as well as related tasks and surveys. Examples of contextual measures include peer substance use, familiarity with (knowledge of) different substances, and alcohol sipping outside of a religious context.

Results: The contextual model ($R^2 = 0.100$, AUC = 0.69) performed better than both the inhibition control ($R^2 = 0.019$, AUC = 0.59) and reward sensitivity models ($R^2 = 0.028$, AUC = 0.60). The hierarchical model containing inhibition control, reward sensitivity, and contextual measures ($R^2 = 0.122$, AUC = 0.71) did not improve the fit over the contextual model alone ($p = 0.097$). Individually significant predictors ($p < 0.05$) included a lack of planning subscale for inhibition control (OR = 1.07), a sensation seeking subscale for reward sensitivity (OR = 1.10), and externalizing symptoms (OR = 1.05), familiarity with substances (OR = 1.21), peer substance use (OR = 2.12), and non-religious alcohol sipping (OR = 2.40) for contextual measures.

Discussion: Contrary to expectations, brain and behavioral variables associated with inhibition control and reward sensitivity were not adequate in classifying early initiators from non-initiators. Future work will utilize a mediated-moderation approach to model the complex relationships between these different modalities and EAI. Further, our findings that increased substance familiarity is predictive of EAI challenge contemporary, education-based substance use prevention programs. Future work is needed to understand the causal relationship between substance familiarity and alcohol initiation at this age.

M49. NEURO-CORRELATES OF DEPRESSION AND ANXIETY IN ADOLESCENCE

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Background: Internalizing disorders, such as depression and anxiety, are common and debilitating disorders, typically emerging during adolescence with heightened prevalence in girls. Internalizing disorders have been associated with dopaminergic dysfunctions of the striatum (Pizzagalli 2022). Innovations in brain imaging methodologies now show that indices of dopamine can be indirectly quantified through estimates of brain-tissue iron accrual (Haacke et al., 2005). Past works suggest that functional MRI data can be repurposed to estimate brain-tissue iron content (Cabral et al., 2023; Parr et al., 2022; Price et al., 2021; Larsen et al., 2020), which offers a scalable means to investigate dopaminergic processes in adolescence, in vivo and non-invasively. Leveraging this progress in MRI techniques, our study aimed to investigate the relationship between brain-tissue iron accrual in the dorsal striatum and internalizing symptoms severity in adolescents with depression and anxiety.
Methods: We analyzed data from the Boston Adolescent Neuroimaging of Depression and Anxiety Human Connectomes Project including 215 adolescents (ages 14-17-years) of which ~70% reported a depressive and/or anxiety disorder. Brain-tissue iron levels were estimated from BOLD fMRI data. Internalizing symptom severity was assessed using the self-reported Revised Child Anxiety and Depression Scale (RCADS). Data from the baseline visit was included. Symptoms were reassessed at 6- and 12-months.
Results: Participants with complete data were included (n=198, 126 girls, ages 15.42 ± 0.85). Female participants reported higher symptom severity compared to males ($t(211)=4.99$, $p < 0.001$). We found that tissue iron content in the caudate was higher in females and not significantly different between sexes in the putamen. Preliminary correlation analyses suggest that lower levels of brain-tissue iron in the caudate was associated with higher internalizing symptom severity. Future analyses will focus on longitudinal effects.
Discussion: This study provides preliminary evidence that brain tissue iron concentration (which supports dopaminergic processes) may be different in girls and boys, and tissue iron may relate to internalizing symptoms severity. Establishing neuro-correlates of internalizing psychopathology may advance our understanding of the biological mechanisms underlying affective disorders and potentially inform novel targets for early preventative-intervention care.

M50. A TEST OF THE "P-FACTOR HYPOTHESIS" REVEALS PRELIMINARY EVIDENCE OF DEPRESSIVE REALISM IN EARLY CHILDHOOD

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Background: Depressed adults, adolescents, and children typically perform more poorly on tests of cognitive function than their healthy counterparts. But why? In adults, compelling evidence supports the “P-Factor Hypothesis,” which suggests that it is not depression itself that causes poorer cognitive performance, but rather overall psychiatric health—as indexed by number of psychiatric diagnoses. However, no study has tested this hypothesis in young children.
Methods: Here, we attempted to close this gap in the literature with a study of 218 children, ages 4.01 – 8.13 years (Mage= 5.82 years, SD= 0.97; 49.54% assigned female sex). All children

completed the Kaufman Brief Intelligence Test-2 (KBIT-2), and their parents completed a full psychiatric diagnostic interview about their child.

Results: In two ANCOVAs using Type II sums of squares and controlling for parental education, simply having a depression diagnosis was not associated with IQ ($F(1, 211)= 0.03$, $p= .86$), whereas number of psychiatric diagnoses (i.e., healthy, 1 diagnosis, 2+ diagnoses) was associated with IQ ($F(2, 211)= 3.72$, $p= .03$). Among these 3 diagnostic groups, mean IQs were: healthy = 108.8, 1 diagnosis = 116, and 2+ diagnoses = 102. Mean IQs initially seemed to support the "P-Factor Hypothesis," as the most psychiatrically unwell children performed the most poorly on the IQ test. However, Tukey's HSD indicated that the 1 diagnosis group demonstrated higher IQ scores than the healthy group ($p = .01$) and the 2+ diagnosis group ($p = .004$), whereas the healthy and 2+ diagnosis groups did not differ statistically in IQ ($p = .18$). Of note, most (21/27) children in the 1 diagnosis group either had an anxiety or depressive disorder.

Discussion: These preliminary findings could support the idea that depressive realism—which suggests that higher IQ predicts depression and anxiety due to a more accurate world view—is present even in young children. A larger sample size containing children with more comorbid diagnoses is needed to more fully understand how number of childhood psychiatric diagnoses is associated with IQ.

M51. A SYSTEMATIC REVIEW OF THE EFFECTS OF INTERVENTION ON THE BRAIN AND BEHAVIOUR IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDERS

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Background: Autism spectrum disorders (ASDs) are characterised by a range of features, including restricted interests, repetitive behaviour, and differences in social communication and social behaviour. The neural underpinnings of these differences remain a topic of ongoing research, with recent findings indicating that both structural and functional differences may typify the brains of individuals with ASDs. Given the significant impact of ASDs on individuals and their families, it is essential to understand how interventions may affect brain structure and behavioural outcomes in this population.

Our ongoing systematic review aims to aggregate and synthesise data from neuroimaging studies investigating the effects of interventions on individuals diagnosed with ASD. Our inquiry focuses on characterising the nature of interventions applied in this context, their consequent relationships with changes in brain structure and function, and behavioural outcomes.

Numerous studies have examined the efficacy of interventions for individuals with ASDs; however, the specific neural structures and mechanisms associated with the effects of these interventions have been less well researched. To our knowledge, no previous systematic review has simultaneously focused on the neural and behavioural changes associated with various interventions in individuals with ASD.

Methods: Our review will include studies that employed neuroimaging techniques and behavioural measurements pre- and post-intervention to examine neural and behavioural changes in individuals with ASDs.

Our ongoing systematic review is being conducted according to the principles delineated in the Cochrane Handbook for Systematic Reviews of Interventions, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses, and PICO framework.

Included studies must have been peer-reviewed, published in English between January 2004 and January 2024, and must have incorporated both pre- and post-intervention neuroimaging and behavioural data. Interventions may have included behavioural, therapeutic, educational, and linguistic approaches, among others. Studies involving medical and pharmacological interventions will be excluded.

Articles meeting search criteria have been identified through a search of seven databases. All search records have been uploaded to Covidence, and duplicates have been eliminated after machine screening and verification. The article screening process is ongoing. We are currently conducting title and abstract screening, with each article screened independently by at least two trained study personnel. The second stage, full-text review, will be conducted independently for each article by at least two trained study personnel. In the third stage, extraction and coding, data from remaining studies will be extracted and coded independently by at least two trained study personnel.

Results: We will record and report the number of studies generated by our database search, the number of duplicate articles, the number of articles excluded during title and abstract review and full-text review phases, and the number of articles retained for systematic review.
Study personnel will use a Google Form to record study design; participant demographics; imaging (modality, task paradigm); intervention characteristics; behavioural measure(s)/instrument(s); and study findings, among others.

Descriptive statics will be reported for data collected at each stage. We will calculate Inter-Rater Reliability (IRR) at each stage. We will evaluate study quality and risk of bias using items adapted from National Institutes of Health instruments and additional items developed by the review's first author. To assess the risk of bias in the studies included in this systematic review, we will use the ROBINS-I tool.

Discussion: Not applicable.

M52. ADHERENCE TO EARLY TREATMENT WITH KATONA NEUROHABILITATION AND POST-TREATMENT HIPPOCAMPAL VOLUME PREDICT NEURODEVELOPMENT OUTCOMES IN EXTREMELY PRETERM CHILDREN

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Background: Preterm birth incidence has increased in recent years. Because the risk for morbidity and prevalence of developmental deficits augment as the number of weeks of gestation decreases, extremely preterm infants are at greater risk for cerebral palsy, epilepsy, and autism spectrum, learning, and attention/hyperactivity disorders.
Methods: Fifteen extremely preterm-born participants were treated from two months to two years old and followed up until past three years of age. The participants received Katona

neurohabilitation, which provides vestibular and proprioceptive stimulation and promotes movement integration through the intensive practice of human-specific elementary movements that present early in life. Subcortical brain volumes were obtained from magnetic resonance images acquired at the beginning and after the intervention; thus, 30 MR images were analyzed. Also, treatment adherence to Katona neurohabilitation and neurodevelopmental outcomes were drawn.

Results: Absolute subcortical volumes increased after treatment; however, most of the subcortical volumes adjusted by intracranial volume decreased. Regression analyses showed that after-treatment hippocampal volumes had a discrete predictive value. However, treatment adherence showed a clear association as a predictor of mental and psychomotor neurodevelopment after treatment.

Discussion: The inhibition of subcortical function enables cortical control and increased connectivity, which may explain the decreases in subcortical volumes adjusted by intracranial volume. Treatment adherence showed a clear relevance in predicting the effectiveness of Katona neurohabilitation.

M53. UNDERSTANDING THE ROLE OF EDUCATIONAL ENVIRONMENT IN THE WHITE MATTER AND MENTAL ARITHMETIC

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Background: Higher levels of educational opportunity are linked not only with improved student learning outcomes in both reading and mathematics but also with differences in white matter development (Roy et al., 2024). Although small-scale studies have demonstrated that focused interventions can drive learning-related changes in the white matter (Jolles et al., 2016), it remains unclear how differences in educational opportunities relate to white matter development and academic learning at a population level. To this end, this preregistered study looks to test several hypotheses to better understand the developmental dynamics between mathematics learning and white matter tracts, and how educational factors might influence this brain-behavior relationship.

Methods: The proposed analysis will leverage data from the upcoming ABCD 6.0 data release, which includes both longitudinal neuroimaging and behavioral data. The neuroimaging data for the baseline and Year 2 follow-up have been processed using pyAFQ (Kruper et al. 2020). Once the ABCD 6.0 data are released, we plan to process the available Year 4 neuroimaging data using the same pipeline. We plan to identify sub-bundles of the superior longitudinal fasciculus (SLF) as our tracts of interest (Sagi et al. 2024).

Our primary behavioral metric of interest is the Stanford Mental Arithmetic Response Time Evaluation (SMARTE), a tablet-based assessment probing fluency in single-digit arithmetic, multi-digit arithmetic, and dot enumeration.

The ABCD data also include several measures related to participants' developmental context, including educational opportunity and context, parental income, parental education, area deprivation index (ADI), neighborhood cohesion, household conflict, social mobility, air pollution, and measure of bias and discrimination. We plan to examine the link between educational opportunity, SMARTE performance, and white matter development, while controlling for other environmental covariates.

Results: In this study, we plan to test the following hypothesis: growth in SMARTE measures are related to growth in the white matter properties in sub-bundles of the superior longitudinal fasciculus (SLF). Based on previous evidence linking white matter properties of the SLF to arithmetic skill (Tsang et al. 2009; Grotheer et al., 2019), we expect to observe changes in the white matter properties, specifically fractional anisotropy (FA) in sub-bundles of the left and right SLF, that correspond to growth in SMARTE performance.
To test this hypothesis, we will leverage the longitudinal data to understand how changes in the white matter relate to growth in SMARTE by fitting mixed-effects models to predict white matter changes from changes in SMARTE scores while controlling for other contextual factors. We will also fit a generalized additive model using white matter data from Year 4 to see whether changes in SMARTE can predict instantaneous measures of white matter. We expect that Year 3 to Year 5 growth in SMARTE will manifest in measurable white matter differences during Year 4.

Discussion: The results from the proposed study will offer insights into the role of education in shaping the white matter properties underlying mathematical thought and potentially open the door for researchers to examine the impact of educational policies and curricular decisions on brain development and learning.

M54. PARTNERING WITH YOUTH TO CO-CREATE TASKS AND MEASURES FOR DEVELOPMENTAL COGNITIVE NEUROSCIENCE RESEARCH

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Background: Valid and reliable assessments of mental states and processes is essential for developmental cognitive neuroscience research. The creation of large measures and tasks that are relevant and meaningful for participants from diverse populations is a necessary step. Yet, this development predominantly occurs by members of research teams who differ in important ways from the participant populations under study (e.g., age, life experiences). One approach to increasing validity and reliability of stimuli and tasks is through the co-creation of research with participation populations. By including members of study populations in the scientific research process as more than participants, this co-creation process can be mutually beneficial to both scientists and child and adolescent participants. The current co-creation projects are focused on utilizing youth advisory boards and citizen science partnerships to help with the design of developmental cognitive neuroscience projects to investigate the extent to which curiosity modulates cognitive and neural indicators of visual processing.
Methods: To aid in the creation of ecologically valid and developmentally appropriate developmental cognitive neuroscience research, three projects were enacted. First a Youth Advisory Board (YAB) was created to assist with studies investigating curiosity. High school students nominated by their school counselors for the YAB met monthly for half a year to learn about the process of research and provide feedback on several projects relating to curiosity, visual information processing, and science education. Additionally, two citizen science projects, posted online and run at local libraries were conducted to help create more ecologically valid stimuli for measures of curiosity and visuospatial thinking.
Results: Members of the YAB impacted the research process in the following ways 1) Students spurred us to develop a new measure of curiosity that was more representative of high school

students' experiences; 2) Students helped to refine task instructions to be more developmentally appropriate; 3) Students helped to develop new stimuli for a curiosity and visuospatial processing study. Students participating in the YAB received first-hand experience with developmental cognitive neuroscience research through experience in study development. Additionally, for the citizen science projects, students of varying ages helped to design stimuli for curiosity and spatial thinking measures. First, a curiosity scavenger hunt was developed for students of all ages to help create a measure of scientific curiosity. For this activity, children took images of phenomena in their environment that sparked their curiosity, providing real-life examples that provide insight to what sparks children's curiosity. This study was run on the online citizen science platform SciStarter.org. Submissions will be compiled and used to create a measure of phenomena that might spark individuals curiosity. Second, a citizen science event was run at a local library where children aged 4 to 10 were invited to create stimuli for a spatial thinking measure. Children used magnetic tiles to create various shapes, photographed by the researchers, to be used in future experiments measuring spatial thinking.
Discussion: By involving people from the target population in the research process, we developed measures and stimuli for cognitive neuroscience studies that reflect the population of interest and their life experiences. Though logistically challenging, this collaborative process ensures research relevance, aids in applying findings to real-world situations, and provides children and adolescents opportunities to engage in research in authentic ways.

M55. A LONGITUDINAL INVESTIGATION OF THE IMPACT OF NEIGHBORHOOD-LEVEL OPPORTUNITY ON WORKING MEMORY OF EMOTIONAL STIMULI IN ADOLESCENCE

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Background: Neighborhood resources, such as access to medical care, housing, and education, are well known to shape health outcomes. Yet, few research studies have evaluated the neurobiological mechanisms in which neighborhood quality impacts cognitive processing of threatening stimuli. Previous literature has documented that individuals from lower socioeconomic status (SES) Background:s show increased activation when looking at negative stimuli when compared to those with higher SES (Muscatell et al., 2012; 2018). No studies to our knowledge, however, have explored how neighborhood conditions impact processing of affective information. Neighborhood conditions encompass an important context in which individuals develop in; thus, exploring associations between neighborhoods and cognitive processing of affective stimuli is imperative for documenting the impact of structural inequality on development. Here, we evaluate whether neighborhood quality impacts performance during an emotional working memory task, longitudinally.
Methods: Participants (N=98, Mage =18.33, 51% female at birth) completed a longitudinal study in their preschool years, and a follow-up during adolescence. Childhood neighborhood resources and conditions were measured using the Child Opportunity Index (COI; Noelke et al., 2020). The COI is a composite metric of the quality of resources, opportunities, and conditions present in each neighborhood. Twenty-nine indicators across education, health/environment, and social/economic domains are used to calculate a composite score.

In the adolescent follow-up, participants completed an emotional face N-Back task inside an fMRI scanner, adapted from the ABCD study. The task included two runs of 6 blocks each; each block contained 20 trials and presented either black-and-white neutral, happy, or fearful faces. Of the 98 participants scanned, 2 participants did not complete the task, and 4 participants were further excluded because they had < 50% accuracy across all trials. Thus, the final analysis sample is comprised of 92 participants.

Linear mixed models were used to evaluate the association between emotion stimulus condition, childhood opportunity, and accuracy performance during 2-back trials. All behavioral analyses were conducted in R using the lmer package. All analyses included participant identifiers as a random effect term and controlled for age at the fMRI visit and sex assigned at birth. Preliminary analyses of task effects (2back vs 0back) were conducted in FSL.

Results: Analyses revealed that there was a significant main effect of task conditions. Participants performed better in the happy condition ($B = 4.76$, $p < 0.001$), and worse in fearful condition ($B = -2.34$, $p < 0.05$), in comparison to the neutral condition. COI was positively associated with emotional working memory ($B = 0.12$, $p < 0.05$). Analyses also revealed a significant interaction between task condition and COI. Specifically, greater COI score was associated with better performance on the 2-Back trials for fearful faces only ($B = 0.09$, $p < 0.05$). FSL analyses indicated that participants recruit expected regions in the prefrontal and parietal cortex in support of N-back task performance.

Discussion: Findings from behavioral data indicate that individuals residing in lower-resourced communities exhibit differences in working memory performance for fearful versus happy and neutral stimuli. These results suggest that the community context shapes cognitive processing of affective cues and underscores the importance of enhancing resources and informing policy initiatives to mitigate the impact living in a low resourced environment has on development. In addition, preliminary analyses confirm that participants activate regions of the cognitive control network more on 2 vs. 1 back trials in this task. Subsequent unbiased whole brain analyses will examine the association between COI and neural activation for fearful > neutral and happy > neutral trials.

M56. CHILDHOOD NEIGHBORHOOD-LEVEL SOCIOECONOMIC FACTORS ARE ASSOCIATED WITH NEURAL NETWORK EFFICIENCY DURING YOUNG ADULTHOOD

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Background: Socioeconomic disadvantage during childhood is well-established as increasing risk for physical and mental health difficulties that persist over time. Researchers have sought to identify the neural mechanisms that underlie these disparities, with studies finding socioeconomic differences in functional connectivity in large-scale neural networks, such as the central executive network (CEN), default mode network (DMN), and salience network (SN) (Rakesh et al., 2021). In addition to family-level factors, neighborhood-level aspects of the environment play a critical role in shaping children's development. Although neighborhood-level socioeconomic disadvantage has been associated with neural function (Tooley et al., 2020), research is needed on how specific aspects of the neighborhood environment, such as air pollution and noise, may

influence the functional organization and efficiency of neural networks. In this resting-state functional magnetic resonance imaging (fMRI) study, we used graph theory analysis to examine the associations between neighborhood socioeconomic exposures during childhood and the organization and efficiency of the CEN, DMN, and SN in young adulthood.

Methods: Participants were typically developing 18- and 19-year-olds (N = 46, 70% female) from diverse socioeconomic Background:s (e.g., parental education range: 5-22 years, M =13). Neighborhood measures included the social vulnerability index (SVI), which reflects vulnerability to disease and disaster based on socioeconomic factors (Center for Disease Control [CDC], 2020), an air pollutant exposure composite (CDC, 2020), and chronic noise exposure measured by equivalent continuous sound level (LAeq; DOT, Seto and Huang, 2023). SVI, air pollution exposure, and LAeq were extracted for the childhood home address of each participant following prior methodology (Fan et al., 2021). Resting-state fMRI data were processed using the CONN toolbox (Whitfield-Gabrieli and Nieto-Castanon, 2012), with nodes of each network defined by the Gordon-Schaeffer 100 node parcellation (Schaefer et al., 2018). Graph theory measures of network topology (e.g., global efficiency, clustering coefficient) were computed to characterize the local and global organization and efficiency of each neural network.

Results: Results showed that higher neighborhood social vulnerability (β = -.07, p = .03) and higher air pollutant exposure (β = -.04, p = .02) were significantly associated with lower global efficiency in the SN. Higher chronic noise exposure was significantly associated with lower clustering coefficient in the CEN (β = -.04, p = .04). All analyses controlled for age, sex, parental education, and head motion.

Discussion: Findings suggest that neighborhood-level social vulnerability, air pollution, and chronic noise exposure during childhood are associated with the functional organization of the brain during young adulthood. Greater interconnectedness is optimal for faster and more efficient communication between long-range brain regions. Greater neighborhood social vulnerability and air pollution exposure were associated with reduced global efficiency in the SN. These results are consistent with the notion that these neighborhood factors may alter the interconnectedness of the SN, which is essential for detecting important cognitive and emotional environmental stimuli, and thereby supporting attentional and emotional processes (Uddin, 2016).

Greater neighborhood noise exposure was associated with a lower clustering coefficient in the CEN, suggesting that neighboring nodes are less interconnected, which may indicate reduced local efficiency or functional segregation in the CEN. The neural architecture supporting cognitive control may become less organized or less specialized under conditions of increased neighborhood noise. Intervening to improve neighborhoods may impact neural development during childhood in ways that support long-term physical and mental health outcomes.

M57. PANDEMIC EFFECTS: MATERNAL STRESS AND FOOD INSECURITY IN RELATION TO MATERNAL COGNITIVE CONTROL CIRCUITS AND CHILDREN'S SOCIOEMOTIONAL FUNCTIONING AT 2-3 YEARS

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Background: The COVID-19 pandemic had a pervasive impact on daily stress and exacerbated pre-existing negative social determinants of health (e.g., food and housing insecurity) among

families of young children. Elevated parental stress and unstable access to resources could be implicated in dysregulation of cognitive control systems in parents, conferring risk for the intergenerational transmission of self-regulatory deficits. The goal of this study is to test effects of maternal stress and food insecurity on early emerging psychopathology symptoms among pandemic-born 2-3 year-olds. We also aim to evaluate whether maternal cognitive control networks are predicted by maternal basic needs instability and perceived stress, and whether maternal cognitive control networks associate with emerging psychopathology in children.

Methods: Mothers with and without SARS-CoV-2 infection in pregnancy were enrolled in the COVID-19 Mother-Baby Outcomes (COMBO) Initiative. Mothers completed surveys assessing food insecurity (assessed at 2, 4, 6, 9, 18, and 24mo postpartum), perceived stress (Perceived Stress Scale 4 and 18mo postpartum), and child socioemotional functioning (Child Behavior Checklist; CBCL 1.5-5 at age 2 and 3). Food insecurity was assessed via standardized questions ("Within the past 1 month have you worried that your food would run out before you got money to buy more?" and "Within the past 1 month did the food you bought just not last, and you didn't have money to get more?"). Resting state fMRI data was acquired on mothers before children turned 2 years old. fMRI data were processed using ABCD-HCP Pipeline.

Results: Thirty-two percent of the sample (133 out of 415) experienced food insecurity. In adjusted regression models, food insecurity predicted greater child internalizing symptoms at age 2-3 (β=.13, p=.007), but not externalizing symptoms (β=.01, p=.84). Greater maternal perceived stress associated with both internalizing (β=.20, $p < .001$) and externalizing (β=.27, $p < .001$) symptoms. Prenatal exposure to SARS-CoV-2 was not associated with child internalizing or externalizing symptoms. In the subset of mothers who completed resting-state fMRI scans (n=76), adjusted regression Results: suggested that food insecurity (β=.29, p=.03), but not maternal stress (β=.18, p=.17) associated with increased connectivity between frontoparietal (FPN) and default mode networks (DMN). Greater FPN-DMN connectivity was associated with marginally greater child internalizing symptoms (β=.25, p=.05), but not externalizing symptoms (β=.15, p=.24) in children when they were 2-3 years old.

Discussion: Lack of access to basic needs and parental stress confer risk for early signs of psychopathology in pandemic-born children, with food insecurity uniquely associating with child internalizing symptomatology. Food insecurity specifically predicted the entanglement of networks in mothers that should be segregated to support adaptive cognitive control. Preliminary Results: suggest dysregulation of maternal cognitive control networks appear to be most strongly associated with early emerging internalizing symptoms in children, although this effect was modest. Improving families' access to basic needs and mental health services has the potential to have a two-generation impact on parent and child health.

M58. EARLY LIFE UNPREDICTABILITY PREDICTS DEFICITS IN REWARD LEARNING IN YOUNG CHILDREN**

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Background: Unpredictability represents a novel type of childhood adversity characterized by inconsistency in caregiver interactions, environmental instability, and chaos. Dimensional models of childhood adversity suggest that specific dimensions of experience could lead to distinct

**Flash Talk

neurodevelopmental trajectories that increase risk for psychopathology. Moreover, preclinical models suggest that unpredictability in maternal sensory signals impacts neurobiological functioning, including reward learning deficits. However, studies on childhood unpredictability often inconsistently operationalize this construct, which may diminish the reproducibility of findings. As such, we seek to identify dimensions of unpredictability across common parent-report operationalizations of this construct using exploratory factor analysis (EFA). Then, we utilize these emerging parent-reported dimensions of unpredictability, and an observational measure of unpredictability in caregiver signaling to better understand the relationship between unpredictability and reward learning in children.

Methods: The present analyses comprise 245 participants recruited between 4-7 years old (Mage=5.84 years, 50.2% female, 50% nonwhite) who completed the Piñata task, a validated child-friendly version of the monetary incentive delay task with three reward levels: 0 stars, 2 stars, or 4 stars. A subset of these participants' caregivers (N=145) completed measures of unpredictability, including the Questionnaire of Unpredictability in Childhood, the Family Routines Inventory, the Confusion, Hubbub, and Order Scale, the Family Life Project Chaos Scale, and the Food Insecurity Questionnaire. Caregiver-child dyads (N=89) participated in a parent-child interaction task, which was quantitatively coded for entropy rate, or the degree to which the caregiver's future behavior could be predicted from their current behavior. An EFA was conducted using oblique rotation and factors were extracted for linear models. Finally, linear mixed modeling was used to evaluate the association between each measure of unpredictability (entropy and extracted factors) on reward accuracy between each reward condition. Each model included participant IDs as random effects and gender as a covariate.

Results: For parent-reported measures of unpredictability, a two-factor solution was indicated. The first factor compromised variables related to environmental stability: food insecurity, household instability, parental environment, parental predictability, stability of the physical environment, and safety and security. The second factor comprised variables related to routines and organization: parental monitoring and involvement, household chaos, household disorganization, and family routines. Participants showed increased accuracy with reward levels 2 ($p < 0.001$) and 4 ($p < 0.001$) relative to level 0. Increased entropy was associated to lower accuracy at reward levels 2 ($t(174)=-2.342$, $p=0.02$) and 4 ($t(174)=-2.733$, $p < 0.01$). Neither factor of parent-reported unpredictability was significantly associated to reward accuracy.

Discussion: Our factor analysis highlights how differing parent-reported measures of unpredictability may not be measuring the same underlying construct. Thus, these factors can inform future research seeking to operationalize unpredictability in a nuanced way. Additionally, we show that unpredictable caregiver signaling during early childhood was related to reduced reward learning. These findings are the first to replicate pre-clinical findings of unpredictable caregiver signaling in a sample of young children, as previous work has focused on measuring this construct in caregiver-infant dyads. Furthermore, they provide increased evidence for unpredictability as a distinct early life risk factor in development and suggest reward learning as a potential pathway. Future research should investigate neural activity during reward processing tasks to better elucidate this relationship, and associations with psychopathology.

M59. TIMING-DEPENDENT ASSOCIATIONS BETWEEN HARSH AND WARM CAREGIVING AND FUNCTIONAL BRAIN ARCHITECTURE: LONGITUDINAL IMPLICATIONS FOR RISK AND RESILIENCE

Cleanthis Michael*[1], Arianna Gard[2], Scott Tillem[1], Felicia Hardi[1], Erin Dunn[3], Andrew Smith[4], Vonnie McLoyd[1], Jeanne Brooks-Gunn[5], Colter Mitchell[1], Christopher Monk[1], Luke Hyde[1]

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Background: Environmental experiences exert a powerful influence on development and health across the lifespan. Caregiving is one of the strongest species-expected environmental determinants of mental health in children, partly through its impact on brain development. Cross-sectional and prospective studies focusing on cortico-limbic circuitry suggest that the effects of adverse caregiving (e.g., harshness) depend on developmental timing. However, limited prospective longitudinal research has examined such sensitive periods in humans with (a) the ability to parse timing-specific from cumulative effects, (b) both adverse (e.g., harshness) and supportive (e.g., warmth) caregiving, and (c) other relevant brain systems beyond the cortico-limbic circuit.

Methods: The present study investigated how harsh (parent-reported psychological aggression) and warm (observed responsiveness) caregiving during early (3 years), middle (5 years), and late (9 years) childhood relate to brain architecture during adolescence (15 years) and mental health in early adulthood (21 years) during the peak of the COVID-19 pandemic. We examined 173 youth (55% female; 80% Black) from the Future of Families and Child Wellbeing Study, a longitudinal birth-cohort study with high representation of low-income, racially minoritized families that have been underrepresented in neuroimaging research. Connectivity and graph theoretic analyses of combined resting-state and task-based fMRI data characterized brain architecture at the: (a) regional level as betweenness centrality (influence on information flow) of prefrontal cortex (PFC) and amygdala; (b) circuit level as PFC-amygdala connectivity; and (c) whole-brain level as modularity (network segregation). Leveraging recent statistical innovations (structured life-course modeling approach; SLCMA), we disentangled timing-dependent from cumulative associations to identify sensitive periods in the neurobiological embedding of caregiving.

Results: SLCMA demonstrated that brain architecture was sensitive to the timing (early, middle, or late childhood), rather than the accumulation (combining across early, middle, and late childhood), of caregiving. Specifically, we found that the associations of harsh caregiving were widespread across the entire brain (higher modularity) in early childhood, but localized to PFC-amygdala circuitry (more negative connectivity) in late childhood. The associations of warm caregiving were localized to the amygdala (higher centrality) and PFC (lower centrality) in middle childhood. Importantly, warmer caregiving in middle childhood forecasted lower anxiety and depression in adulthood during a major stressor (COVID-19 pandemic) via higher amygdala centrality in adolescence. Sensitivity analyses with randomly permuted brain architectures and key covariates (demographics, socioeconomic status, concurrent internalizing symptoms) confirmed the specificity and robustness of our findings.

Discussion: This prospective longitudinal study spanning less than 20 years demarcates neurodevelopmental windows of vulnerability and opportunity, with implications for subsequent emotional wellbeing during a global unprecedented stressor. These findings are consistent with the notion that the developing brain may be particularly shaped by both stressful and supportive environments during sensitive periods of enhanced plasticity to ultimately confer psychiatric risk and resilience. Such neurodevelopmental precision can inform the environments and mechanisms targeted by interventions and prevention efforts that focus on developmental stage, history, and psychosocial context. Our results may also encourage reform of policies that restrict caregivers' capacity to express behaviors that promote children's neurodevelopment and mental health.

M60. NEURAL REPRESENTATIONS OF SHARED ATTACHMENT SCHEMAS IN ADOLESCENTS FOLLOWING EARLY CAREGIVING ADVERSITY

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Background: How are attachment schemas dynamically represented in the brain? This study tested the hypothesis that stimulus-evoked neural patterns in midline cortico-subcortical circuitry reflect the content of early caregiving experiences acquired by adolescence.
Methods: The sample comprised 98 adolescents (10-17yo; 43F/55M), 54% of whom were exposed to caregiving-related early adversity (crEA). We measured BOLD responses to abstract shape animations designed to evoke attachment schemas (secure: big oval returns to small oval after being separated; vs insecure: big oval abandons small oval after separation). To evaluate dynamic shifts in how the content was represented in the brain, we segmented each animation into 6 events and then computed the representational similarities using inter-subject spatial pattern correlations (pISCs).
Results: The extent to which neural representations were similar/shared across individuals varied as a function of early experience and attachment schema content. Namely, at the moments of abandonment in insecure animations, crEA exposure was associated with increased pISCs in the amygdala, ventral striatum, hippocampus, and ventromedial prefrontal cortex. Conversely, non-exposed comparisons exhibited higher pISCs in the ventral striatum and posterior medial cortex, specifically during the reunion events.
Discussion: Findings provide preliminary insight into how shared semantic content of early caregiving experiences is represented similarly and dynamically in the adolescent socioemotional brain.

M61. A LONGITUDINAL STUDY OF MATERNAL PRENATAL INFLAMMATION, EEG POWER AND PRE-ACADEMIC SKILLS

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Background: Maternal inflammatory conditions have been linked to various offspring neurodevelopmental outcomes. The underlying mechanisms may be better understood by investigating the effect of in utero exposure to maternal inflammatory markers on brain development. Prior research has shown that maternal prenatal inflammatory makers, such as C-reactive protein (CRP) and tumour necrosis factor-alpha (TNF-α), are associated with cognition, brain structure and brain activity in infants and children. Hence, this study aimed to examine the longitudinal relations between prenatal exposure to maternal inflammatory markers, brain electrophysiology and pre-academic skills.

Methods: Data were from the Growing Up in Singapore Towards healthy Outcomes (GUSTO) birth cohort. Maternal serum levels of CRP, TNF-α, Interferon-gamma (IFN-γ) and Monocyte chemoattractant protein-1 (MCP-1) were obtained at 26 weeks' gestation (N=1214). Child resting electroencephalography (EEG) was recorded at 18 months for 3 minutes using 128-channel Geodesic Sensor Nets (Net Amp 300, Electrical Geodesic; n=150). Power spectral density was derived with the Harvard Automated Processing Pipeline for EEG (HAPPE) and Batch EEG Automated Processing Platform (BEAPP). Pre-academic skills were assessed using the Lollipop Test, Number Knowledge Test and Peabody Picture Vocabulary Test, Fourth Edition, at age 4 (n=783). Pearson's correlation and linear regression was used to determine associations between inflammatory markers, EEG power and pre-academic skills. Structural equation modelling (SEM) was then used to investigate EEG power as a mediator between inflammatory markers and pre-academic skills.
Results: Maternal prenatal CRP positively correlated with low-frequency power (absolute delta, absolute theta and relative delta; r: 0.166 to 0.205) and negatively correlated with all pre-academic skills (general knowledge [colours, shapes], numeracy and vocabulary; r: -0.076 to -0.183). Low-frequency power negatively correlated with general knowledge and numeracy (r: -0.196 to -0.257). Number sense remained associated with maternal prenatal CRP and absolute low-frequency power after linear regression models were adjusted for monthly household income, maternal education, ethnicity, pre-pregnancy BMI and gestational age (Cohen's f2: 0.134-0.206). SEM showed that absolute delta power provided an indirect path from maternal prenatal CRP to number sense after adjusting for monthly household income (Indirect/total effect: 55.4%; x2: 0.169; CFI: 1; TLI: 1; RMSEA: 0; SRMR: 0.011) and pre-pregnancy BMI (Indirect/total effect: 52.4%; x2: 0.064; CFI: 1; TLI: 1; RMSEA: 0; SRMR: 0.007) in two separate models. Maternal prenatal TNF-α, IFN-γ and MCP-1 were not associated with EEG power and pre-academic skills.
Discussion: Elevated maternal prenatal CRP was associated with higher low-frequency power and poorer pre-academic skills in this study. These Results: suggests a longitudinal effect of dysregulated gestational immune environment on the cognitive and learning profiles of children. It also highlights the need to understand how childhood brain function is altered by in utero exposures, as this may influence later academic achievement.

M62. EARLY EXPOSURE TO INTIMATE-PARTNER VIOLENCE PREDICTS ANGER BIAS IN EARLY AND MIDDLE CHILDHOOD: AN 8-YEAR LONGITUDINAL INVESTIGATION

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Background: Dimensional models of early adversity propose that violence, but not deprivation, is associated with specific transdiagnostic processes that confer risk for psychopathology, such as fear learning and emotion dysregulation. Moreover, exposure to violent environments may also influence social information processing biases that facilitate threat detection, such as anger bias.
Methods: We examined associations of intimate-partner violence measured early in development (18-36 months), anger bias, and emotion recognition in early (72 months) and middle (96 months) childhood in a sample of 126 mother-child dyads. Analyses controlled for deprivation, parents' emotion socialization, socioeconomic disadvantage, age, and child's sex assigned at birth.

Results: Experiences of intimate-partner violence were associated with anger bias in early (β = .24, p = .01), and middle (β = .185, p = .04) childhood, while experiences of deprivation were not. Moreover, intimate-partner violence was not associated with global emotion recognition after controlling for experiences of cognitive deprivation.
Discussion: This pattern suggests that young children who experience violence show attentional biases that facilitate threat detection, which in turn could increase their risk for psychopathology and other negative outcomes.

M63. FAMILY ADVERSITY AND THE ERROR-RELATED NEGATIVITY IN CHILDREN: SUPPORTIVE PARENTING AS A PROTECTIVE FACTOR

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Background: High levels of stress and adversity in the family environment have been significantly associated with reduced executive function in children (Lund et al., 2020). At the neural level, family adversity may influence children's error-related negativity (ERN), an event-related potential (ERP) that reflects neural processing underlying error monitoring. A larger negative ERN amplitude suggests more efficient neural processing of error monitoring. Studies have found that children exposed to high levels of family adversity may have an altered ERN compared to children with less adversity exposure (Brooker, 2018). However, these studies have yielded mixed Results: (Perera-W.A. et al., 2021), which points to the role of moderators influencing these associations. Supportive parenting is theorized and found to be a main protective factor that may mitigate the negative impacts of high family adversity on health, cognitive, and neural outcomes (Kahhalé et al., 2023; Newland, 2014). However, few studies have examined the associations among family adversity exposure, supportive parenting, and the ERN in children. Therefore, the goal of this study was to examine the moderating role of supportive parenting in associations between family adversity and ERN amplitudes in children.
Methods: Participants were typically developing 5- to 13-year-olds (50% male, N = 50) from socioeconomically diverse families living in the mountain west region of the U.S.A. Multiple linear regression analyses were performed. The first factor was a family adversity composite score, computed via a principal component analysis using parental perceived stress, material hardship, and stressful life events scores. The second factor was positive parenting, which was the sum of parent's self-reported parenting style on the Multidimensional Assessment of Parenting Scale (Parent and Forehand, 2017). The dependent variable was ERN amplitude, which was measured via an electroencephalography (EEG) during an error monitoring task (Davies et al., 2004; Lin et al., 2020). For each participant, from a response-locked averaged ERP of all incorrect trials, the ERN amplitude was measured. Multiple linear regression analyses were performed, including a family adversity-by-positive parenting interaction term, while controlling for child's age, sex, and number of errors on the flanker task.
Results: Results: revealed that the interaction between family adversity and positive parenting was significant (p < .001), indicating that the association between family adversity and children's ERN varied depending on the level of parental support. A simple slopes analysis indicated that at low levels of parental support, increased exposure to family adversity was associated with a smaller ERN amplitude (β = .39, p = .02). At high levels of parental support, increased exposure to family

adversity was associated with a larger ERN amplitude ($\beta = -.40$, $p < .01$). These results remained significant when additionally controlling for race/ethnicity and family income.
Discussion: These findings elucidate the associations among family adversity, parental support, and children's neural function associated with error monitoring. Specifically, these Results: suggest that children experiencing high adversity in the home, along with low levels of parental support, may have altered neural activation associated with error monitoring. Supportive parenting may act as a protective factor for children experiencing high levels of family adversity, leading to improved neural processing underlying error monitoring. Error monitoring is a cognitive control skill that plays a pivotal role in important life domains, such as school success and mental health. Therefore, understanding these associations may inform the design of more effective interventions that lead to improved executive function and mental health and academic outcomes in children.

M65. SOCIOECONOMIC DISADVANTAGE IN THE ADOLESCENT BRAIN COGNITIVE DEVELOPMENT STUDY: ASSESSING ASSOCIATIONS WITH WORKING MEMORY AND EMOTION REGULATION

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Background: Previous research has indicated that socioeconomic disadvantage can lead to poorer mental health outcomes, though the mechanisms are not well understood. Through this investigation we seek to characterize the associations among socioeconomic disadvantage and emotion regulation in children in the Adolescent Brain Cognitive Development (ABCD) study and test working memory as a mediator.
Methods: Data from 11,876 children and adolescents from the baseline and year 3 wave of the ABCD study will be used. Socioeconomic disadvantage will be measured using the Area Deprivation Index and income-to-needs scores derived from self-report measures. Emotion regulation will be characterized as suppression and reappraisal, measured from survey data. Working memory will be operationalized behaviorally and through neural activation and assessed using the NIH Toolbox List Sorting Task and N-back task, respectively. Mixed effects modeling will be used to assess the association between socioeconomic disadvantage and each type of emotion regulation as well as how the differing dimensions of adversity are associated with working memory. Structural equation modeling (SEM) will be used to assess if disruptions in working memory mediate the relationship between socioeconomic disadvantage and emotion regulation impairments.
Results: -
Discussion: -

M66. LONGITUDINAL TRAJECTORIES OF RESILIENT PSYCHOSOCIAL FUNCTIONING LINK TO ONGOING CORTICAL MYELINATION AND FUNCTIONAL REORGANIZATION DURING ADOLESCENCE

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Background: Adolescence is a period of marked brain remodeling mediating biological and psychosocial maturation, but also heightened susceptibility to environmental adversity that can impact developmental trajectories (Parkes et al., 2021; Paus et al., 2008). Studying longitudinal trajectories in the presence of adversity exposure (Holz et al., 2023) and psychiatric symptoms (Parkes et al., 2021; Yu et al., 2023; Ziegler et al., 2019) has thus been fundamental to advancing our understanding of inter- and intra-individual differences in psychiatric susceptibility. At the same time, there is a growing emphasis on recognizing that many individuals retain mental well-being despite adversity, i.e., show resilient adaptation (Hoppen and Morina, 2019; Kalisch et al., 2017; Kessler et al., 2017). To comprehend dynamic bio-behavioral adaptation to a constantly changing environment, it has been vital to integrate neurodevelopmental assessments, complementary to inter-personal and physiological factors. Here, we were specifically interested in ongoing myelination, due to its double role in mediating adaptive circuit maturation and efficiency (Mount and Monje, 2017; Paus, 2010): While myelination restricts structural plasticity by consolidating established connections, it has also been found to continuously modulate network dynamics to adapt to ever changing environmental circumstances (Mount and Monje, 2017; Xin and Chan, 2020).

Methods: We investigated myeloarchitectural maturation associated with trajectories of psychosocial functioning relative to differences in environmental adversity exposure in a longitudinal cohort of adolescents and young adults (age 14-26 years; Neuroscience in Psychiatry Network). Conceptualizing resilience as a better than predicted outcome given the adversity faced, we quantified continuous stressor resilience scores by predicting mental well-being from measures of environmental adversity, including adverse life events, childhood trauma, parenting style, family situation, and socioeconomic status, and extracting the model residuals. To study its dynamic nature, we then linked changes in stressor resilience scores to maturational trajectories of local myelination (as approximated by magnetic transfer saturation (MT). Here, we took both regional mean MT as well as intra-cortical profiles into account, by sampling intensity values along 10 intracortical depths. Based on that, we computed large-scale microstructural profile covariance (MPC) which allowed us to estimate synchronized maturational profiles across the cortical landscape. Across analyses, microstructural findings were contextualized with functional network changes.

Results: Our findings suggest that developing towards more resilient mental health outcomes is linked to a higher rate of anterolateral prefrontal myelination alongside stabilized functional connectivity of those regions with abstract cognitive networks. Moreover, we observed stronger cortex-wide myeloarchitectural re-organization of association cortices. Conversely, adolescents who became more susceptible to stressors with age exhibited maturational trajectories more closely tied to earlier stages of adolescence, reflected in weaker microstructural reorganization and less stable functional connectivity in several association regions, specifically the prefrontal cortex.

Discussion: Together, resilience and susceptibility to psychosocial adversity show considerable intra-individual variation reflected in dynamic, multi-level cortical refinement of late-maturing association cortices. Thus, our findings suggest that the degree to which adolescents and young

adults develop to cope with psychosocial stressors is supported by myelin plasticity – reflected in both local growth and globally synchronized intra-cortical differentiation - accompanied by functional stability. This may reflect a benefit of enhanced consolidation protecting against stress-induced re-modeling.

M67. RELATIONS BETWEEN CONFLICT-RELATED MIDFRONTAL THETA AND COGNITIVE CONTROL IN DIFFERENT PRESCHOOL-AGED GROUPS

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Background: Children develop better attention and action control as they age (Chevalier et al., 2021). Cognitive control undergoes significant development during the preschool years, contributing to improvements in inhibition and cognitive flexibility (Best et al., 2009). Conflict monitoring, crucial for cognitive control, involves signaling the activation of control mechanisms when conflict arises, and children demonstrate improvement in tasks requiring conflict monitoring and resolution as they age (Chevalier et al., 2021, 2019; Cragg, 2016). Conflict detection involves a network of brain structures, including the anterior cingulate (ACC) and lateral prefrontal cortices, as well as their connections to parietal regions (Adam et al., 2019; Chevalier et al., 2021; Conejero et al., 2016; Nigbur et al., 2011).
Neural oscillatory activity between 4 and 8 Hz, known as theta frequency, is suggested to coordinate cognitive processes within the neural circuits involved in cognitive control (Adam et al., 2019; Chevalier et al., 2021; Conejero et al., 2016; Nigbur et al., 2011). Enhanced midfrontal theta oscillations are directly associated with cognitive control performance (Adam et al., 2019; Chevalier et al., 2021; Nigbur et al., 2011). In a recent study, Meyer and colleagues (2019) found that theta power in the fronto-medial region increased in preschool children during cognitive tasks. Nonetheless, the underlying neural mechanisms contributing to the development of cognitive control in preschool-aged children remain poorly understood. This study aims to determine how midfrontal theta in response to conflict changes with age.

Methods: Our target sample size is 60 children aged 3 to 5 years inclusive. As the need arises, we will over-recruit children aged 3 years to ensure sufficient sampling of this age, especially given that children in this age group will likely have more missing data for the EEG task. Currently, we have collected data from 38 children. Recruitment will occur through fliers distributed to local childcare facilities, preschools, community locations, family-targeted websites, and our lab database. Participants will be paid a $100 gift card for agreeing to participate. As part of a broader assessment that includes other cognitive tasks, children will be fitted with a 32-channel wireless EMOTIV Pro EEG Head Cap and perform a simple version of the Animals Stroop task (Adams and Jarrold, 2009). Data will be collected in Emotiv Pro at a 256Hz sample rate (the 20148Hz sampling is automatically downsampled). Children are first asked to name the animals (cat, pig, cow, dog, sheep) and then to name the animals without their heads before completing 10 practice trials. During this time, support is provided by the research assistant administering the task. Thereafter, there are 48 trials of each type, with research assistants providing limited support. During no-conflict trials, children are presented with pictures of well-known animals (e.g., dog, cow, pig) whereas conflict trials will include chimera (e.g., a dog with a pig head). Trials are presented for a maximum of three seconds and the examiner inputs whether the child's verbal response is accurate or not to advance the subsequent trial. Inter-trial interval is 500ms. There is a

short break halfway through the task to check impedances. A study with infants (Conejero et al., 2018) found that there was a change in midfrontal theta when they viewed similar conflicting stimuli. Therefore, regardless of whether the youngest children are able to articulate responses to the conflict trials, we expect still to be able to measure theta in response to conflict.

Results: We will present the preliminary results for the poster. The results are pending at this stage.

Discussion: The study anticipates finding a positive correlation between age and midfrontal theta power, indicating increased cognitive control development with age. These findings will enhance understanding of brain development supporting cognitive control.

M68. INVESTIGATING THE ROLE OF SUBJECTIVE AWARENESS IN THE DEVELOPMENT OF EXECUTIVE FUNCTION

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Background: Research on the development of metacognition has historically remained independent from research on the development of executive function (EF) skills. Recent theoretical proposals unify metacognition and EF under the skill of reflection, or the ability to consciously reprocess information in real-time (Lyons and Zelazo, 2011; Roebers, 2017). Reflection is manifested as pausing, thinking twice before responding, articulating action plans, and monitoring progress toward a goal. It is a trainable, modifiable skill that improves EF performance and modulates neural indicators of conflict detection in young children (Espinet et al., 2013). Metacognitive decisions regarding when to consciously reflect and when to respond automatically may differentiate the flexible, adaptive self-regulation typical of adolescents and adults from the inflexibility and perseveration characteristic of younger children (Chevalier et al., 2015). The benefits of reflection contrast with articulatory suppression (i.e., the verbalization of task-irrelevant words), which impairs EF performance in children (Fatzer and Roebers, 2012), presumably through discouraging linguistically mediated reflection. The present study examined the relations between metacognitive and EF performance in the Dimensional Change Card Sort (DCCS; Zelazo et al., 2013), while experimentally manipulating the propensity to reflect in 7- to 9-year-olds (n = 56).

Methods: To assess metacognitive monitoring, children were asked “Did you answer the last one right?” with a 5-point scale from 0 (definitely wrong) to 4 (definitely right). To assess metacognitive control, children were asked “Do you want to include the last one in your final score?” with “Yes" and “No” as available options. First, we calculated participants’ overall accuracy and reaction time. Then, to compute a metacognitive monitoring discrimination score, we calculated the difference between mean monitoring judgments during correct vs. incorrect trials. For metacognitive control, we calculated the difference between the likelihood that a child chose to include their correct vs. incorrect responses.

Children were randomly assigned to one of four conditions for the Metacognitive DCCS, including reflection training and articulatory suppression (two control conditions omitted due to space limits). Reflection training included instructions to “pause and think about which of the two games [they’re] playing” instead of “answering without thinking” (Espinet et al., 2013). Articulatory suppression included instructions to repeat aloud the syllable “da-” while playing, in tune with a metronome (Fatzer and Roebers, 2012).

Results: Children in the reflection condition had better accuracy ($\beta = 1.28$, $p < .01$) and displayed a trend toward greater post-error slowing ($\beta = 0.78$, $p = .10$) than those in the suppression condition. Children were significantly more confident in their accuracy on correct vs. incorrect trials ($\mu = 1.59$, $t = 7.82$, $p < .01$) and were more likely to include correct vs. incorrect trials ($\mu = .33$, $t = 5.20$, $p < .01$). Finally, children in the reflection condition showed greater metacognitive control discrimination ($\beta = 1.42$, $p < .05$), but not metacognitive monitoring discrimination ($\beta = .36$, $p > .05$), than those in the suppression condition.
Discussion: Children, on average, displayed successful metacognitive discrimination, but children who underwent reflection training had higher task accuracy and selectively withdrew incorrect answers at a higher rate than those performing articulatory suppression. Also, there was a trending relation between reflection training and adaptively slowing down after errors. The present study is the first to measure children's EF skills and metacognition within the same task, and our experimental intervention similarly influenced performance at both the task- and meta-level. Overall, Results: are consistent with a process model showing how reflection, metacognition, and EF skills work together to yield intentional action.

M69. SEX-SPECIFIC RELATIONSHIPS BETWEEN GRAY MATTER VOLUME AND EXECUTIVE FUNCTIONING IN YOUNG CHILDREN WITH AND WITHOUT PRENATAL ALCOHOL EXPOSURE

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Background: While sex differences in regional and global brain volumes throughout the lifespan are well documented, it remains largely unknown how sex differences in brain structure may relate to cognition. Moreover, associations between sex, brain structure, and executive function in the context of neurodevelopmental conditions remain almost entirely opaque. Prenatal alcohol exposure (PAE) is the most common cause of developmental delay in North America. PAE has a prevalence rate of about 10% and is the leading cause of fetal alcohol spectrum disorder (FASD), which affects in 2-4% of the US population. PAE is associated with alterations in brain structure and difficulties in cognition, including executive function. Moreover, behavioural outcomes of individuals with PAE differ by sex similar to the general population with males with PAE tending to show more externalizing symptoms (ie. aggression, hyperactivity) while females with PAE show more internalizing symptoms (ie. anxiety, depressive symptoms). A better understanding of brain-behavior relationships in children with and without PAE could aid in the future optimization of support services and/or provide additional information aiding advocacy for individuals with PAE.
Methods: In the present study, we investigated the association between gray matter volume and executive function using T1-weighted MRI in a longitudinal sample of young children aged 2-8 years with and without PAE (N=169 (42 exposed), 534 scans (84 exposed)). Regional gray matter volumes were segmented with MaCRUISE software. Executive function was assessed with the BRIEF Global Executive composite (GEC) T-score, a parent report measure of naturalistic executive function, and the Statue subtest of the NEPSY-II, which measures inhibition and motor persistence in a controlled setting. Mixed effects models were used to investigate statistical

relationships between the regional volumes of 39 frontal-cortical and subcortical gray matter regions associated with scores on the GEC and Statue subtest. Three-way interactions of sex, PAE status, and executive functioning (either GEC or Statue), including age as a covariate were examined.

Results: We found significant three-way interactions of sex, PAE, and executive function ($p < 0.05$ after FDR correction) in 28 regions (22 GEC, 6 Statue). More precisely, unexposed males showed negative relationships between executive function ability and volume, while males with PAE showed positive relationships. Unexposed females showed positive relationships between volume and executive function ability, while females with PAE showed weaker positive or no relationships. In regions where the three-way interaction was not significant, reduced mixed effects models indicated a significant two-way interaction of sex and executive function in 25 regions (22 Statue, 3 GEC). Here, males showed a negative relationship between volume and executive function while females showed a positive relationship, regardless of exposure status.

Discussion: Our results suggest that females (especially unexposed females) and males with PAE show a positive volume-executive function relationship, in line with what was observed in previous research in older samples of unexposed adolescents and adults. On the other hand, unexposed males showed negative relationships, possibly reflecting an earlier stage of brain maturation. The positive relationship found in males with PAE may indicate accelerated maturation in this group, consistent with evidence from studies of early adversity, and the notion that neurodevelopment in males is more vulnerable to environmental factors than in females. This study highlights the importance of considering sex in studies investigating associations between brain volume and executive function for probing beyond group-level trends, especially as they relate to populations with neurodevelopmental conditions.

M70. THE MEDIATING ROLE OF PARENTING PRACTICES FOR THE PREDICTION OF CHILDREN'S COGNITIVE CONTROL

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Background: Post-Error slowing (PES) refers to the prolongation of reaction time (RT) after an error, compared to the RT after a correct response. PES is a well-known indicator of the development of the executive attention network and cognitive control. It begins manifesting behaviorally in early childhood, continues to develop throughout preschool and kindergarten ages, and increases up to the ages of 7 to 9 years old. Mothers' parental practices can improve or diminish different aspects of a child's cognitive control; however, the literature linking mothers' own cognitive control to their child's cognitive control is scarce. The present study aims to elucidate the mediating effect of mothers' parenting practices to the development of their child's PES.

Methods: As part of a larger study, 143 mothers and their children performed an Emotional Day-Night (EDN) task and participated in a dyadic interaction collaborative task called the "Etch-A-Sketch". In the EDN task, the mothers' and children's PES was measured. The dyadic interaction was offline coded for each mother's apathy and intolerance towards their child during the task.

Results: Findings indicated that there was no direct path between mothers' and children's PES. However, there was a significant mediation through mothers' apathy and intolerance, such that, mothers with less mature levels of PES showed higher levels of apathy and intolerance, which, in turn, were related to a less developed PES effect in their children.

Discussion: This finding suggests that mothers' parenting practices are, to some extent, the intermediate factor in the intergenerational transfer of cognitive control.

In addition, we are currently analyzing this mediation effect using an electrophysiological measure considered to reflect cognitive control, specifically error processing, i.e., mid-frontal theta band power.

M71. DIFFERENTIAL ASSOCIATIONS BETWEEN CHILDHOOD ADVERSITY AND ADOLESCENT NEUROCOGNITION: APPLICATION OF DIFFUSION DECISION MODELING

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Background: Evidence on theoretical models of adversity suggests that deprivation-related experiences and threat-related experiences pose developmental risks through differential processes. While deprivation is related to changes in cognitive performance, threat operates through emotional learning. However, the reliability of conventional behavioral cognitive measures (e.g., reaction time, accuracy) is poor and often lacks specificity given the multidetermined nature of task performance. Moreover, these questions have not clearly been explored in underrepresented samples. To address these limitations, computational models of cognition, such as diffusion-decision modeling could be applied to better characterize latent processes underlying observed behavior. In particular, the drift rate parameter, which measures individuals' efficiency of evidence accumulation (EEA) for goal-relevant information during decision-making, has been suggested as a key mechanism associated with cognitive functioning and risk for psychopathology. Therefore, the current project aims to examine how experiences of threat exposure, social deprivation, and material hardship differentially link to EEA, specifically in an emotionally salient task.

Methods: A total of 187 adolescents aged 15 to 17 years from the Future of Families and Child Wellbeing Study (FFCWS), a population-based longitudinal cohort study, with substantial representation of marginalized youths (83% Black and Hispanic), were included in the analyses. Participants completed an emotional-faces, gender-identification task while undergoing functional MRI. Reaction times (RT) and responses were recorded and fitted with a diffusion-decision model. Diffusion model parameters, including EEA, were estimated using the Dynamic Model of Choice package in R.

Two types of deprivation measures were examined: material hardship, which evaluated the lived experiences of poverty; and social deprivation, which measured the lack of social relationships and support. Specifically, household material deprivation (i.e., ability to pay for housing, utilities, food, and healthcare) was computed using a cumulative sum score of endorsed items from ages 1, 3, 5, and 9 from FFCWS. Social deprivation (i.e., physical and emotional neglect, intimate partner and community support) was represented using a composite score from ages 3, 5, and 9. Violence exposure (i.e., physical and emotional abuse, intimate partner and community violence) was represented with a composite score using data collected at ages 3, 5, and 9. Multiple regressions were used to examine how adverse experiences were associated with EEA.

Results: Results showed that EEA was significantly associated with cumulative material hardship experience ($r = -0.16$, $p = 0.027$), but not violence exposure or social deprivation (ps $>$ .200). Association between EEA and material hardship remained after controlling for relevant covariates, including pubertal status, race, and sex, as well as experiences of threat and social deprivation.
Discussion: We found that exposure to material deprivation across childhood, but not threat or social deprivation, correlates with lower EEA, suggesting less effective decision-making processes. Notably, this association was found during an emotion task, suggesting a link between material deprivation and affective neurocognitive mechanism. Our findings suggest that deprivation of essential living conditions in childhood may exert greater influence on cognitive processes compared with social input, thus providing further specificity in how different dimensions of adversity could operate through neurocognitive processes. In particular, these findings suggest that material deprivation could not only influence children's decision-making abilities through cognitive mechanisms, but it could also operate through affective mechanisms. These findings provide evidence for future studies that examine potential alterations to brain functioning underlying these links.

M72. THE CONTRIBUTION OF NEUROTEMPORAL DYNAMICS OF VISUAL PROCESSING TO CHILDREN'S READING SKILLS: AN SSVEP STUDY

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Background: Reading difficulty has traditionally been attributed to a phonological deficit, where readers struggle to connect letter sequences with corresponding speech sounds. However, reading is a multidimensional skill that involves several cognitive and sensorial processes. Indeed, converging evidence from behavioral studies suggests that visual processing speed is a unique and significant predictor of reading ability, independent of phonological processing and general performance skills. Some EEG studies usin'g the Event-Related Potential (ERP) paradigm found differences between dyslexia and control groups in the latency–the response delay relative to the onset of the stimulus–of their N1 component during word processing, while other studies have found no such effect, given the lower signal-to-noise ratio (SNR) of ERP signals and that we have to average across trials to obtain latency estimates.
Methods: In this study, we utilized the Steady-State Visual Evoked Potential (SSVEP) paradigm, known for its high SNR and capability to provide individual-level latency estimates through a data-driven component analysis approach. Specifically, we presented three types of stimuli: frequent English words, PseudoFonts, and NonWords, to investigate hierarchical word processing via the contrasts of Word vs PseudoFont, NonWord vs PseudoFont, and Word vs NonWord. Participants were instructed to press a button upon detecting an increase in font size to maintain attention throughout the experiment. EEG-SSVEP data were collected from 67 middle school students, covering a broad age range (8-y-o to 15-y-o) and reading abilities spanning 3rd to 8th grade. This extensive dataset enables a distinct and comprehensive exploration of the connections between brain activity and behavior. Participants' reading proficiency (i.e, reading fluency, reading comprehension) were also collected.
We concentrated on estimating the latency of the neural signal, offering insights for the temporal dynamics of the cortical responses. For SSVEP data, response phases can be computed at multiple

stimulation frequency harmonics. By fitting a line through the phases at harmonics with significant signals, the slope of the linear phase function can be used to estimate the time delay for the SSVEP (i.e., response latency, Norcia et al. (2020)). Of note, the high SNR of SSVEP signals and data-driven component analysis approach make it possible to investigate the latency estimates not only at the group but also at the individual participant level, which offers a unique opportunity to investigate individual differences.

Results: Linear correlations between latency estimates and reading scores showed that participants with higher reading proficiency had shorter latency across all three conditions. Additionally, older participants demonstrated shorter latencies. Moreover, latency estimates across three stimulus contrasts were highly correlated.

Discussion: These results suggest that the neurotemporal dynamics of visual word processing may serve as a good predictor of reading abilities and reading difficulties. Findings of the current study lay the groundwork for future translational and clinical applications, particularly in children with developmental dyslexia.

M73. NEURAL CORRELATES OF MOVIE-BASED VISUAL AND AUDIOVISUAL NARRATION PROCESSING IN CHILDREN AND ADULTS

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Background: Multisensory integration is crucial for our daily interactions (e.g., audiovisual integration for speech comprehension). It allows a cohesive narration perception and fosters effective communication (Noppeney, 2021). Data on the precise behavioral and neural mechanisms supporting early audiovisual narration processing remains rare, possibly due to practical challenges when testing younger children. Movie paradigms enable a more naturalistic study of the development and characteristics of such mechanisms while being more suitable for a wide age range of participants. Here, we aimed to analyze visual and audiovisual narration processing in children and adults using a manipulated movie fMRI design.

Methods: We developed an fMRI movie-watching paradigm including blocks of visual and audiovisual conditions to test audiovisual speech integration and in-/congruency effects. Visuals were based on cartoon movie sequences from “The Snail and the Whale”, however, the narration was manipulated to create 4 task conditions: 1) audiovisual match (AVm), 2) AV non-match due to content manipulation (AVn), 3) auditory non-match/unintelligible due to speech manipulation (backwards speech) (AVu), 4) visual only (control). 3T fMRI data from 63 healthy children (age = 8.92 ± 1.84y; 31♀) and 28 healthy adults (age = 25.85 ± 2.69y; 21♀) were acquired and t-tests compared brain activation patterns within (pFWEc < .05, pCDT < .001 unc.) and between groups (pFWEc < .05, pCDT < .005 unc.).

Results: Overall, we identified shared and distinct neural activation patterns in children and adults. More specifically, children recruited bilateral parietal, temporal, and limbic areas more strongly for AVm compared to AVn scenes. The opposite comparison (AVn > AVm) revealed higher activation bilaterally in middle and inferior frontal regions, the angular and middle cingulate gyrus and the precuneus. Temporal regions, the left lingual gyrus, bilateral angular gyrus and frontal regions showed higher activation during AVm compared to AVu.

Adults showed higher brain activation for AVm > AVn and AVm > AVu in visual and auditory regions, but also in higher-level frontal processing areas. No significant differences in brain activation were found for AVn compared to AVm scenes.

When comparing the groups of children and adults, children activated the bilateral medial frontal cortex and anterior cingulate gyrus and the right superior frontal gyrus more strongly than adults during AVn scenes.

Discussion: Our results indicate that processing meaningful, matching audiovisual information triggers multisensory integration, indicated by the recruitment of integration areas in the posterior temporal cortex such as posterior parts of the middle temporal gyrus in both adults and children (Petrides, 2023).
In children, audiovisual incongruency resulted in frontal activation increases (i.e. inferior frontal gyrus) (Hein et al., 2007; Nath and Beauchamp, 2012) as indicated by AVn > AVm. When comparing matching to unintelligible narration, semantic processing was evidenced by a heightened engagement of the superior temporal cortex and the angular gyrus (Belin et al., 2000; Hein et al., 2007; Kuhnke et al., 2023).

Stronger recruitment of frontal regions and regions for conflict monitoring (Botvinick et al., 2004) during AVn scenes children compared to adults may suggest that children were more challenged processing or trying to integrate the context of a movie when narration is not matching in context.

Our data suggest that the adapted movie paradigm is well-suited for analyzing different forms of audiovisual integration and semantic processing. In the future, our findings may be complemented by connectivity-based analyses. An increased knowledge of the neural correlates during audiovisual integration may provide the foundation for future investigations including clinical populations (e.g., language disorders).

M74. EXAMINATION OF HIGH-DEFINITION TRANSCRANIAL BRAIN STIMULATION TO ENHANCE FOREIGN LANGUAGE LEARNING IN ADULT LEARNERS

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Background: Knowing more than one language can result in better social and occupational outcomes. However, learning a new language is particularly challenging for adult learners (Bernal Castañeda, 2017). While transcranial electrical stimulation techniques have been utilized to enhance various cognitive functions in adults, there is limited, but promising research on the effects of brain stimulation on foreign language learning (Balboa-Bandeira et al., 2021). The current study aims to assess whether high-definition transcranial alternating-current stimulation (HD-tACS) facilitates word learning in a foreign language > word learning in a sham control condition for adult learners.
Methods: Data was collected from sixty-four adults. Participants individually completed a cognitive behavioral battery as well as both an active word learning session with HD-tACS stimulation and a sham learning session. The order of the learning sessions was counterbalanced across participants and conducted on separate visits. During the learning sessions, an association learning task was used to familiarize participants with the Russian label for objects using a set of pictures. The learning paradigm and task timing were similar to word pair training, used in

previous brain stimulation studies (e.g., Fiori et al., 2018; Perceval et al., 2017). The learning session consisted of training blocks and response-with-feedback blocks, to cultivate expressive and receptive word learning. Stimuli were presented one at a time on a computer monitor, and the total session lasted approximately 25 minutes. The HD-tACS protocol involved the application of 7 surface electrodes using conductive gel positioned in brain regions associated with language and executive functioning. HD-tACS was applied during each learning session (during the full session for the real stimulation session and a shortened time during the sham stimulation session). This approach is the current gold standard of sham in non-invasive brain stimulation and has been shown to match the perceptual experience of real stimulation prior to the participant's habituation. After each learning session, participants completed an expressive word assessment and visual recognition assessment. Participants were asked to return to complete a follow-up visit 2-4 weeks after the second learning session to complete the expressive and recognition word assessments from their prior visits to access retention. The accuracy of the assessments were compared across the HD-tACS and sham conditions. Additionally, accuracy during the three response blocks of the learning sessions was measured and compared across conditions.

Results: To reduce confounds within the data, including exposure effects, we focused on only Visit 1. When analyzed as a between-subject design, effect sizes up to 0.30 were observed across 6 of 7 language learning metrics. These findings suggest brain stimulation may enhance foreign language learning in Russian during the learning, outcome, and retention phases. However, we note that we have a small sample size and none of the findings are statistically significant, perhaps due to power. Initial findings also revealed individual differences in working memory and past language experiences on brain stimulation effects. For example, individuals with higher levels of initial working memory exhibited greater language learning effects of brain stimulation than those with lower initial levels of working memory.

Discussion: Findings from this work will help educators and scientists to better understand how adults learn a foreign language and potentially provide evidence for a new approach to facilitate foreign language learning.

M75. UNCERTAINTY-DRIVEN EXPLORATION FOLLOWING ACTIVATION OF SOCIAL ATTACHMENT

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Background: Optimal learning requires constant arbitrating of the exploration-exploitation dilemma, that is, choosing between exploiting known options (exploitation) and exploring unfamiliar options (exploration). As social creatures who, starting from birth, depend on social bonds for survival, we develop explore-exploit strategies within strongly attached social relationships. Indeed, a core tenet of attachment theory is that by continuously providing the child's needs, caregivers, and later other supporting figures, create a stable attachment representation – a sense of safety that allows the child to explore the uncertain (Bowlby, 1982). However, different exploratory decisions may yield different learning outcomes, highlighting the need to investigate how attachment representations affect specific exploration strategies. Here, we used behavioral and computational Methods: to investigate how experimentally activating the attachment representation affects two different exploration strategies in a complex reward-learning environment. We differentiated between exploration driven by information/uncertainty seeking

(directed exploration) and exploration decided randomly (random exploration). Notably, individual tendencies toward one exploration strategy or another have been associated with different psychological outcomes (e.g., ADHD, anxiety, and depressive symptoms), stressing the need to disentangle directed and random exploration and understand how attachment relationships affect them. Because attachment relationships increase the sense of safety and uncertainty tolerance, we hypothesized that activating the attachment representation will increase specifically uncertainty-driven directed exploration.

Methods: Participants (final N = 109, mean age = 32.9, SD = 3.9; 64% male, 32% female, 4% other) performed a multiarmed bandit reinforcement learning task, searching for rewards on a grid (Schulz et al., 2018). The rewards were spatially correlated. Thus, clicking and exploring different tiles on the grid was required to learn the spatial structure. Before and during the task, participants were instructed to think either of an attachment figure or a familiar acquaintance.

Results: Compared to participants who were primed to think about an acquaintance, participants primed to think about an attachment figure had a higher likelihood of clicking unrevealed tiles, b = 2.26 [0.78,3.74], Z=2.99, p =.003, OR = 9.59 [2.18,42.22]. They also clicked tiles on the grid that were farther away from revealed tiles, suggesting that they explore farther away from known information, b = 0.22 [0.06,0.37,], Z=2.64, p =.008, β=.11 [.03,.19]. Importantly, a computational model (Schulz et al., 2018) revealed that participants primed to think about an attachment (vs. acquaintance) figure had higher estimates of a parameter reflecting directed exploration, t(98.10) = 3.39, p = .001, d = 0.64, but not a parameter reflecting random exploration, t(102.25) = -1.34, p = .182, d = -0.26. Interestingly, participants who were primed for attachment had marginally lower reward gain, b = -1.29 [-2.62,0.05], t(7842) = -1.89, p =.058, β=-.06 [-.12,.00], and higher directed exploration estimates associated with lower reward obtainment, r = -.20, t(107) = -2.12, p =.037. The latter findings suggest that in the specific examined environment, excessive exploration (promoted by attachment) may not be the most beneficial strategy.

Discussion: Overall, our results support the hypothesis that attachment representation activation during reward learning does not just increase a general sense of exploration, but rather promotes specifically directed exploration driven by uncertainty seeking. Our findings shed light on developmental theories that connect caregivers and attachment figures to children's exploration and learning. By that, they may also help understand patterns of reduced exploration and learning in youth who grew up in adverse caregiving environments.

M76. CHILDREN LEVERAGE PREDICTIVE REPRESENTATIONS FOR REWARD-GUIDED CHOICE

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Background: Prior work has revealed that when learning to take actions that yield reward, children rely more on 'model-free' learning computations, in which they repeat actions that led to reward, and with increasing age, harness detailed mental models of their environments to construct step-by-step plans. Recent work in adults, however, has suggested that this dichotomy is oversimplified — adults use alternative strategies that combine the simplicity of model-free learning with the flexibility of full model-based planning. One such strategy is the use of the 'successor representation' (SR), a more temporally abstract mental model, in which state representations take into account the likely occupancy of future, 'successor' states. The SR enables

rapid updating of learned value representations when the rewards in the environment change, without the costly iterative simulation that full model-based learning requires. To date, however, it is unclear whether children and adolescents leverage the SR to guide choice.

Methods: Here, we adapted a task recently used in adults (Kahn and Daw, 2023) to examine whether children and adolescents similarly use the SR for reward-guided choice. Participants between the ages of 8 and 22 (N = 152) completed the task online. Participants completed 200 pairs of choice trials, which each comprised a 'shop' trial and a 'traversal' trial. On traversal trials, participants first chose one of two islands. On each island, participants then selected one of two shops, in which a shopkeeper paid out a gold coin with a reward probability that changed throughout the task. On shop trials, participants were taken directly to a shop, where its shopkeeper paid out a coin with the same probability as on the traversal trials. Critically, in the task, participants could learn through experience to navigate to the most rewarding shops, through constructing step-by-step plans via a full mental model of the task or through relying on a more temporally abstract representation — the SR.

Results: To determine participants' learning strategies, we analyzed their first-stage island choices on traversal trials. Participants were more likely to choose an island when they had experienced reward from a shop located on that island in the preceding 'shop' trial, $\beta = .25$ [.21 - .29], $p < .001$. Because participants did not choose between the islands in shop trials, their influence on subsequent island choices indicates that, across age, participants leveraged task structure knowledge for learning.

If participants relied on detailed models over which they performed full, step-by-step model-based planning, then the influence of the shop reward should be greater if they had not recently experienced reward from the other shop on the same island (which would have made them already highly likely to visit the island). We observed an age-invariant shop reward x other shop reward interaction, $\beta = -.11$ [-.14 - .08], $p < .001$, consistent with full model-based planning. If participants relied on more abstract task models in which representations of first-stage states themselves took into account their likely successors, then the influence of the shop reward should be greater if they had visited that same shop when they last chose the island (and therefore were likely to have linked the island to this 'successor' state). We also observed an age-invariant shop reward x last island choice interaction, $\beta = .12$ [.08 - .15], $p < .001$, consistent with use of the SR across development.

Discussion: Together, our results provide evidence for the early-emerging use of predictive representations to guide choice. In future analyses, we will characterize the dynamics of value-guided learning with reinforcement-learning models that estimate the separable contributions of model-free, full model-based, and SR-based learning to participants' choices. Such analyses will provide greater insight into the change — or consistency — in value-guided learning strategies from childhood to early adulthood.

M77. UNDERSTANDING HOW PHYSIOLOGICAL MECHANISMS AND PARENT REPORT MEASURES PREDICT SENSORY OVER RESPONSIVITY IN AUTISM

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Background: Over 50% of youth with autism spectrum disorder (ASD) experience sensory over-responsivity (SOR), a heightened negative response to sensory stimuli that causes significant impairments in daily life activities (Tomchek et al., 2004, Hilton et al., 2007). While lab assessment and parent reports are both considered valuable in measuring sensory responses, the two are not correlated (Ramappa et al., 2023, Tavassoli et al., 2019). One hypothesis as to why standardized lab tasks do not correlate with parent reports is that children regulate their behavioral responses in a standardized setting. For example, they may find a stimulus aversive without showing outward behavioral reactions to it. Physiological measures, such as skin conductance (SC), could help us understand such regulation by identifying individuals who have low behavioral responses but high physiological arousal.

Aims: The purpose of this study is to determine whether parent report measures and physiology (skin conductance) can be used together to better predict SOR behaviors in a lab setting compared to parent report alone.

Methods: SC levels were measured while 8 to 18 year-old ASD participants (n=83) and typically developing participants (TD, n=54) completed the Sensory Processing 3-Dimensional (SP3-D) Assessment (Mulligan et al., 2019). The total number of SOR responses, such as clenching fists or grimacing while being exposed to stimuli, were scored across visual, tactile, and auditory domains. Skin conductance response (SCR) was calculated as the percent change of the average SC 2 seconds before stimulus onset subtracted from the maximum SC from 1-6 seconds after onset, averaged across all sensory stimuli. Parents completed the Parent Report SP3-D Inventory, the Screen for Child Anxiety Related Disorders (SCARED), and the Child Behavioral Checklist (CBCL), from which the CBCL Emotion Dysregulation Index was calculated (Schoen et al., 2017, Miller et al., 2017, Birmaher et al., 1997, Samson et al., 2014). A factor analysis determined that these parent report measures were strongly correlated, therefore they were combined into one reactivity-dysregulation (RD) factor.

Results: There was no main effect of parent-reported SOR alone or the RD factor on observed SOR behaviors in the SP3-D assessment, however diagnosis did have a main effect on observed SOR whereby ASD youth had higher SOR behaviors. Additionally, results showed an interaction effect of RD with SCR on predicting the total number of observed SOR behaviors ($p < 0.04$). Across both ASD and TD groups, for children who had higher RD, higher SCR was associated with higher observed SOR behaviors. For children with low RD, higher SCR was associated with lower SOR behaviors.

Discussion: While prior research has indicated that parent report does not relate to observed behaviors, these findings illustrate it may actually serve as a moderator of the relationship between physiological reactivity and observed behavior. Children who are more regulated according to their parents may be more likely to regulate their behaviors in the lab setting, even if they find the stimuli aversive and have high physiological reactivity. Children who are rated by parents as more dysregulated may be less likely to regulate their response in the lab, therefore they are more likely to show consistency between their physiological and behavioral responses (i.e., to have both higher physiological and more behavioral responses in the lab). These results provide context for when and how parent report can predict observed SOR behaviors. These results also demonstrate how physiology and behavior can be used together to help differentiate children who are affected by aversive stimuli but can suppress their responses versus children who are not affected by the stimuli at all.

M78. ALTERED MARKERS OF BRAIN METABOLISM AND EXCITABILITY ARE ASSOCIATED WITH EXECUTIVE FUNCTIONING IN YOUNG CHILDREN EXPOSED TO ALCOHOL IN UTERO

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Background: Prenatal alcohol exposure (PAE) is known to impact brain and cognitive development, and structural and functional brain differences are well-documented in children with PAE. However, the effects of PAE on brain metabolites, natural chemicals that are involved in various aspects of brain metabolism and functioning, are not well understood. Levels of brain metabolites can be measured non-invasively using magnetic resonance spectroscopy (MRS). Here, we present the first study of PAE-related brain metabolite differences and metabolite-cognition associations in early childhood.

Methods: We measured levels of five metabolites (N-acetylaspartate+N-acetylaspartylglutamate, total creatine, total choline [tCho], glutamate+glutamine [Glx], and myo-inositol) in two cohorts of children with PAE and unexposed children using MRS in the anterior cingulate cortex (ACC; cohort 1) and left temporo-parietal cortex (LTP; cohort 2). Participants were drawn from longitudinal studies of brain development in children with PAE and unexposed children: Cohort 1 included 21 datasets from 20 children with PAE (11 females, mean age 5.38 ± 1.11 years) and 76 datasets from 72 unexposed children (33 females, mean age 4.51 ± .95 years); Cohort 2 included 28 datasets from 24 participants with PAE (16 females, mean age 6.45 ± .764 years) and 128 datasets from 71 unexposed children (34 females, mean age 6.45 ± .925 years). Global executive function (EF) was measured using the care-giver report Behavior Rating Inventory of Executive Function (BRIEF or BRIEF-Preschool; Gioia et al., 2000, 2003), and inhibitory control was assessed using the Statue subtest of the NEuroPSYchological Assessment – Second Edition (NEPSY-II; Korkman et al. 2007) in Cohort 1. Pre-reading skills (phonological processing and speeded naming) were measured using the NEPSY-II in Cohort 2. Group differences in metabolite levels and associations between metabolites and cognitive scores were tested using linear mixed effects regression.

Results: tCho, a marker of tissue microstructure and metabolism, was elevated in both regions in children with PAE compared to unexposed children (ACC: beta=.226, p=.016; LTP: beta=.135, p=.02). Glx, a marker of excitability, was elevated in the ACC/Cohort 1 (beta=1.474, p=.025). In Cohort 1, the PAE group exhibited more difficulties with global EF (beta=24.92, $p < .001$), and higher tCho was associated with better EF within both groups (beta= -14.83, p=.035). In addition, higher Glx in the ACC was associated with poorer inhibitory control within the PAE group only (interaction: beta= -.83, p=.026). We did not find significant associations between metabolites and pre-reading skills in either group (cohort 2).

Discussion: Together, these findings point to altered membrane metabolism and excitability in young children with PAE. Elevated tCho may reflect a developmental delay in the decrease of tCho levels across childhood, indicating overactive membrane metabolism in early childhood that may be related to previously observed alterations in cortical and white matter structure in youth with PAE. Our findings linking higher Glx to poorer inhibitory control indicate that children with PAE may be particularly susceptible to prefrontal hyperexcitability and the influence of the excitation/inhibition balance on EF skills.

M79. INDIVIDUAL DIFFERENCES IN ESTRADIOL AND TESTOSTERONE AT AGES 9-10 YEARS UNDERLIE DIFFERENT ASPECTS OF STRUCTURE-FUNCTION COUPLING

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Background: Puberty is a dynamic period of neuroendocrine plasticity, with dramatic increases in sex hormones (e.g., estradiol, E2; testosterone, T; dehydroepiandrosterone, DHEA) and extensive development of brain structure and function. Animal research has linked E2 to dendritic arborization and synaptic pruning and T to neuron survival and neurogenesis. However, human neuroimaging work has focused largely on cortical macrostructure measures that are far removed from such neurobiological phenomena, but largely overlooked the role of pubertal development in structure-function coupling. Multi-compartment models of diffusion-weighted magnetic resonance imaging (MRI), such as restriction spectrum imaging (RSI), can estimate microstructure (i.e., cell bodies, neurites) with more detail, which may help elucidate organizational roles of hormones in micro- and functional architecture development. Thus, we begin this line of inquiry by leveraging RSI and functional MRI data from the Adolescent Brain Cognitive Development℠ Study (ABCD Study®) to assess latent structure-function coupling in children ages 9-10 years (i.e., before and in early puberty) and potential roles of endogenous sex hormone levels therein.
Methods: From the ABCD Study 5.1 release, we used biospecimen, demographic, and neuroimaging data collected from children ages 9-10 years (N=3656). Biospecimen data included salivary estimates of E2 (in female youth), T, and DHEA. Imaging data included estimates of cortical microstructure from isotropic and directional intracellular diffusion (RNI, RND) via RSI and functional connectivity (FC) estimates from resting-state functional MRI. Covariates included child's age, sex, race/ethnicity, handedness, body mass index, total household income, MRI manufacturer, and head motion during MRI scans. After regressing covariates out of RNI, RND, and FC data, we used partial least squares (PLS) to identify latent dimensions of structure-function coupling between FC and each RNI and RND. Then, participant loadings on the primary latent dimensions were regressed on hormone levels to assess endocrine differences in structure-function coupling.
Results: The first latent RNI-FC dimension accounted for 62% of shared microstructure-connectivity variance. Greater RNI in most cortical regions (highest in cuneus, superior parietal, and primary sensorimotor regions) was related to stronger connectivity within auditory and somatosensory (SM) networks, but weaker connectivity within retrosplenial temporal (RsTp) network and between SM and salience (SN) networks. Youth with higher T levels had higher FC scores in this latent dimension ($\beta = 0.08$; $p < 0.05$). The first latent RND-FC dimension accounted for 29% of shared microstructure-connectivity variance. Greater RND across inferior (e.g., lingual, inferior temporal, parahippocampal) and superior frontal and parietal regions was linked to weaker connectivity within RSTP, cingulo-opercular, ventral attention (VAttn), and SN networks, but greater connectivity between VAttn and dorsal attention (DAttn) networks. Female youth with higher E2 levels had higher RND scores in this latent dimension ($\beta = 0.09$; $p < 0.05$).
Discussion: Together, these results suggest distinct patterns of individual differences in cellular density (indexed by RNI) and neurite density (indexed by RND) at ages 9-10 years that underscore individual differences in functional network connectivity and are differentially linked to sex

steroid hormones. Youth with greater cellular density had stronger within-network connectivity (except in RsTp), but weaker between-network connectivity, which were linked to higher T levels. Conversely, youth with greater neurite density exhibited weaker within- and between-network connectivity (except between DAttn and VAttn), and these patterns were related to higher levels of E2 in female youth. Overall, these Results: suggest differing patterns of structure-function coupling at ages 9-10 years with distinct endocrine underpinnings.

M80. SOCIAL ANXIETY IN ADOLESCENTS: INSIGHTS FROM NEUROMELANIN-SENSITIVE MRI IN THE SUBSTANTIA NIGRA

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Background: Social anxiety (SA) is a highly prevalent condition characterized by persistent fear of negative evaluation. Onset typically occurs in adolescence, just as salience of peer feedback increases. Children with social SA often have comorbid generalized anxiety (GAD) symptoms, which are defined as excessive and uncontrollable worry across numerous domains. While some evidence suggests a link between dopamine (DA) system function and SA, the underlying mechanisms are underexplored. DA is crucial for regulating emotional and reward response to social situations, which gain increased salience during adolescence and are often impaired by SA disorders. Research on the DA-SA relation has primarily been explored in adults due to invasive methods such as PET and SPECT, which utilize radioactivity and are contraindicated in children. Thus, novel methods are needed to study the etiology of SA in youth. Neuromelanin sensitive MRI (NM-MRI) is a non-invasive neuroimaging method that provides a putative proxy measure of DA system function in the substantia nigra (SN). We used these methods in adolescents to test the relation between DA system function and SA symptom severity. To determine specificity or generalizability of effects, relations with GAD symptom severity were also assessed. Given the high comorbidity of SA and GAD, this approach was crucial to distinguish whether observed neural mechanisms were specifically related to SA.

Methods: Adolescents (N=44, 41% female) 10-15 years of age (12.38 ± 1.45 years) underwent a NM-MRI scan. Social and GAD symptoms were measured via parent report on the social anxiety and generalized anxiety domains from the Screen for Child Anxiety Related Disorders. Social and GAD total domain scores were highly correlated ($r(43)=.67$, $p= < .001$). Two voxelwise analyses were performed within an anatomically defined SN mask (625 voxels) to test relations between NM-MRI signal intensity and total domain scores for each anxiety type. To test for symptom specificity, each anxiety type was residualized on the other and analyzed using the same voxelwise analysis methods. Multiple comparisons were accounted for through a permutation test in which independent variables were randomly shuffled with respect to individual NM-MRI signal maps. Region of interest (ROI) based regression analysis including both anxiety types were performed to confirm results. Analyses covaried for age due to its relation with lifetime NM accumulation.

Results: Higher NM-MRI signal intensity (i.e., higher DA system function) was associated with more severe SA (442/625 voxels, $p=.004$), but not GAD (91/625 voxels, $p=.109$) domain scores. Similar relations were observed post residualization for both SA (365/625 voxels, $p=.009$) and GAD (14/625 voxels, $p=.32$) domain scores. An ROI analysis confirmed Results: ($R2 =.24$, $F(3,40)=4.2$, $p=.01$; SA: $b= .40$, $SE= .13$, $t=2.96$, $p=.005$; GAD: $b= .20$, $SE=.13$, $t=-1.531$, $p=.13$).

Discussion: Results offer preliminary evidence that higher DA system function is associated with more severe social, but not generalized, anxiety. This may be due to the role of reward in social interaction. Our findings suggest specificity for neural mechanisms associated with social and GAD and provide foundation for future work to investigate their etiology. Furthermore, our methods support the utility of NM-MRI as a non-invasive proxy measure of DA system function in adolescents. To enhance our understanding of how DA system function relates to SA, future research should explore the relations between NM-MRI signal and brain activity during situations that elicit SA symptoms. Integrating functional data with our current methods will provide a more comprehensive understanding of the neural contributions to anxiety.

M81. EARLY-LIFE STRESS, HIPPOCAMPAL–CORTICAL FUNCTIONAL CONNECTIVITY, AND CHANGES IN EPISODIC MEMORY PERFORMANCE AS PREDICTORS OF MENTAL HEALTH SYMPTOM TRAJECTORIES IN YOUTH**

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Background: Episodic memory, the capacity to form and retrieve conscious memories of specific past events, is central to healthy human development. Altered episodic memory processes play key roles in the development and maintenance of a variety of mental health symptoms following stress exposure. Though structural differences in the hippocampus, a region heavily implicated in episodic memory processes, have been linked with mental health symptoms, whether functional connectivity between the hippocampus and cortical brain regions underlies variability in symptom trajectories in youth has remained largely unexplored. In addition, it is currently unknown how early-life stress (ELS) might moderate associations between hippocampal-cortical resting-state functional connectivity (rsFC) and changes in episodic memory across time. The present study aimed to probe whether ELS moderates associations between hippocampal–cortical rsFC and changes in episodic memory in childhood, and how these neural–environmental interactions may underpin symptom trajectories.

We hypothesized that we would be able to identify latent groups of youth that differ in their trajectories of mental health symptoms. We predicted that change in episodic memory performance would mediate the relationship between hippocampal–cortical rsFC and mental health symptom trajectories. Finally, we predicted that exposure to ELS would moderate this mediating effect.

Methods: The current sample included children aged 9-14 years who took part in the baseline (T1), 6-month (T2), 1-year (T3), 18-month (T4), 2-year (T5), 30-month (T6), and 3-year (T7) follow-up assessments of the ABCD Study, and who had usable resting-state data at T1. These criteria resulted in a final sample of N = 3,359. Data from the NIH Toolbox Picture Sequence Memory Task was used to assess episodic memory performance (T1, T5). Hypothesis-driven ROI-based analyses were used to examine anterior and posterior hippocampal rsFC with the ventromedial prefrontal cortex (vmPFC). The youth self-reported Brief Problem Monitor Scale was used to assess mental health symptoms (T2-T7). The Life Events Scale was used to assess ELS (T3).

A latent class growth analysis was conducted to explore different non-linear trajectories of mental health symptoms across 6 timepoints. A final model was selected based on Bayesian Information Criterion (BIC) and entropy scores. We ran moderated mediation logistic regression models with hippocampal-cortical rsFC as the predictor variable, ELS as the moderator variable, differences in

****Flash Talk**

episodic memory performance between T1 and T5 as the mediator variable, and mental health symptom class membership as the dependent variable. We ran separate models for rsFC between different subregions of the hippocampus and the vmPFC. Participant age, household income, and scanner site were included as covariates in all models.

Results: Our latent class growth analysis revealed that a 5-class solution displayed optimal model fit. These different profiles included: a low symptom group, a moderate symptom group, a moderate to high symptom group, a high to moderate symptom group, and a stable high symptom group. ELS moderated the association between right anterior hippocampus–left vmPFC rsFC and change in episodic memory, such that the positive relationship between hippocampal-vmPFC rsFC and change in episodic memory became weaker as exposure to ELS increased. Finally, ELS significantly moderated the strength of the indirect effect of hippocampal-vmPFC rsFC on the likelihood of belonging to the high symptom group compared to the moderate symptom group through change in episodic memory.

Discussion: Exposure to higher levels of stressful events may alter typical trajectories of episodic memory development, which may have cascading effects on mental health symptoms in childhood.

M82. HIGHER LEVELS OF PHYSICAL ACTIVITY MAY INSULATE CHILDREN FROM THE NEGATIVE EFFECTS OF AIR POLLUTION EXPOSURE ON MEMORY: A BASELINE STUDY OF THE ABCD COHORT

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Background: The hippocampus continues to develop throughout childhood and adolescence. Given its high sensitivity to social and environmental influences, it is critical to understand how environmental neurotoxicants, such as air pollution, impact hippocampal-dependent memory function. The hippocampus is also amenable to the positive influence of physical activity and exercise, with higher levels of physical activity and exercise predicting better hippocampal-dependent learning and memory performance. Yet, while physical activity might be beneficial, it may also increase the uptake and deposit of air pollutants, ultimately augmenting air pollutants' harmful effects. Leveraging baseline data from the landmark Adolescent Brain Cognitive Development (ABCD) Study, we aimed to determine whether physical activity and air pollution interact to influence immediate and delayed memory performance in 9-10 year-olds.

Methods: Rey Auditory Verbal Learning Test Immediate and Delayed Recall scores were used as our measure of hippocampal-dependent memory. Physical activity was measured as the self-reported number of days during the week where a child participated in less than 60 minutes of vigorous intensity physical activity. Using hybrid spatiotemporal models, annual estimates of 15 particulate matter components of fine particulate matter pollution were quantified for each participant using their primary residential address at study enrollment. We used linear mixed effects models to test the interaction of physical activity and individual pollutants, using study site as our nesting variable and adjusting for sex, age, race and ethnicity, total family income, urbanicity, neighborhood safety, and pubertal stage. We corrected for multiple comparisons across pollutants within each outcome (FDR correction of 15 pollutants per immediate and delayed recall).

Results: Results: show that air pollution and physical activity interact to predict immediate (n = 7,597, 48% female), but not delayed (n = 7,659, 48% female) recall scores. At lower levels of physical activity, higher levels of elemental carbon (beta = 0.27, SE = 0.09, t(7556.51) = 2.95, pfdr = 0.04), iron (beta = 0.002, SE = 0.0001, t(7530.00) = 2.48, pfdr = 0.05), and organic carbon (beta = 0.07, SE = 0.03, t(7580.55) = 2.38, pfdr = 0.05) exposure was associated with poorer performance on immediate recall.
Discussion: Our results suggest that air pollution and physical activity do not have a net-benefit nor net-harm on delayed memory at ages 9-10 years. However, higher levels of elemental carbon, iron, and organic carbon at lower levels of physical activity predicted worst performance on immediate recall. This suggests there may be a potential protective effect of physical activity in moderating air pollution impacts on immediate learning and memory performance. Future studies should consider the joint effects of physical activity and air pollution on hippocampal structure, given its importance in learning and memory behavior.

M83. PICTURE PERFECT: INVESTIGATING RELATIONS BETWEEN HIPPOCAMPAL SUBFIELD VOLUMES AND EPISODIC MEMORY IN PRESCHOOLERS USING A VISUOSPATIAL PARADIGM

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Background: Early childhood is a developmental period marked by significant improvements in episodic memory (e.g., Bauer, 2015). During this same window, the hippocampus undergoes protracted development. Specifically, previous work has shown longitudinal changes in hippocampal subfield volume along the longitudinal axis from early to mid-childhood (e.g., Canada et al., 2021). However, the earliest age range that has investigated this relation is 4-8 years and has focused on mnemonic discrimination (e.g., Canada et al., 2019) and source memory (e.g., Riggins et al., 2018). Our study aims to expand on these findings by investigating potential differences in hippocampal subfield (CA1, CA2-4/DG, and subiculum) volumes in a younger sample of children, 3-5 years (Mage = 3.99 ± 0.49 years), using a visuospatial memory task.
Methods: For this investigation, we utilized a cross-sectional sample of 26 participants from a larger longitudinal study. Participants completed a modified version of the visuospatial memory task from Kurdziel et al. (2013) across two visits (nap and wake), each with three phases. Participants encoded the locations of cartoon images in either a 3x3 (for children under 48 months) or 4x3 grid (for children between 48 and 56 months) and, after reaching a minimum threshold of 70%, completed an immediate retrieval phase and then, following either a nap or equivalent period of wakefulness, completed a delayed recall phase. Participants also completed an MRI where a high-resolution T2 scan (.4mm x .4mm x 2mm) of the medial temporal lobe was collected, which was then processed in Automatic segmentation of Hippocampal Subfields (ASHS; Yushkevich et al., 2014) to derive the hippocampal subfields.
Results: Multiple regression analyses controlling for potentially confounding variables such as intracranial volume and delay between immediate and delayed recall revealed that left subiculum body volume significantly predicted delayed recall at the sleep visit (b = .029, t = 2.7, p = .0134) while right CA2-4/DG body volume significantly predicted delayed recall performance at the wake visit (b = .011, t = 2.54, p = .0191). These results remained significant after controlling for

immediate retrieval performance. No significant relations were seen for models predicting immediate recall performance from hippocampal subfield volume or predicting change in recall performance (delayed recall – immediate recall) for either nap or wake sessions.

Discussion: These findings add to previous literature in older children showing relations between hippocampal subfield volume and episodic memory (e.g., Canada et al., 2019; Riggins, 2014) and suggest potential differential roles of the hippocampal subfields in supporting visuospatial recall following periods of wake and sleep. Moreover, the results in right CA2-4/DG body are in line with previous literature in older children indicating a role for right posterior hippocampus in item-space memory (Lee et al., 2020). The subiculum results, on the other hand, provide support for the subiculum's role in memory consolidation following sleep by transferring information from the hippocampus to more distributed cortical representations (e.g., Tukker et al., 2020). Because 3-5 years is also characterized by the transition out of napping (Galland et al., 2012) and sleep is strongly linked to memory performance in childhood (for a review, see Gómez and Edgin. 2015), a future direction is to investigate relations between nap status (habitual vs. non-habitual napper), hippocampal subfield volumes, and visuospatial memory.

M84. HIPPOCAMPAL SUBFIELD VOLUME AND RELATIONAL MEMORY IN PERIADOLESCENT CHILDREN: PRELIMINARY FINDINGS FROM THE PRANK STUDY

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Background: Childhood is a critical epoch for structural (and functional) brain development and cognitive maturation. One key example is structural change in the hippocampus at the level of its subfields and development of hippocampal-dependent relational memory (RM). While associations between hippocampal subfield volumes and certain memory tasks have been observed, the specific relationship between subfield volumes and RM in children warrants further investigation. The hippocampus is composed of subfields including the subiculum, cornu ammonis (CA) with its three components (CA1, CA2, CA3), and the dentate gyrus (DG). These subfields can be observed and their volume can be measured using ultra-high-resolution structural MRI data.

Methods: Here we report preliminary findings on the relationship between hippocampal subfield volumes and RSM performance in a sample of periadolescent children (age 8-13 years). Participants from the Polygenic Risk of Alzheimer's disease in Nebraska Kids (PRANK) study (R01 AG064247) completed a relational subsequent memory (RSM) task in which they were asked to remember pairs of items followed by a memory test for the studied pairs outside the scanner. The MRI protocol was adapted from the Human Connectome Project (HCP) Development/Aging study and included a T2-weighted quasi-coronal slab orthogonal to the long axis of the hippocampus (voxel size = .4 x .4 x 2 mm; slices = 30). MRI data were preprocessed using the HCP minimal preprocessing pipeline software. Hippocampal subfield volumes were then calculated using the Automatic Segmentation of Hippocampal Subfields (ASHS) pipeline. We conducted a Least Absolute Shrinkage and Selection Operator (lasso) penalized regression to assess the relationship between an outcome of hippocampal-dependent memory ability (RSM performance) and predictors including sex, age, hippocampal subfield volumes, and the interaction of age with subfield volumes.

Results: The model, fitted with 19 predictors, produced coefficients for each predictor. Among these, 5 predictors exhibited robust associations with the non-zero coefficients, indicating their inclusion in the final model. Sex (β = 0.19) and age (β = 0.09) exhibited positive coefficients, suggesting a positive relationship with RSM performance. Additionally, we found a positive relationship between right CA1 and RSM performance (β = 0.08). Interestingly, the interaction term for age and left CA23 and left subiculum were negative, suggestive of indirect associations with RSM performance. That is, as age increases, the combination of reduced values in left CA23 (β = -0.08) and left subiculum (β = -0.08) was found to be associated with better RSM performance. Overall, the lasso regression model explained approximately 13.4% of the variability in RSM performance (PDE = 0.134). These findings suggest that predictors including sex, age, right CA1 volume, and interactions of left CA23 and left subiculum with age were predictive of hippocampal-dependent memory ability in our sample.
Discussion: In summary, these findings provide compelling evidence regarding the involvement of hippocampal subfields, particularly the right CA1, left CA23, and left subiculum, in RM performance during childhood. Through unraveling the complex interplay among hippocampal subfield volumes and RM, these findings open avenues for a more profound comprehension of memory development. Such insights hold promise for elucidating developmental trajectories and guiding interventions aimed at enhancing cognitive outcomes during this pivotal phase of neurodevelopment.

M85. MEMORY REINSTATEMENT AT ITEM AND CATEGORY LEVELS DIFFERS ACCORDING TO RETRIEVAL SPECIFICITY DEMANDS IN ADOLESCENTS AND ADULTS

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Background: Over time we accumulate memories that overlap through shared features. However, the neural mechanisms that allow us to select among similar memories at retrieval are still maturing into adolescence. Here, we asked how this ongoing maturation, as well as the level of specificity required behaviourally, influence the information that adolescents retrieve when recalling overlapping memories.
Methods: Adolescents (12-13 years; N=36) and adults (N=36) learned to associate unique artifacts with natural objects from four categories (apples, shells, leaves, rocks), yielding object pairs that overlapped at the category level. During subsequent functional magnetic resonance imaging (fMRI) scanning, they were shown artifacts and prompted to retrieve the paired objects in preparation for questions that probed memory at general (apple vs. rock) and/or specific (apple 1 vs. apple 2) levels. We used representational similarity analysis (RSA) to measure neocortical reinstatement at both item and category levels during this preparatory retrieval period.
Results: Both adolescents and adults showed item and category reinstatement when preparing for memory questions that could be answered using multiple levels of specificity. However, age differences emerged when preparing for questions that required either general or specific memories. Both age groups reinstated at the category level for both general and specific questions, however, only adults modulated item reinstatement according to the question specificity. In particular, adults reinstated at the item level while preparing for specific questions but showed item suppression prior to general questions. While adolescents did not modulate item

reinstatement, they did show that decreased category reinstatement was advantageous for specific question performance (i.e. decision speed) on a trial-by-trial basis. Moreover, trials with reduced category reinstatement were associated with greater inferior frontal gyrus (IFG) engagement, suggesting that adolescents may recruit this region's memory selection mechanisms to reduce interference from overlapping category information. Further developmental differences in the neural mechanisms supporting specific memory retrieval were evident in hippocampal subregion engagement. Both age groups engaged the posterior hippocampus more when preparing for specific questions than general, in line with past work suggesting the posterior subregion is involved in detailed memory retrieval. However, adolescents alone also demonstrated greater engagement for specific questions extending to the anterior hippocampus, suggesting that they may show less spatially localized activation of the hippocampus than adults.
Discussion: Together, these results highlight that differences between adolescents and adults in the neural correlates of memory retrieval may be most prominent under demands for high memory specificity. Further, the prefrontal and hippocampal mechanisms supporting retrieval of specific information among overlapping memories may continue to mature into adolescence.

M86. THE STRUCTURE OF EPISODIC MEMORY

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Background: Are lab-based and more naturalistic measures of episodic memory assessing the same underlying phenomena? To answer this question, we gave children, 4-7 years (n=104), a battery of tests of episodic memory.
Methods: The lab-based assessments included measures of mnemonic discrimination, holistic recollection, and relational binding. The naturalistic measures included measures of memory for short animated videos and their own autobiographical memories.
Results: When controlling for age and IQ, we find that these assessments separate into a two-component structure. Mnemonic discrimination and relational binding group together as a lab-based memory component. Memory for cartoons and autobiographical memories group together as a naturalistic memory component. Finally, holistic recollection stands alone – it is only weakly related to the other measures.
Discussion: Our findings caution researchers from drawing broad conclusions from fully lab-based memory assessments, as they may be measuring different phenomena than memory for real world events. Further, our results suggest that episodic memory does not develop as a unified whole, but rather different facets have different trajectories.

M88. EPISODIC MEMORY ENCODING AND REINSTATEMENT IN THE DEVELOPING BRAIN: A CONSIDERATION OF EARLY CAREGIVING EXPERIENCES

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Background: Episodic memory, although present in rudimentary forms in infancy, undergoes considerable changes across development. Advances in developmental cognitive neuroscience have elucidated the neural mechanisms that contribute to memory development. However, much of the focus has been on neural activity during memory encoding or retrieval, with less emphasis on how memories are represented post-encoding. In adults, reinstatement in the medial prefrontal cortex (mPFC) during rest periods relates to later memory performance, but it is unclear whether this effect occurs during development. Here, we examined the neural mechanisms of memory encoding and reinstatement in a developmental sample (children and adolescents). Moreover, because these regions are highly sensitive to experiences, like caregiving-related early adversities (crEAs), we ask whether a history of crEAs influences neural encoding and reinstatement.
Methods: Youth (6 -17 years) participated in a memory task and resting state fMRI as part of a larger fMRI study. Some youth had a history of cREAs in the form of previous institutionalization (N=29) and some did not (N=46). On each trial of the memory encoding task, youth viewed a scene for 500 ms before an object or a face appeared for an additional 2500 ms, followed by a jittered intertrial interval. Youth saw a total of 20 scene-item pairs, consisting of 7 scenes that were each paired with either 2 or 4 items. Scene-item pairs were presented either once or twice, resulting in 33 total encoding trials. Resting state scans (5 min each) occurred immediately prior to and following memory encoding. After completing additional fMRI tasks, youth were tested on their memory for both items (old/new judgement) and associations (pairing of items with the scene and in the correct location) outside the scanner. To examine episodic memory, we focused on memory for associations. Memory performance was used to label encoding trials as either 'remembered' or 'forgotten.' We first measured brain activity during encoding using a traditional subsequent memory analysis in which we contrasted neural activity for remembered vs. forgotten encoding trials using a whole-brain GLM. Then, to measure reinstatement, we performed a searchlight analysis calculating the multivariate pattern similarity between each encoding trial and TR in the post-encoding rest period and then contrasted the reinstatement of remembered vs. forgotten encoding trials (after accounting for pre-encoding rest).
Results: Youth with and without a history of cREAs exhibited above-chance behavioral memory performance. During the encoding of remembered vs. forgotten associations, youth without a history of cREAs showed significant activation in the right hippocampus. Remembered associations were reinstated more than forgotten associations during post-encoding rest in the mPFC after accounting for pre-encoding rest. Youth with cREAs engaged different brain regions during encoding and reinstatement, but after accounting for age and memory performance, significant differences between groups were only found during encoding. Specifically, youth with cREAs exhibited greater activity in the precuneus and mPFC for associations that they would later forget.
Discussion: Our results align with previous literature showing hippocampal involvement in associative memory encoding in childhood and adolescence. This study also advances our understanding of memory processes outside of encoding — namely, post-encoding rest, where we find reinstatement in the mPFC relates to memory for associations. Interestingly, cREAs were associated with different memory regions during the encoding of associations. Specifically, subsequent forgetting effects in the precuneus and mPFC, but not subsequent memory effects in the hippocampus, were observed following crEAs. The current findings suggest that hippocampal encoding and mPFC reinstatement are present in childhood and adolescence, and that these patterns may be altered by crEA exposure.

M89. SEGREGATION OF THE ANTERIOR/POSTERIOR HIPPOCAMPUS AND THE PMAT NETWORK DURING DEVELOPMENT AND ITS RELATION WITH EPISODIC MEMORY

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Background: Hippocampal–cortical functional connectivity is non-uniform across the hippocampus, differing primarily along its longitudinal axis.
Methods: Using resting-state fMRI data from two independent developmental samples (HCP-D, n = 353; JHU: n = 89), we investigated anterior and posterior hippocampal functional connectivity specialization within the framework of the posterior medial – anterior temporal episodic memory network (PM - AT) model during development.
Results: Whole brain analysis showed that during development, the posterior compared to anterior hippocampus, was increasingly connected to nodes of the PM network: including the posterior cingulate cortex, angular gyrus and medial prefrontal cortex. We computed a segregation index defined as the difference between within- and between-network connectivity divided by within network connectivity of the AT, PM networks and anterior and posterior hippocampus. This segregation index was positively correlated with age in both samples, suggesting increased specialization of the anterior and posterior memory systems during child development. Episodic memory performance was also positively correlated with the segregation index. Structural equation modeling analysis revealed a significant mediation effect of the segregation index between age and episodic memory performance.
Discussion: These results suggest that the increased specialization of the anterior temporal and posterior medial systems contribute to episodic memory during child development.

M90. MOTHER-CHILD INTERACTION IN A MULTIMODAL ENVIRONMENT: FUSING HYPERSCANNING-EEG DATA, MOTION AND EYE MOVEMENT USING DIFFUSION MAPS

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Background: Mother-child interactions are fundamental for a child's long-term social, emotional, and cognitive skills. Therefore, the study of these interactions is well documented and has evolved over the years from merely observing and rating them to examining the neural underpinnings during the interactions. This became possible due to technological advancement that led to the development of the hyperscanning method, aimed at investigating the concept of inter-brain synchronization. Mother-child interactions demand several social mechanisms, such as body and eye movements, all controlled by the brain. Therefore, the current work is aimed at revealing the synchronization patterns of these modalities and combining them using the diffusion maps method to fully characterize this significant interaction.
Methods: Twenty-two Hebrew-speaking toddlers (mean age=33 months, sd=5.38, 17 males) and their mothers (mean age=35 years, sd=5.79) participated in two interaction conditions while several modalities, i.e. EEG, joint attention, and motion synchronization data were collected. Using the diffusion maps method, dimension reduction and data fusion of the modalities were

performed. Each diffusion map (per modality) and multimodal diffusion map were correlated with maternal parenting style and the child's long-term language abilities.
Results: Mother-child interactions were different in the two experimental conditions. Higher interaction condition was characterized by less inter-brain synchronization. Nonetheless, more joint attention towards each other episodes and more movements of the dyads were apparent in this high interaction condition. Only the multimodal diffusion map, as opposed to each modality separately, showed significant relations. Higher interaction between the dyads was related to the lower intrusive parenting style of the mother, together with better long-term language abilities of the child.
Discussion: The results suggest that the fusion of several modalities allows a full characterization of mother-child social interaction. The results also highlight the role of mother-child interaction in the child's long-term language abilities and that parenting style predicts positive mother-child interaction.

M91. USING WEIGHTED BLANKETS TO REDUCE HEAD MOTION DURING FMRI IN A PEDIATRIC POPULATION

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Background: Head motion is a major confounding variable during magnetic resonance imaging (MRI) and is particularly prevalent in pediatric populations. Research groups have employed several techniques to reduce motion during functional MRI (fMRI), but one technique that has received less attention is using weighted blankets during scanning. Here, we report on the utility of using weighted blankets to reduce motion during task-based fMRI scanning of 5-7-year-old children.
Methods: During a larger longitudinal project, 78 kindergarten and first-grade children (age M = 5.85 ± 0.55 years) participated in two runs of a reading-related task in the scanner, lasting 6.5 minutes per run. Approximately 22% of the participants opted to use 5-pound weighted blankets that covered their waist and a portion of their legs. Head motion during each run was quantified using the Artifact Detection Tools software, and each run received a percentage head motion score by dividing outlying volumes by total volumes (N = 310).
Results: While the weighted blanket and non-weighted blanket groups did not significantly differ in average head motion (7.3% and 11.2%, respectively), they did significantly differ in motion during the second run (7.3% and 15.2%, respectively). This resulted in a 52.3% reduction in overall movement during the second run, which occurred later in the scanning session.
Discussion: Reducing head motion is key to successfully scanning pediatric populations. Using weighted blankets is a cost-effective and simple technique to significantly reduce motion across long scanning sessions for young participants. Further analyses will pinpoint if individual differences moderate this relationship.

M92. A COMPARISON OF FREESURFER, HIPPUNFOLD, AND AUTOMATIC SEGMENTATION OF HIPPOCAMPAL SUBFIELDS (ASHS) FOR ESTIMATING HIPPOCAMPAL VOLUMES IN EARLY CHILDHOOD

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Background: The human hippocampus (Hc) is a neural substrate, comprised of multiple internal circuits (i.e., subfields), including the Cornu Ammonis (CA) fields 1-4, dentate gyrus (DG), and subiculum that subserves episodic memory across the lifespan (Amaral and Lavenex, 2007). Hc subfields are thought to undergo extended postnatal development (Lavenex and Lavenex, 2013). However, studies on Hc subfield development with human children are limited, partially due to the methodological limitations. Furthermore, existing studies on Hc subfields employ a range of publicly available segmentation software packages, which have different input resolution thresholds. Yet, scarce research has investigated the performance and reliability across these packages, especially among young children. The current study aims to compare Hc subfield volumes (CA1, CA2-4/DG, subiculum) extracted by three automated software packages — FreeSurfer, HippUnfold, and Automatic Segmentation of Hippocampal Subfields (ASHS), among a sample of 4-8 years old children.

Methods: The current study utilized a subset of 19 children from a larger study (Mage = 6.85±1.59; 47.4% female). All children provided a whole-brain T1-weighted .9mm isotropic scan and an ultra-high resolution T2-weighted scan (.4mm x .4mm x 2mm) of the medial temporal lobe. T1-weighted scans were processed in FreeSurfer 7.1.1 (Fischl, 2012) and HippUnfold 1.4.1 (DeKraker et al., 2022), and T2-weighted scans were processed in ASHS (Yushkevich et al, 2014) to derive Hc subfield volumes, respectively.

Results: Pearson's correlations between Hc total and subfield volumes derived from the three software packages (rHippUnfold with FreeSurfer, rHippUnfold with ASHS, rFreeSurfer with ASHS) were as follows: left total (r = [.72, .80, .67], rmean = .73), right total (r = [.89, .75, .68], rmean = .77); left CA1 (r = [.79, .73, .72], rmean = .75), right CA1 (r = [.88, .63, .67], rmean = .73); left CA2-4/DG (r = [.58, .55, .68], rmean = .61), right CA2-4/DG (r = [.75, .70, .64], rmean = .70); left subiculum (r = [.53, .58, .31], rmean = .47), right subiculum (r = [.67, .45, .29], rmean = .47). These Results: showed that the total Hc and subfield volumes (rmean-left = .61; rmean-right = .63) derived from all methods were overall comparable bilaterally. Additionally, volumes of the bilateral CA1 extracted by the different packages showed the highest mean correlation (rmean = .74). This was followed by the bilateral CA2-4/DG (rmean = .65), and with the subiculum volumes exhibiting the lowest average correlation (rmean = .47). Further, HippUnfold and FreeSurfer showed the strongest correlation in estimating the mean volumes across each bilateral subfield, which might be attributed to the same input resolution of the T1w images. Intraclass correlations in terms of absolute agreement indicated good reliability for left CA1ICC(2,1) = .75, right CA1ICC(2,1) = .81; moderate reliability for left totalICC(2,1) = .71, right totalICC(2,1) = .62, right CA2-4/DGICC(2,1) = .59; and poor reliability for left CA2-4/DGICC(2,1) = .36, left subiculumICC(2,1) = .41, right subiculumICC(2,1) = .12. Lastly, volumes extracted by FreeSurfer and HippUnfold consistently showed the highest correlations for each right Hc subfield, but the pattern was less clear for the left Hc.

Discussion: Our findings revealed correlations and reliabilities in the Hc subfield volumes extracted using FreeSurfer, HippUnfold, and ASHS. Further, the analyses revealed considerable variability in the estimations of subfield volumes between the methods, especially for the bilateral subiculum. Our next steps are to 1) compare the three packages to our manual tracing and calculate spatial overlap between methods; 2) investigate similarities and differences between the methods

in estimating subfield volumes in the Hc head and body, respectively; and 3) test if relations between subfield volumes and memory performance differ as a function of package used.

M93. A PIPELINE FOR CREATING STANDARDIZED, CHILD-FRIENDLY AUDIOVISUAL LANGUAGE STIMULI FOR NEUROIMAGING EXPERIMENTS

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Background: Designing engaging, well-controlled neuroimaging tasks for children can be difficult and time-consuming. For instance, many experiments focused on language processing rely on auditory stimuli, which typically require researchers to record their own stimuli. Standardizing the length and other acoustic properties of these stimuli can be challenging and tedious. To increase participants' engagement, many pediatric neuroimaging experiments also rely on audiovisual stimuli (e.g., animated videos). Here, to simplify and accelerate the process of creating language stimuli, we developed an automated pipeline to generate auditory stimuli from text and subsequently generate animated audiovisual stimuli from audio files.

Methods: We created a pipeline to turn a list of text stimuli first into speech audio files, and then into videos in which an animated character speaks the desired sentence or passage. We used this pipeline to generate stimuli for an event-related fMRI study which required audiovisual stimuli for 800 different 8-word sentences, each 4 seconds long. First, we developed a script to generate audio files using Google Cloud Text-to-Speech software. The audio stimuli can be generated using any voice and can be standardized to be within a certain range of duration (in our case, 3 to 4 seconds), which is achieved by adaptively changing the speed of the audio. The audio stimuli can also be customized using Speech Synthesis Markup Language (SSML), which allows for specifying pauses, tone, and special pronunciation. We evaluated all of the available voices and settings to select natural-sounding options for our experiment. Second, to create audiovisual stimuli from audio files, we developed a process that uses Windows Power Automate and Adobe Character Animator to generate video stimuli of a specified duration in which an animated character (in our study, a friendly monster) speaks the sentence, with mouth movements synchronized to the audio file. The character's body movements, position on the screen, and size can all be randomized, resulting in engaging but controlled stimuli.

Results: We successfully utilized the pipeline to generate 800 audiovisual stimuli to use in an event-related fMRI study. It took 12 minutes and 28 seconds to generate 800 audio stimuli for sentences (0.935s per stimulus) using our script. After a careful manual review, only 7 audio files had to be regenerated and 4 sentences had to be swapped out due to audio issues, resulting in a total 1.375% remake rate. Overall, our automatic audio generation process was able to create 800 audio stimuli in < an hour with minimal errors. Using the video-generating pipeline, we created 800 video stimuli in a couple days, with a process that could run on a laptop with minimal supervision. After a careful manual review, 63 out of the 800 animated stimuli needed to be recreated due to issues with the videos, resulting in a 7.125% remake rate.

Discussion: This new pipeline for stimuli creation may allow for more efficient and standardized creation of engaging stimuli to use in neuroimaging experiments with children. This method is especially useful for fMRI studies, in which engaging stimuli help sustain children's attention and reduce motion. The audio generation process in particular is fast, has a very minimal error rate,

and uses open-source tools, making it especially useful for other researchers. The entire pipeline will be made openly accessible.

M94. MAYBE IT'S SCIENTISTS WHO ARE "HARD TO REACH" - LESSONS LEARNED FROM A YEAR OF COLLECTING RACIALLY AND SOCIOECONOMICALLY INCLUSIVE TWO-BRAIN FNIRS DATA IN LOCAL CHILDCARE CENTERS AND SCHOOLS

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Background: In the last few years, parent-child fNIRS studies have suggested that neural synchrony may support children's healthy cognitive and emotional development by linking socially contingent experiences with outcomes in domains including language and emotion regulation. However, most neural synchrony studies to date have been conducted with White, middle- to high-SES families. In a 2023 review of 16 neural synchrony studies(Alonso et al., 2023), no study reported inclusion of Hispanic families, and only 4 included Black families. The majority did not report SES, or included only middle- to high-SES families. It is critically important that we design inclusive two-brain studies to understand mechanisms supporting the healthy development of all children.
Methods: In the Family-inspired Neural Synchrony (FINS) study, we aimed to practice inclusive neuroscience while investigating moment-to-moment mechanisms supporting preschool socioemotional and language development. We achieved this by running a mobile study to meet families where they are, which also adds ecological validity to our approach.
Results: To date our sample is 65% non-White, SES-diverse, with 78% moms, 18% dads, and 4% grandmas.
Discussion: I will share how inclusion influenced our study, including hypothesis development, regions of interest, budgeting, recruitment, compensation, and session protocol. Not only did we collect the sample we were hoping for, we heard anecdotally from our partners that our approach "just felt different," and we learned a lot. We'll share direct and practical takeaways to guide similar efforts in the future.

M95. BRAIN-WIDE ASSOCIATION STUDIES OF LIFESPAN MENTAL HEALTH ACROSS FUNCTIONAL TASK STATES**

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Background: There is widespread concern and Discussion: regarding the reproducibility of brain-wide association studies (BWAS) in neurodevelopmental research. Venues are broad but include previous Flux annual meetings and roundtables as well as our society's official journal, Developmental Cognitive Neuroscience. Multiple large-scale studies have revealed stark challenges in statistical power for the common approach of cross-sectionally linking individual differences in resting-state functional MRI (fMRI) to neurodevelopmental outcomes. As a result, a growing interest has emerged in reconsidering the relative utility of resting-state in BWAS and

****Flash Talk**

biomarker development, with commentary including that we should "put rest to rest" in favor of cognitive or emotional task-based fMRI. Nevertheless, comprehensive evaluation of the relative predictive utility of resting-state and task-based fMRI has remained elusive, owing to computational complexity and the need for large-scale independent datasets to ensure generalizability. Lack of resolution of such foundational issues in neurodevelopmental research obscures paths forward for both investigator-initiated and consortium efforts. Leveraging meta-scientific principles of multi-assessment and multi-dataset benchmarking, along with leading multivariate prediction techniques and state-of-the-science high performance computing, this project examined the magnitude and reproducibility of BWAS of lifespan mental health outcomes across both fMRI resting state functional connectivity and task-based activation.

Methods: Multivariate predictive models, via whole-brain regularized regression with nested cross-validation, were used to link individual differences in resting-state functional connectivity and activation from 5 distinct task-based paradigms (working memory, inhibitory control, relational processing, gambling, and emotional) to 26 distinct cognitive, personality and mental health outcomes across two independent lifespan datasets: Adolescent Brain Cognitive Development (ABCD; N=4,572, ages 9-11) and the Human Connectome Project-Young Adult (HCP-YA; N=844, ages 22-35). Model performance was evaluated via correlation between true scores and predicted scores in held out, cross-validated data.

Results: In all multivariate BWAS (rest and task), cognitive phenotypes (e.g., NIH Toolbox: median out-of-sample r: .254, max r: .450) had substantially higher reproducibility than personality (e.g., NEO, UPPS-P, median r: .100, max r: .310) or mental health (e.g., CBCL median r: .063, max r: .189) phenotypes. Prediction of cognitive, personality, and mental health phenotypes were highly consistent across rest and nearly all cognitive and emotional fMRI tasks, with no evidence of a relative advantage of rest (median r: .117, max r: .423) or task (median r: .114, max r: .450). Iterative comparison of multivariate algorithms (including elastic net, ridge regression) suggested BWAS of neurodevelopmental outcomes are optimal when incorporating broadly distributed, whole-brain patterns rather than isolated single or very few brain regions.

Discussion: The results make clear that multivariate prediction, the leading BWAS approach, from task-based fMRI activation does not have a systematic advantage over resting-state fMRI for neurodevelopmental outcomes. Instead, relative reproducibility rates of BWAS are driven by the specifics of the phenotypes, with robust evidence that resting-state and all cognitive and emotional functional states are most predictive of cognitive phenotypes. Results have critical implications for future work refining common and specific variability across functional neuroimaging metrics in health and disease and selecting developmentally relevant and brain-based phenotypes.

M96. REPRODUCIBLE BRAIN CHARTS: AN OPEN DATA RESOURCE FOR MAPPING THE DEVELOPING BRAIN AND MENTAL HEALTH**

**Flash Talk

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Background: Many mental illnesses emerge in childhood and adolescence and are increasingly understood as disorders of brain development. Large and heterogeneous samples are required to study such disorders in a reliable, reproducible, and generalizable manner (Marek et al., 2022). To this end, we introduce Reproducible Brain Charts (RBC), an open data resource that harmonizes several of the largest studies of brain development in youth.

Methods: The RBC project contains data from 5 prominent studies: PNC (n=1601), HBN (n=2611), NKI (n=1329), BHRC (n=610), and CCNP (n=195). To harmonize phenotypic data, we first matched questionnaire items from the CBCL (used in 4 studies) and the GOASSESS (used in PNC) (Hoffmann et al., 2024). After testing many models, we adopted a bifactor model proposed by McElroy et al (2018). Model factors capture major dimensions of psychopathology, including a general ("p") factor as well as specific factors for internalizing, externalizing, and attention symptoms (Hoffmann et al., 2023).

We curated neuroimaging data using CuBIDS (Covitz et al., 2022), which summarizes the heterogeneity in image acquisition and facilitates metadata-based quality control (QC). Next, we adopted the "FAIRly-big" strategy (Wagner et al., 2021) for reproducible image processing, ensuring all preparation and analyses were accompanied by a full audit trail in DataLad (Halchenko et al., 2021). Structural MRI data were processed using FreeSurfer and sMRIPrep, yielding commonly used measures of brain structure. Functional MRI data were preprocessed using C-PAC (Craddock et al., 2013), yielding measures such as functional connectivity matrices, ReHo, and ALFF (Li et al., 2021). Processed structural and functional data were parcellated with 16 commonly used atlases. An important feature of RBC is the emphasis on harmonized measures of imaging QC. Structural images were independently rated by 2-5 experts using Swipes for Science. Functional images were assigned QC scores based on median framewise displacement (FD) and normalization quality. All harmonized phenotypes as well as raw and processed images are openly shared via DataLad and the International Neuroimaging Data-sharing Initiative (INDI).

Results: We illustrate the utility of RBC and the increased statistical power in the aggregated sample by examining: i) the relationship between derived neuroimaging features and age and psychopathology; and ii) whether those associations are influenced by RBC's QC protocols and imaging data harmonization with CovBat-GAM (Chen et al., 2022). We used Generalized Additive Models (GAMs) to delineate developmental effects and assess the relationship between imaging measures and dimensions of psychopathology, while controlling for covariates such as sex and data quality (e.g. Euler number or FD). Specifically, we evaluated cortical thickness (CT), surface area (SA), and gray matter volume (GMV) from structural images as well as between- and within-network connectivity (BNC and WNC) from fMRI. We found that QC and harmonization effectively removed variability due to dataset differences while retaining heterogeneity due to inter-individual variation. This resulted in convergent developmental patterns across datasets. Furthermore, while CT, SA, and GMV all decreased with age, lower SA and GMV were linked to higher overall psychopathology. BNC displayed an overall decrease with increasing age, whereas WNC increased with age. Finally, greater connectivity between the default mode and frontoparietal networks was positively associated with higher overall psychopathology, suggesting a loss of segregation between those two networks.

Discussion: Through systematic integration of diverse datasets and rigorous methodology, we anticipate that RBC will accelerate large-scale, robust, and reproducible research in developmental and psychiatric neuroscience.

M97. HIPPOCAMPAL STRUCTURE, WORKING MEMORY, AND READING IN MINORITIZED YOUTH: NOVEL PATHWAYS TO READING PROBLEMS

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Background: Among youth with reading problems, a left-lateralized cortical "reading" network fails to engage during reading. Notably, this network is properly engaged during reading among youth with low reading scores but who are living in socioeconomic deprivation, suggesting that other neural networks underlie their reading problems.

Alternate networks might include subcortical structures. Hippocampal volume is vulnerable to early life stress, to which these youth are disproportionately exposed, and supports working memory (WM), which is associated with reading. Given age-related increases in hippocampal volume, WM, and reading, and associations between WM and reading, we hypothesized that hippocampal volume would be associated with reading through WM. Using a cross-sectional developmental design, we explored this in younger (average age 9; N=59) and older children (average age ~14; N=201).

Methods: Black and Latinx youth completed structural MRI, reading tests (Woodcock Johnson-III Letter-Word Identification, Word Attack), and a WM test (Wechsler Digit Span Backwards). Linear regressions and mediation analyses evaluated associations between hippocampal volume (Freesurfer 7.0), reading, and WM, controlling for age, sex, intracranial volume, maternal education, maternal demoralization, material hardship, and birthweight.

Results: In older children, left hippocampal volume associated with reading (p's $< .01$) and WM ($p=.02$), which also associated with reading (p's $< .001$). Proportion mediated was significant (23%, $p < .05$). No associations were detected in younger children.

Discussion: Results suggest that the hippocampus, and relatedly, WM, may be critical drivers of reading problems in adolescents living in socioeconomic deprivation. Such findings point to new targets for reading intervention.

M98. EDGE COMMUNITIES ACROSS THE HUMAN LIFESPAN

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Background: Edge time series and functional connectivity (eTS and eFC) are higher-order representations of brain networks that complement and extend the conventional node-centric approach (Faskowitz et al., 2020). A key feature of eTS is that it yields an overlapping node community structure (via edge community assignment), which has been previously described in functional networks of adults (Jo et al., 2021; Chumin et al., 2022). However, we do not yet know if and how edge community structure varies across the human lifespan. Here, we used a straightforward and computationally tractable approach, termed eFC lures, to detect edge communities at subject-levels and examined age-related changes in edge community structure.

Methods: eTS, a framewise multiplication of pairs of z-scored node time series, were computed for 100 cortical nodes of the Schaefer atlas for 585 subjects from the Nathan Kline Institute (NKI)

- Rockland sample dataset (age 6-84 years; Nooner et al., 2012). First, 10 subsets of the dataset, uniformly sampled across age with replacement, were generated by concatenating the eTS across subjects within subset and K-means clustering was used to obtain cluster labels for each edge (100 iterations at each K=2-20, with adjusted Rand index (ARI) used to find the best partition across iterations). Partitions were aligned across subsets using the Hungarian algorithm, with sum squared error (SSE) computed at each K and averaged across the 10 subsets. The SSE curve was then used to find the optimal number of communities at K=7. The K=7 cluster centroids from the subset became "eFC lures" for the clustering algorithm to derive edge communities for the remaining out-of-subset subjects. Specifically, we calculated the maximum similarity of each edge's eFC to the 7 cluster centroids and assigned that edge the community label of the maximally similar cluster centroid.

Results: Across subsets, edge communities were largely consistent (mean ARI=0.68±0.13). Next, we created a spin-test null distribution of community assignments (10,000 randomizations; $p < 10\text{-}8$, FDR-corrected) to test whether canonical functional networks (Yeo et al., 2011) were significantly overrepresented within each of the communities. The frontoparietal control network was significantly overrepresented in communities 2, 4, 5; default mode network in communities 2, 5, 6, 7; dorsal attention network (DAN) in communities 1, 3, 4, 7; limbic network in 2, 5; salience ventral attention network in communities 2, 3, 5; somatomotor network (SMN) in communities 1, 3, 6; and the visual network in communities 1, 4, 7. For any functional network, the edges associated with a network spanned at least two or more edge communities which aligns with previous findings of pervasive overlap in edge communities found in young adults (Jo et al., 2021). In other words, edges that connect functional networks were found to participate in multiple edge communities.

Lastly, the maximum similarity to eFC lures varied for systems across age. We found that eFC lure similarity of edges within the DAN ($R=0.153$, $p=0.0002$) and those bridging DAN-SMN ($R=0.160$, $p=0.0001$) had a significant, positive correlation with age. Our results suggest that edge community structure becomes less variable (increased similarity to eFC lure) with increasing age, notably for edges that involve the DAN. These results align with previous studies that have found increased within-DAN connectivity in development (Farrant et al., 2015) and throughout adulthood (Spreng et al., 2016).

Discussion: We show that eFC lures as templates for edge clustering are a computationally tractable way of deriving single subject edge communities that can be used to study changes across lifespan. Edge communities detected using eFC lures were largely consistent across subsets, while showing a variability in network organization across the human lifespan.

M99. INVESTIGATING ASSOCIATIONS BETWEEN STRESSFUL LIFE EVENTS AND TRIPLE-NETWORK (I.E. DEFAULT, EXECUTIVE CONTROL, AND SALIENCE) CONNECTIVITY USING PRECISION NEUROIMAGING METHODS: IN A LONGITUDINAL ADOLESCENT SAMPLE

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Background: Adolescence is a developmental period often characterized by high levels of stress and vulnerability to onset of psychiatric disorders. While stressful life events (SLEs) can be

developmentally normative, youth exposed to high or chronic stress are at greater risk of developing psychopathology. Previous work has demonstrated clinical populations show differences in salience (SN), executive control (CEN) and default network (DN) function and between network connectivity when compared to a healthy populations. Known as the triple-network model, the DN, CEN, and SN collectively support higher-order processes including cognition, perception, and social and affective processes. To date, only one study has investigated the effect of acute stress exposure in adolescents on triple-network connectivity and found reduced SN-DN, reduced SN-CEN and increased DN-CEN connectivity during acute stress.

The development of precision neuroimaging methods, which involves the collection of multiple sessions of fMRI data within the same individual, has allowed us to define network topography with a high level of detail. Using these methods, researchers found the canonical DN, as well as other networks, are comprised of multiple distinct networks which show evidence of domain-specialization and were previously blurred together when using group averages. No studies have characterized triple-network function using individually-defined network topography.

In this study, we will examine whether stress exposure is associated with fluctuations in triple-network connectivity in a longitudinal adolescent sample. We will (1) characterize network activity over time, using individualized network topography and (2) investigate whether fluctuations in stress are associated with triple-network connectivity over time within an individual.

Methods: We will utilize data collected (n=30) during an ongoing longitudinal study. As part of the study, participants (12-18 years) have completed monthly clinical and behavioral assessments, as well as monthly MRI scans over one year. SLEs were rated using the UCLA Life Stress Interview. The total stress impact score, calculated as the total sum of impact scores of all reported events, provides a weighted average of number and severity of stressors. Scans were collected at the Harvard Center for Brain Science, using a 3T MRI scanner and 32-channel head coil. Rapid structural (T1/T2-weighted) images, and fixation functional (T2*-weighted) images were acquired. Network topography for each participant was defined using multiple high quality resting-state BOLD runs and Multi-Session Hierarchical Bayesian Model (Kong et al, 2019). Network topography was used to characterize individually-defined networks that best overlap with canonical triple-network models (DN-A, DN-B, SAL-PMN, FPN-A, and FPN-B). Network activity and connectivity will be characterized over time. We also plan to investigate whether exposure to stress is associated with fluctuations in network connectivity over time.

Results: We expect that triple network activity and between-network connectivity will be more variable between individuals, and less variable within individuals over time. Additionally, we predict DN will be anti-correlated (i.e. show reduced negative connectivity) with SN and CEN. Further, we will investigate whether within-individual variations in between network connectivity are associated with changes in stress. We predict the DN to be less anti-correlated with SN and CEN during elevated stress, based on previous work by Corr et al., (2022).

Discussion: To our knowledge, this will be the first study to characterize triple-network function using individually-defined network topography and precision neuroimaging in a longitudinal adolescent population. Our novel approach also offers opportunities to explore both broader and finer-grained networks. Additionally, this research will inform our understanding of interactions between stress and variability in functional connectivity.

M100. DEV-ATLAS: A NEW REFERENCE ATLAS OF FUNCTIONAL BRAIN NETWORKS FOR ADOLESCENTS

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Background: Adolescence is a critical period for neural changes, including maturation of the brain's cognitive networks, but also a period of increased vulnerability to psychopathology. It is well accepted that the brain is functionally organized into multiple interacting networks and extensive literature has demonstrated that the spatial and functional organization of these networks shows major age-related changes across the lifespan, but particularly during adolescence. Yet, there is currently no reference functional brain atlas derived from typically-developing adolescents, which is especially problematic as the reliable and reproducible identification of functional brain networks crucially depends on the use of such reference functional atlases. In this context, the aim of this study was to construct and validate the first reference functional brain atlas based on typically-developing youth between the ages of 8 and 17 years. We term this new atlas, "Dev-Atlas".

Methods: We utilized datasets from typically-developing adolescent participants from three large developmental projects (Philadelphia Neurodevelopmental Cohort (PNC), the Pediatric Imaging, Neurocognition, and Genetics (PING) study, and the Lifespan Human Connectome Project – Development (HCP-D), age range: 8-17 years). We also used an independent smaller sample collected at Boys Town National Research Hospital, for replication (n=214, 53% males, mean age=12.23 (2.63) years). After strict quality control analyses and preprocessing using fmriprep, our final main sample was 1,391 individuals (47% males, mean age=13.56 (2.7) years; PNC: n=848, PING: n=78, HCP-D: n=465). For each individual dataset, the first-level analysis was carried out using probabilistic single-subject Independent Component Analysis (ICA) as implemented in MELODIC-FSL V3.15, in order to identify individual components. Then, we used the multiscale clustering of individual component algorithm (MICCA) process validated in our previous work (Naveau et al., 2012) to identify reliable functional brain networks across all individuals. This process identified 56 components. After excluding artefactual and non-reproducible components, 20 networks were included in Dev-Atlas. We further conducted linear model analyses to test the effect of age and sex on the spatial maps of the networks and the between-network functional connectivity (FC) using the GIFT Toolbox within the HCP-D and PNC samples (the two largest datasets), separately.

Results: We identified 20 reproducible networks across all datasets (Main and Replication) that were classified within 7 domains (Default-Mode (DM, 5 networks), Cognitive Control (CC, 2 networks), Salience (1 network), Dorsal Attention (3 networks), SensoriMotor (5 networks), Visual (3 networks), Cerebellum (1 network)). We identified large effects of age on the spatial topography of the majority of networks, as well as on the FC between networks, that were largely consistent across both HCP and PNC. Negative effects of age were typically seen in posterior parts of the networks while positive effects were detected in the anterior parts. The DMN showed reduced FC with the other networks with older age. Sex effects were also detected on the DM and CC networks. No significant sex-by-age interactions were detected.

Discussion: We have created Dev-Atlas, an atlas of functional brain networks based on typically developing children and adolescents between 8 to 17 years of age. Networks are shown to be

reproducible across independent datasets, and were sensitive to age. This atlas could be used on future independent samples in the context of spatially constrained ICA, as we plan to make Dev-Atlas freely available to the research community.

M101. STIMULANT MEDICATIONS MIMIC THE BRAIN EFFECTS OF SLEEP AND REWARD

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Background: Prescription stimulants such as methylphenidate, promoted as a treatment for attention-deficit hyperactivity disorder (ADHD), are being used by an increasing portion of the population (6.1\%), primarily children. These potent norepinephrine and dopamine reuptake inhibitors promote wakefulness, suppress appetite, enhance physical performance, and are purported to increase attention. Prior functional magnetic resonance imaging (fMRI) studies on smaller datasets have yielded conflicting Results: that are difficult to reconcile with the proposed attentional effects of stimulants.
Methods: We utilized resting-state fMRI (rs-fMRI) data from the large Adolescent Brain Cognitive Development (ABCD) study to understand the effects of stimulants on brain functional connectivity (FC) in children (n = 382 taking stimulants; 8-11 years old) using network level analysis (NLA). We validated the ABCD findings in a randomized precision imaging drug study with highly-sampled (165-210 minutes) healthy adults receiving methylphenidate (Ritalin) 40 mg.
Results: Stimulants were consistently associated with altered FC in action and motor regions, as well as the salience (SAL) and parietal memory networks (PMN), which are closely linked by dopamine, but not the brain's attention systems (e.g. dorsal attention network, DAN). The action and motor cortex pattern closely matched the brain effects of sleeping longer, while differences in SAL and PMN, networks associated with dopamine and reward-motivated learning, were greater for stimulants than for sleep. Furthermore, taking stimulants negated the effects of sleep deprivation on FC and behavior.
Discussion: The combined noradrenergic and dopaminergic effects of stimulants drive brain organization towards a more wakeful and rewarded configuration, explaining improved task effort and persistence without direct effects on attention networks. Some of the benefits of stimulants could also be attained by getting sufficient sleep each night. Any additional stimulant-specific effects not shared with being better rested may derive from equalizing the incentive salience of high- and low-reward actions and memories.

M102. CHANGE IN BRAIN ACTIVITY DURING REWARD PROCESSING IS ASSOCIATED WITH TREATMENT RESPONSE AND LATER DEPRESSIVE SYMPTOMS IN ADOLESCENTS WITH ANXIETY DISORDERS

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Background: Alterations in reward-related brain activity have been found to predict response to psychological treatment in adolescents with anxiety disorders. However, it remains unknown whether these effects are driven by reward anticipation or feedback, which reflect different aspects of reward responding, or whether brain activity changes as a function of treatment response. The current study investigated these questions in the context of a randomized clinical trial of cognitive-behavioral therapy (CBT) for anxiety disorders in adolescents.

Methods: This study used an fMRI paradigm to investigate reward-related brain activity in youth age 9-14 with anxiety disorders (ANX; N=133) before and after 16 weeks of CBT or an active comparison (child-centered therapy, CCT). Age- and sex-matched healthy comparison (HC) youth (N=38) completed scans on a similar timeline. A subset of ANX youth completed a 2-year follow-up assessment of depressive symptoms.

Results: Within anticipation, ANX compared to HC youth demonstrated reduced brain activity in reward-related dorsal striatum and thalamus, which normalized with treatment. Reduced pretreatment activation in the precuneus/cuneus predicted treatment response, and pre-to-post increases in posterior cingulate cortex (PCC) predicted more depressive symptoms at 2 years. Within feedback, ANX compared to HC youth had elevated pretreatment activity in angular gyrus, PCC and inferior frontal gyrus, which normalized with treatment. Pre-to-post reductions in brain activity in left angular gyrus corresponded with treatment response.

Discussion: Treatment response corresponded with activity in default-mode associated regions (PCC, angular gyrus, precuneus), suggesting that self-referential processes interfere with reward feedback in youth with anxiety disorders. Self-referential processing interfering with reward processing could represent a target to augment interventions geared towards improving reward responding in youth with anxiety disorders and at-risk for depression.

M103. ASSOCIATIONS BETWEEN ANTISOCIAL BEHAVIOR AND REWARD-RELATED NEURAL ACTIVATION IN YOUTH EXPOSED TO NEIGHBORHOOD DISADVANTAGE: THE MODERATING ROLE OF CALLOUS-UNEMOTIONAL TRAITS

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Background: Reward pursuit in the face of serious consequences is a defining feature of many antisocial behaviors (AB), which are broadly defined as actions violating social norms and/or the rights of others. However, research on the neural correlates of reward processing in individuals with antisocial behavior is mixed, with studies finding both hyper- and hypoactivation of neural reward systems in individuals with AB. Callous-unemotional traits represent one key target for delineating heterogeneous presentations of AB and their underlying neural correlates.

Methods: The current study examined whole-brain activation during a child-friendly fMRI reward task in 448 adolescents (7-19 years old; M = 14.7yrs) recruited from neighborhoods with above-average neighborhood disadvantage.

Results: Analyses revealed that the relationship between antisocial behavior and reward-related activation was moderated by youth's level of callous-unemotional traits. Specifically, greater antisocial behavior was associated with greater activation in the left anterior insula, left thalamus, and left lingual gyrus during losses (vs. neutral trials), but only for youth with lower levels of CU traits. Youth with higher levels of CU traits showed the opposite pattern, such that greater antisocial behavior was associated with less activation in the same regions. Additionally, callous-unemotional traits were uniquely related to activation in the left calcarine during wins vs. neutral trials, such that higher levels of CU traits were associated with less activation in this visual processing region during win vs. neutral trials.
Discussion: The current analysis builds upon a growing literature elucidating the neural mechanisms underlying antisocial behavior in youth. In particular, we observed significant links between antisocial behavior and loss-related activation in the anterior insula, a region implicated in empathy and response inhibition, as well as regions key to sensory integration and perception (e.g., thalamus, lingual gyrus). Notably, these associations were moderated by youth's level of callous-unemotional traits, such that youth with comorbid antisocial behavior and CU traits evidenced the lowest activation to losses in a region implicated in response inhibition. This work aligns with existing theoretical models hypothesizing that insensitivity to losses is a core feature of comorbid antisocial behavior and CU traits, thus emphasizing the importance of accounting for individual characteristics such as CU traits while delineating the neural reward-related systems underlying antisocial behavior in the critical context of neighborhood disadvantage.

M104. ADOLESCENT MEMORY-DRIVEN VALUE INTEGRATION DIFFERS BY VALENCE

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Background: Adolescence is a crucial time for understanding the development of adaptive decision-making, especially in situations that have not been encountered before. One way adults can make such novel decisions is by integrating across multiple previous experiences. Research has demonstrated that compared to adults, adolescents may form stronger memories when events co-occur with positive feedback (Davidow et al., 2016; Rosenbaum et al., 2022). Yet, evidence from reinforcement learning models has suggested more protracted learning and weaker memory in adolescents when associated with negative feedback (Nussenbaum and Hartley, 2019). Thus far, it has not been tested in the same task whether such differences in valence-driven learning impact memory formation and integration.
Methods: To address this open question, participants (current n = 111, with more participants being added, ages 8-30) completed a Sensory Preconditioning paradigm (Brogden, 1939; Wimmer and Shohamy, 2012; Gerraty, Davidow, et al., 2014), a motivated learning, memory, and decision-making task with three phases. In a preconditioning phase, participants learned paired associations during sequential presentations of images without receiving feedback. In a conditioning phase, a subset of the same images was associated with monetary gain, monetary loss, or a neutral outcome through feedback learning. In a final decision-making phase, participants were tested for memory

of the conditioned images, and on the tendency to integrate multiple memories for generalization. We conditioned and tested for learning from positive and negative feedback.

Results: We tested (1) memory for previously conditioned compared to (2) integration for generalized items. When testing this comparison, we found a significant valence by age interaction (Beta = -33.18, df = 2, p = 0.006). For conditioning memory for monetary gains, decision accuracy was high, with no age-related associations. However, conditioning memory for monetary loss increased with increasing age, such that the youngest participants were near chance, and the older participants showed high accuracy that was no different from their gain performance. For the novel integration test, we found a linear increase with age in the tendency to generalize, and this did not differ by valence.

Discussion: These age-related differences may be driven by variability in initial learning, or in the integration of value information across experiences, particularly for scenarios in which reward is not present. Further behavioral analysis will investigate the support for these alternative mechanisms and relate behavioral performance with resting state functional connectivity in a subset of participants (13-30 years old). Our intriguing findings emphasize the need for further exploration of the development of memory and decision-making mechanisms and their relation to motivated learning.

M105. IMAGING DIGITAL MEDIA: A NEUROIMAGING META-ANALYSIS

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Background: Research on digital media and neurocognition has blossomed with the advent of the digital age and social media. Much of the current literature focuses on how digital media engagement relates to cognitive functions like reward, social processing and cognitive control (Chiu and Chein, 2022). Indeed, brain regions associated with cognitive control like the dorsolateral prefrontal cortex and anterior cingulate cortex (Sun et al., 2012; Schmitgen et al., 2020), as well as brain regions underlying reward responsivity, such as the orbitofrontal cortex and the nucleus accumbens (Ko et al.,. 2009; Zhou et al., 2019) are highlighted in studies of digital media engagement. However, a broad and systematic analysis of brain regions reported across digital media neuroimaging studies has not yet been conducted.

Methods: Here, we conducted a coordinate-based meta-analysis spanning digital media (both social and non-social media) and using both structural and functional MRI, adopting a granular approach to aggregate across modalities. We used an Activation Likelihood Estimation (ALE) approach to identify significant clusters in MNI-space for five separate ALEs. An ALE was run for all studies, and then separately for functional, structural, social and non-social digital media studies. We then conducted follow-up focus-count analyses to describe the relative contributions of each paper to the significant clusters.

Results: We find that the most significant regions overall – anterior insula, precuneus and amygdala – are under-emphasized in the existing literature. We find that precuneal results are driven by non-social media usage and functional MRI studies; amygdala results are driven by social-media specific usage studies; and anterior insula results are supported by both structural and functional MRI and primarily non-social media usage studies. All results primarily report results that are negative in direction; such that papers that contributed to each significant cluster primarily reported either lower functional activation or smaller volume in high/ relative to low digital media

users. The papers included in these analyses span multiple age groups including children, adolescents and adults. Future analyses to be included with the poster will determine whether these clusters change as a function of age.
Discussion: These regions have been implicated in digital media relevant processes like social-emotional processing, reward, cognitive control and decision-making, but are rarely emphasized in current work. This may prompt reconsideration of which brain networks may be important for future work investigating digital media engagement.

M106. PRENATAL ENVIRONMENT IS ASSOCIATED WITH THE PACE OF CORTICAL NETWORK DEVELOPMENT OVER THE FIRST THREE YEARS OF LIFE**

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Background: Environmental influences on brain structure and function during development have been well-characterized, and the pace of early brain development has been associated with important risk factors and behavioral outcomes. As children mature, intrinsic cortical networks become more segregated, with sets of brain regions displaying more densely interconnected patterns of connectivity and large-scale systems becoming increasingly distinct. Some theoretical models posit that environmental influences on brain development might arise by way of effects on the pace of brain development, such that brain development proceeds faster in neonates and toddlers from lower-SES backgrounds.
Methods: In a set of pre-registered analyses (#128836 | AsPredicted), we explicitly test whether early SES is associated with differences in the pace of intrinsic cortical network segregation during the first three years of life. We capitalize on a unique cohort of neonates and toddlers (n=261, M=41.3 weeks at first scan) with longitudinal fMRI neuroimaging data and extensively characterized early environments, using generalized additive mixed models to examine moderating effects of prenatal SES on development of cortical network segregation, controlling for sex at birth, amount of uncensored data included, in-scanner motion, and average network connectivity. We take a hierarchical approach, first examining measures of cortical network segregation at whole brain resolution, then analyzing at the level of functional brain systems, and finally in individual brain regions. Finally, we examine whether differences in measures of cortical network segregation at age two years are associated with language and cognitive abilities (Bayley Scales of Development-III).
Results: Cortical network segregation increases with age during the first three years of life, and prenatal SES significantly moderates trajectories of cortical network segregation across scales (global segregation: $F = 6.38$, $pFDR = 0.003$; meso-scale segregation: $F = 9.86$, $pFDR = 0.0001$; local segregation: $F = 13.40$, $pFDR < 0.0001$). Neonates and toddlers from lower-SES Background:s show a steeper increase in cortical network segregation with age, consistent with accelerated network development. We find that associations between SES and cortical network segregation are present primarily at the local scale. Effects of prenatal SES are strongest in the somatomotor and dorsal attention systems and conform to a sensorimotor-association hierarchy of cortical organization ($r = -0.33$, spin-based permutation $p = 0.0018$). Importantly, SES-associated

**Flash Talk

differences in cortical network segregation are associated with language abilities at age two years, such that lower segregation is associated with improved language abilities (β = -0.23, p = 0.017, pFDR = 0.033), even when controlling for prenatal SES (β = -0.25, p = 0.017).
Discussion: We find that the development of cortical brain networks during the first three years of life is strongly associated with features of the early environment, suggesting these influences may play a key role in shaping this trajectory. Being born into a more advantaged (higher SES) environment is associated with a more protracted trajectory of cortical functional network development in early childhood; more protracted cortical network development might reflect prolonged periods of plasticity or alterations in synaptic proliferation and pruning. Importantly, environmental influences on development of cortical network segregation might underlie SES-associated differences in language abilities observed later in development. Our results suggest that infancy and toddlerhood may be an important period for promoting healthy brain development, emphasizing the first years of life as a target for policies supporting optimal child development.

M107. EXPLORING THE RELATIONSHIP BETWEEN EARLY LIFE ADVERSITY (ELA) DIMENSIONS AND THE DEVELOPMENT OF DECISION-MAKING STRATEGIES UNDER MOTIVATIONAL CONFLICT

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Background: Extensive research from developmental psychology indicates that Early Life Adversity (ELA) has persistent effects on the cognitive systems that support risk assessment, reward processing and decision-making, as well as on the neural mechanisms that underlie these processes (Blair et al., 2022). These effects may be particularly relevant in situations involving motivational conflict, where decisions can lead to both rewarding and adverse outcomes. In such scenarios, individuals must balance potential rewards against risks to determine whether to approach or avoid options. Previous studies have shown that in these approach-avoidance situations, both heuristic and optimal policy computations are employed, differentially weighing the probability of rewarding versus threatening outcomes (Korn and Bach, 2019). However, it is unclear how dependence on different decision variables changes over normative development and is shaped by exposure to early adverse environments. We aim to investigate whether exposure to dimensions of ELA —reward availability, unpredictability and controllability— is associated with the use of specific decision-making strategies in an approach-avoidance task. Specifically, we anticipate a main effect of unpredictability and low reward availability on choice strategy, with individuals scoring higher on these factors favoring a policy that reflects higher sensitivity to the probability of threat and a general avoidance bias.
Methods: We will collect data from 150 participants aged 10-25 who will complete an online behavioral task and a self-report questionnaire assessing various dimensions of ELA exposure. Factor analysis will be used to characterize these dimensions, generating individual factor scores based on participants' responses. The behavioral task will simulate threats of virtual predation and energy depletion. Participants will make choices within five-trial blocks, where they will have the option to either wait, incurring a small and deterministic loss, or playing a risky card displaying the probabilities of each potential outcome: gaining a variable amount of points, losing a fixed amount of points, or being robbed, meaning virtual death.

We will use mixed-effects logistic regression models to predict choices as a function of the value of playing, according to the Optimal Policy, as well as strategies that weigh choice variables in a manner that deviates from this policy (e.g. Threat Avoidance policy). Importantly, we will fit computational models to participants' choice data, estimating softmax temperature parameters that reflect their use of an optimal (β optimal) or various suboptimal policies. Linear mixed-effects models will analyze reaction times, evaluating the influence of expected value differences and strategy use.

Results: As data collection is forthcoming, results are speculative. However, we expect higher adherence to a threat-avoidant policy in individuals with high scores in unpredictability and low reward availability. We also expect participants' reaction times to be longer when the expected value difference is smaller.

Discussion: This study aims to elucidate the mechanisms by which ELA dimensions influence decision-making processes, potentially leading to a better understanding of how individuals develop resilience or vulnerability in the face of risks. Decision-making under motivational conflict is clinically relevant, as it may provide insights into how individuals compare the costs and benefits of actions and develop proactive or inhibitory behavior patterns associated with psychiatric symptomatology. Understanding how ELA impacts decision-making in these scenarios may provide insights into the mechanisms underlying these vulnerabilities. By examining specific dimensions of early-life experience, we aim to elucidate how these factors shape the way individuals weigh different potential outcomes, contributing to our understanding of both psychopathological trajectories and normative development.

M108. A HYPERSCANNING STUDY OF NEURAL AND BEHAVIORAL CO-REGULATION AMONG MOTHERS AND THEIR TODDLERS

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Background: Through the process of co-regulation, children and their caregivers coordinate behavioral, affective, and physiological signals that over time support the child's ability to self-regulate. Recent advancements in neuroimaging technology, specifically, the use of in-vivo near infrared spectroscopy (NIRS) during in-vivo parent-child interactions, have made it possible to examine the neural mechanisms that underlie parent-child co-regulation. The current study tested how behavioral co-regulation (i.e., observed dyadic reciprocity) between mothers and their toddler-age children related to neural co-regulation (i.e., brain-to-brain synchrony) in areas of the brain relevant for the generation, regulation, and understanding of emotions—specifically, the prefrontal cortex (PFC) and temporoparietal junction (TPJ).

Methods: Participants were 90 mothers and their 1- to 3-year-old children (mean age = 24.9 months SD = 10.2 months; 53% boys). Behavioral co-regulation was measured during 10 minutes of mother-child floor play and coded using an established system (Coding Interactive Behavior, CIB, dyadic reciprocity scale). Dyadic neural co-regulation was measured during 3 minutes of face-to-face play using a continuous-wave CW6 NIRS system (TechEn, Milford, MA) at a sampling rate of 20 Hz. Fiber optics were split between two caps worn by both members of the dyad, which allowed for simultaneous measurement of mother and child brain activities (i.e.,

hyperscanning). NIRS data were analyze in MatLab (Mathworks, Natick, MA) using the open-source AnalyzIR toolbox.
Results: Higher levels of behavioral co-regulation (observed dyadic reciprocity) were associated with greater neural co-regulation (brain-to-brain synchrony) in mom left TPJ and child right TPJ ($t = 2.80$, $p = .006$) and in mom left TPJ and child left dorsolateral PFC ($t = 2.48$, $p = .01$).
Discussion: Results suggest that greater observed behavioral correlation is supported by higher levels of brain-to-brain synchrony in regions relevant for emotional understanding and regulation. Additional analyses will examine associations between neural co-regulation and other behavioral indices of the mother-child relationship, such as maternal sensitivity, as well as maternal predictors of neural and behavioral co-regulation, including maternal economic and social stress.

M109. PATHWAYS TO ADOLESCENT SOCIAL ANXIETY: INTERACTIONS BETWEEN NEURAL SOCIAL REWARD FUNCTION AND PERCEPTIONS OF PEER THREAT

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Background: The incidence rate of social anxiety disorder (SAD) spikes in early adolescence, particularly in girls. To intervene more effectively, we must advance our understanding of the developmental pathways that contribute to SAD in girls. Research has found that youth with, and at risk for, SAD show higher neural responses to reward cues and perceive more threat in their social interactions relative to youth without, or at lower risk for, SAD. Considering this research, recent theories propose that for youth highly sensitive to incentives, perceiving more social threat may contribute to higher social anxiety (SA) symptoms through reinforcement learning mechanisms. The current study tested a central pathway from these theories; we hypothesized that adolescent girls who report more social threat in daily peer interactions would develop more severe SA symptoms over time, particularly if they showed higher neural responses to social reward cues.
Methods: Participants in this 3-year longitudinal study were 129 girls ages 11-13, with the sample enriched for shy/fearful temperament to increase variability in SA symptoms. At baseline, girls completed a 16-day ecological momentary assessment protocol; 3-4 times per day, girls described their most recent negative peer interaction and indicated how they felt in the interaction using 8 social threat statements (e.g., "I felt criticized"). The number of social threat statements endorsed was summed for each negative interaction and divided by the total number of interactions to create an average "perceived social threat in daily life" score for each participant. At baseline, neural responses to social reward (vs. neutral) cues (i.e., cues indicating potential positive or neutral feedback from a peer the participant believes to be observing them complete a task) were assessed using the Peer Social Incentive Delay task. Social anxiety symptoms were assessed by clinical interviewers at baseline and two-year follow-up. Mplus was used to model interactions between baseline neural responses to social reward (vs. neutral) cues and perceived social threat predicting SA severity two years later, adjusting for pubertal status and baseline SA severity. To model neural responses to social reward cues, we first created a latent factor of neural social reward function using relevant regions-of-interest (ROIs), including the striatum, anterior insula, basolateral amygdala (BLA), precuneus, dorsal anterior cingulate cortex, and mediodorsal nucleus of the thalamus. In secondary analyses, we re-ran the model with any regions that did not load

significantly on the latent factor, as well as with the nucleus accumbens (NAcc), a key reward-related striatal region, alone for comparison.

Results: No significant interactions emerged when neural reward function was modeled as a latent factor or when testing the model with the NAcc ROI. The BLA was the only region not to load on the latent factor. Secondary analyses showed that higher perceived social threat was associated with more severe SA symptoms two years later only for girls with higher BLA activation to social reward cues at baseline (interaction β=.24; B=4.08, SE(B)=1.71, p=.017). Interaction effects were specific to BLA activation to social reward (not threat) cues, though a main effect of BLA activation to social threat (vs. neutral) cues on SA emerged (β=.25; B=3.78, SE(B)=1.63, p=.020). Interactions between social threat and BLA activation to social reward cues also predicted youth self-reported generalized anxiety (β=.27, p=.004) and depression symptoms (β=.25, p=.022) two years later.

Discussion: The BLA plays a key role in reward learning. Perceiving high social threat may be particularly detrimental for girls highly sensitive to reward incentives, potentially due to mediating reward learning processes, though this remains to be tested. Extension of findings to generalized anxiety and depression symptoms suggests possible transdiagnostic risk pathways that merit further investigation.

M110. NEURAL SENSITIVITY TO PEER STATUS AND LINKS TO DIGITAL STATUS SEEKING AMONG ADOLESCENTS

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Background: Adolescents value the attainment of status, are more attuned to their peers, and show increased sensitivities to social hierarchies within their peer groups. The increasing ubiquity and quantifiable nature of social media has transformed adolescent peer relations, leading to new ways of attaining status, such as accumulating more likes, comments, and other digital markers of status. This behavioral tendency, referred to as digital status seeking (DSS), is linked with adolescent risk behaviors. However, it remains unclear what factors underlie DSS. This study examines how neural sensitivity to peer status relates to DSS one year later.

Methods: Participants include 94 adolescents (Mage = 14.71 years, SD = 0.60, females = 52%, males = 48%) who were racially and ethnically diverse (42% white, 27% Black/African American, 15% Hispanic/Latin/x, 7% multi-racial, 5% American Indian/ Alaska native, 4% Asian/Asian American) drawn from a larger 5-year longitudinal study of 873 adolescents from three rural schools in the Southeastern part of the U.S. We utilized data from 2 waves; fMRI data at wave 3 and DSS at wave 4.

Adolescents completed an fMRI task at wave 3 during which they were presented with images of their real-life classmates. Notably, we used peer-nominated sociometric ratings from 873 students across 3 middle-schools to select images of their peers based on who was most popular, least popular, most liked and least liked. This allowed us to examine neural responses to their high and low status peers from their real-life social networks.

At wave 4, DSS was measured using (1) sociometric nominations, in which all classmates in participants' schools indicated "who tries hard to get more activity (i.e. likes, comments, etc.) on

their social media profiles (e.g., Facebook, Twitter, Instagram?)" and (2) self-reported measures (e.g., "how often do you use social media to get new followers").

Results: We found a weak positive correlation between peer nominated and self-reported DSS, $r(92) = .27$ $p < .01$. Moreover, adolescents who were rated by peers as more popular also had higher peer-nominated DSS ($r(92) = .51$, $p < .01$) and self-reported DSS, $r(92) = .31$, $p < 01$. At the whole-brain level, main effects of the contrasts of interest show significant effects of peer status, such that adolescents showed greater activation in the visual system, right insula, dorsolateral prefrontal cortex and temporoparietal junction when viewing high status peers relative to low status peers.

Discussion: Findings from this study provide preliminary evidence for a more nuanced understanding of adolescent peer relations. Popular adolescents were perceived to engage in more DSS. Interestingly, the weak but significant correlations between self-reported and peer-nominated DSS highlight the discrepancies between self and peer perceptions of DSS. Our fMRI findings suggest that high status peers were not only more visually salient relative to low status peers, but also activated regions of the brain responsible for both affective salience and social cognition, suggesting adolescent competencies in processing social hierarchies. Additional analyses will examine whether neural activation to peer status is associated with peer nominated and self-reported DSS.

M112. THE ROLE OF CHILDHOOD ABUSE AND NEGLECT ON BRAIN FUNCTION DURING EMOTIONAL INTERFERENCE: IMPLICATIONS FOR DEPRESSION IN ADOLESCENCE

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Background: Rates of depression among adolescents have risen over the past several decades, becoming a major public health concern both in the United States and globally. Childhood adverse experiences are believed to be key risk factors for the development of depression during childhood and adolescence. The mechanisms by which experiences of childhood adversity, including emotional abuse and neglect, lead to depression during adolescence remain poorly understood. We propose that one potential mechanism by which experiences of childhood adversity could lead to depression may be by their impact on the functioning of brain networks implicated in emotion regulation, which are known to undergo significant maturation during adolescence. Here we focus specifically on brain networks underlying emotional interference resistance, which is a voluntary emotion regulation subprocess involved in modulating attention to prevent emotionally salient distracting stimuli (e.g., threat cue such as an angry face) from interfering with goal-directed cognitive processes. We review evidence that childhood adversity impacts these brain networks, which are also impacted in depression during adolescence, and note that there is a dearth of longitudinal research examining the relationship between mood symptoms in adolescence and alterations associated with childhood adversity in brain networks underlying emotion regulation. Therefore, we propose a mediational model whereby behavioral and brain correlates of emotional interference during an emotional working memory task mediate the relationship between measures of childhood emotional abuse and neglect and the severity and course of depressive symptoms over a longitudinal follow-up period.

Methods: Participants include 180 adolescents (ages 12-18; M = 15.19-years-old, 66% female) with (n = 142) and without (n = 38) clinical depression from a completed 5-wave (baseline and 4 follow-up assessments at 6, 12, 18 and 24 months) longitudinal study examining the associations between neural, emotional, cognitive and behavioral factors and trajectories of mood symptoms among depressed youth. Data will include: (1) baseline past childhood emotional abuse and neglect assessed with the Childhood Trauma Questionnaire (Bernstein et al., 1998), (2) baseline current emotional interference as indicated by slower reaction times and reduced negative amygdala – ventrolateral prefrontal cortex and amygdala – dorsolateral prefrontal cortex connectivity during angry (vs. neutral) emotional face distracter conditions of an emotional working memory fMRI task (Manelis et al, 2022), and (3) baseline, 6-month and 12-month follow-up depressive symptom data from the child Mood and Feelings Questionnaire (Costello and Angold, 1988) and Kiddie Schedule for Affective Disorders and Schizophrenia Depression Rating Scale (Chambers et al., 1985).
Results: Using multiple linear regression, we will analyze whether past childhood abuse and neglect, as measured at baseline, is associated with heightened self- and clinician-reported depressive symptoms at baseline and a greater increase in these symptoms from baseline to 12-month follow-up. We will analyze whether this relationship is partially mediated by behavioral and neural markers of emotional interference at baseline, after taking into consideration covariates such as age, sex, general working memory performance, and family income. Data analysis will be completed prior to the conference.
Discussion: Results will inform our understanding of mechanisms by which early emotional adversity contributes to increasing depression severity in adolescents varying in levels of depressive symptoms. Findings could thus provide insight into novel and earlier neural and behavioral targets for intervention for adolescents with a history of childhood abuse and neglect.

M113. SOCIAL AND COGNITIVE CONTRIBUTIONS TO LONELINESS IN AUTISTIC AND NON-AUTISTIC YOUTH

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Background: Adolescence is a tumultuous developmental period characterized by rapid biological, cognitive, and social growth. The increasing epidemic of loneliness amongst teens poses an alarming risk of poor lifespan outcomes. Notably, autistic youth experience loneliness at a substantially higher rate than their non-autistic peers. Targeting and understanding the development of loneliness during adolescence is central to ameliorating harmful social and neural trajectories.

One risk factor for loneliness is poor social interactions. Cognitive factors that may contribute to poor social interactions include executive functions (EF), such as flexibility and inhibitory control as well as social-cognitive abilities including mental state attribution (or theory of mind, ToM). While these abilities are both atypical in autism (Hemmers et al., 2022), less work has examined their inter-relations. In non-autistic individuals, there is evidence that executive functions contribute to social development, including associations between EF and performance on ToM tasks (Carlson, et. al., 2004). However, limited work has examined how EF is related to social brain development and social well-being (i.e., loneliness). Here, we examine contributions of EF

to social brain development, social cognition, and social well-being in autistic and non-autistic adolescents by testing the following aims: (1) Examine differences in EF, ToM (both cognitive and neural response) and loneliness between autistic and nonautistic adolescents (2) Characterize relations between EF on social-cognitive abilities (ToM), social brain development (functional connectivity), and social well-being (loneliness) in autistic and non-autistic youth.

Methods: 118 eligible participants (Autistic n=39; Non-Autistic n=79) between the ages of 11 and 14 enrolled in this study. Measures: EF domains were measured using the NIH Toolbox Cognitive Battery: Dimensional Change Card Sort (DCCS) Test, Flanker Inhibitory Control Test, and List Sort Working Memory Test (uncorrected standard scores). Loneliness was captured using a modified Children's Loneliness and Social Dissatisfaction Scale with greater scores indicating more loneliness. The ToM abilities were assessed by the percent of accurate responses on mentalizing interactions on the Animated Triangles Task (ATT). For a measure of social brain organization participants viewed a short film, Partly Cloudy, that elicited significant spontaneous mentalizing (Richardson and Saxe, 2018). Using regions of interest associated with mentalizing, we will examine functional connectivity within the mentalizing network and between mentalizing and pain networks.

Results: Groups are matched in age and IQ. The autistic group reports higher levels of loneliness compared to the non-autistic group (autistic $\bar{x} = 45.7$; non-autistic $\bar{x} = 40.5$; $p < 0.001$). Groups differ significantly on Flanker ($\bar{x} = 93.93$; $p < 0.001$), and DCCS ($\bar{x} = 100.73$; $p < 0.05$) in which the autistic group scored lower than the non-autistic group. Correlations between EF and ToM reveal a negative relationship in non-autistic youth only: increased Flanker ($\beta = 0.23$; $p < 0.01$) is associated with improved accuracy on the ATT task mentalizing items. When controlling for age, sex, and IQ, we observe a significant effect of Flanker ($\beta = 0.35$; $p < 0.01$) on loneliness outcomes in non-autistic youth only. We are currently in the process of examining how measures of functional connectivity of the mentalizing network differ between groups and relates to EF in both autistic and non-autistic youth.

Discussion: These results indicate that autistic youth experience more feelings of loneliness. Our preliminary data show that inhibitory control is significantly related to mentalizing and loneliness, respectively; yet this relationship only holds in non-autistic youth. Future directions include examining group differences in functional connectivity of mentalizing network activation during mentalizing events and associations with executive function.

M114. CORTICAL SPECIALIZATION FOR HIGHER AND LOWER ORDER EMOTION PERCEPTION ACROSS DEVELOPMENT

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Background: Reading emotions in others involves multiple levels of cognitive processing: 1) integrating low-level sensory features; and 2) applying semantic knowledge to ultimately; 3) integrate semantic features to identify the specific emotion concepts expressed by others. Children learn emotion concepts from the bottom up, with refinement of semantic and conceptual understanding across childhood and adolescence. However, these three levels of cognition have not been examined in tandem in the context of neurodevelopment. The goal of this project is, therefore to 1) identify regions of the brain associated each level of cognitive processing; and 2)

characterize differences in the distribution of these regions and selectivity strength across development.

Methods: This project uses movie-watching fMRI data (two videos) from 823 5-15-year-olds who participated in the Healthy Brain Network Biobank study. Videos were coded for low-level (e.g., loudness, sharpness, vibrance), semantic (e.g., specific words, faces), and emotion-specific features (e.g., anger, sadness). Both age at scan and pubertal timing will be used to examine associations between feature encoding and development. First, the degree to which each voxel/vertex of each participant responds to each feature was characterized by entering each video feature from all levels as predictors in a regularized regression model (elastic net) with activation as the outcome variable. This procedure shrinks betas for feature timeseries that are weakly associated with activation to zero, resulting in a sparse set of features associated with activation for each voxel/vertex. The model was trained on data from one video with 5-fold cross validation and tested on the second video to avoid overfitting and enhance generalizability. Aim 1: Across the sample, selectivity for each feature at each voxel/vertex was identified by testing if each voxel is more strongly encoding either low-level, semantic, or emotion features based on regression betas. Specifically, we used paired t-tests to determine if one category is represented more strongly than the others across the sample. Aim 2: We used support vector regression to identify differences in the regularized regression betas across age and puberty.

Results: Aim 1: Replicating prior work using highly controlled stimuli, we found that regions of primary visual cortex were selective for brightness (low-level) and vibrance (low-level), the superior temporal gyrus were selective for speech (semantic), and the ventral inferior temporal gyrus for faces and bodies (semantic). Regions of associative cortex are more selective for processing emotional information than for semantic or low-level sensory information during complex emotion processing. Intriguingly, there was low selectivity in regions of the lateral occipital lobe and temporal pole (equal strength representation of all levels of processing), suggesting these may be regions of either inter-subject heterogeneity or heterogenous processing. Aim 2: SVR models found a strong association between selectivity strength and age (model $rs > 0.42$, $ps < 0.001$). An inspection of age–beta associations indicate that cortical selectivity increases with age, particularly for emotion and stimulus category selectivity and less so for low-level features. Together, this suggests that cortical selectivity mappings strengthen across childhood and adolescence.

Discussion: Identifying how low- and high-level feature representation in the brain is associated with age-related emotional development could provide important insight as to how these processes may go awry in pediatric psychiatric disorders.

M115. MNEUROANATOMICAL MEDIATORS OF DEVELOPMENTAL DIFFERENCES IN DEFENSIVE RESPONSES FOLLOWING SOCIAL EVALUATIVE THREAT

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Background: People often exhibit defensive responses following social evaluative threats, such as denigrating others, but the specific manifestation of those defensive behaviors seems to change across development. Our previous study (Yoon et al., 2018) found that overt/simple defensive

behavior (OD) decreased and covert/sophisticated defensive behavior (CD) increased throughout adolescent development. Elucidating the mechanisms of such development may provide an important first step to understanding why some individuals show immature defensive responses, which can hamper social relationships and hinder emotional well-being. Structural brain development may account for the development of defensive behavior, given significant changes that occur during adolescence in the structure of a key brain region implicated in emotion regulation (e.g., the anterior cingulate cortex (ACC)) and self-processing (e.g., the medial prefrontal cortex (MPFC)). The current study aims to test whether the MPFC/ACC serves as a neuroanatomical mediator of age differences in defensive responses to social evaluative threats in youths, while exploring other regions in the whole brain.

Methods: Participants were 58 youths from the ages of 10 to 25. We conducted a secondary analysis of our previous study (Yoon et al., 2018), in which we observed decreased OD and increased CD as a function of age. Using a reciprocal artwork evaluation task, OD was measured by quantifying the tendency to negatively evaluate a partner immediately after receiving negative feedback from the same partner. The CD was measured by quantifying the tendency to negatively evaluate the current partner when the cumulative feedback value from all previous partners was negative.

Structural MRI images were analyzed by implementing the following steps: (1) preprocessing using CAT12.9, which included normalization, correction for bias-field inhomogeneities, segmentation, estimation of total intracranial volume (TIV), and smoothing; (2) confirming a good image quality rating (i.e., better than or equal to B-); (3) running two regression analyses which include OD and CD respectively as independent variables, gray matter volume as a dependent variable, and TIV as a covariate; (5) implementing Threshold-Free Cluster Enhancement for both the region-of-interest and the whole brain analysis; (6) conducting a mediation analysis to test the mediating role of the gray matter volume on the association between age and defensive behaviors.

Results: The region-of-interest analysis found that the larger pregenual anterior cingulate cortex (pgACC) volume was associated with a higher tendency of OD. However, the pgACC volume did not mediate the age-related decrease in OD. The whole-brain analysis found that the larger lateral orbitofrontal cortex (LOFC) volume was associated with a higher tendency of OD. Moreover, the LOFC volume completely mediated the age-related decrease in OD. We did not find any brain region in which the gray matter volume was associated with CD.

Discussion: While the larger volumes of both pgACC and LOFC were associated with a higher tendency of OD, only LOFC was identified as a mediator of the age-related decrease in OD. Given the role of LOFC in learning the value of actions based on punishment and non-reward, youths may internalize the need to inhibit overt defensive responses over time as they learn that this behavior is disliked by others, which could be supported by LOFC maturation. This finding highlights that structural brain development may be partly responsible for the reduction in overt defensive responses across development, which can be confirmed by a longitudinal study. Further, this study provides a potential neurodevelopmental account for immature defensive reactions (i.e., delayed or atypical development of LOFC) and informs the need to target brain developmental patterns when devising a preventive intervention for maladaptive social-emotional development.

M116. AGE-RELATED DIFFERENCES IN THE ASSOCIATIONS BETWEEN SELF-PROTECTION FROM SOCIAL EVALUATION AND MENTAL HEALTH: A COMPUTATIONAL APPROACH

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Background: Adolescence is a period of life characterized by great change in social experience. As peer inclusion takes on greater importance, adolescents demonstrate more reactivity to perceived social evaluation. Adolescence is also a time of heightened vulnerability to developing mental health disorders, which often onset following social stressors such as peer rejection. However, many people who experience peer rejection do not develop mental health disorders. Due to this heterogeneity in outcomes, it is important to identify cognitive strategies that may promote resilience following peer rejection in adolescence. Adults have been shown to recruit self-protective biases, such as focusing on positive traits, ostensibly to dampen the emotional effects of negative evaluation. However, adolescents do not show these self-protective biases. While age-normative, this may confer risk for developing mental health problems. In this study, we ask: does the association between self-protective bias and internalizing symptoms differ by age?
Methods: In these preregistered analyses, we used previously collected data from 107 participants aged 9.98-23.29 years. Participants completed the First Impressions Task, where they predicted whether a peer would like them and then received feedback (set at 50% acceptance/50% rejection) that they believed was real. Participants also completed the Revised Child Anxiety and Depression Scale as a measure of internalizing symptoms. We calculated four metrics of self-protective biases from the task and examined how each of these biases, moderated by age, predicts internalizing symptoms. We are also developing computational models of the task behavior to uncover potential cognitive mechanisms of self-protection (see Discussion).
Results: Using generalized additive models, we found that one's expectations of being accepted interacts with age to predict depression symptoms ($p < .05$, $R2 = 14.2\%$). Predictions generated from the model show that while adults who expect low levels of acceptance have higher depression symptoms, children and teens do not show this association. This indicates that one's expectations of being liked may relate to psychopathology as an adult, but not at younger ages. Additionally, downgrading one's views of rejecting peers is associated with higher generalized anxiety symptoms at all ages ($r = -.23$, $p < .05$), which may suggest that those who are more reactive to rejection have higher risk.
Discussion: These analyses suggest that there may be important differences in how youths' and adults' expectations of social evaluation relate to mental health outcomes. Of note, participants may have used the feedback they received to update their expectations of being liked across the task, which could reveal additional self-protective processes. As such, we will complement these analyses with exploratory reinforcement learning and Bayesian updating models to understand whether youths and adults update their expectations of being liked differently. We have made substantive progress in developing these models, including running preliminary reinforcement learning models. Age-related differences in the model parameters and connections to mental health symptoms will be discussed. Overall, this project contributes to our understanding of how self-protection from social evaluation relates to mental health at different developmental stages.

M117. ASSOCIATIONS BETWEEN SOCIAL ATTENTION AND SLEEP QUALITY IN INFANT SIBLINGS OF CHILDREN WITH AUTISM SPECTRUM DISORDERS

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Background: Shorter sleep duration and increased fragmented sleep are correlated with impaired attention and emerging socio-emotional problems in internalizing issues (e.g. anxiety, separation distress, and inhibition) in typically developing (TD) infants. Sleep duration and sleep fragmentation patterns become more pronounced in 10-month-old TD infants compared to younger infants. Infants in this age group also experience a socio-cognitive revolution as research has found increased theta power during sustained attention. Frontal theta oscillations have been associated with attentional engagement and emotional processing. However, there is a lack of research exploring the relationship between sleep and social attention in the autistic cohort. This study investigated whether being at risk of developing autism predicted sleep quality in infants, and if this could be observed in their neural responses to visual stimuli.
Methods: Data included 10-month-old infants (N=109) who were either at high (N = 68) or low (N = 41) familial risk of developing autism. These infants were recruited for the British Autism Study of Infant Siblings (BASIS) and The Studying Autism and ADHD Risks (STAARS) projects. Electroencephalography (EEG) powers were recorded when the infants watched the social and non-social stimuli videos during the 10-month-old visit. Parents also completed the Sleep and Settle Questionnaire (SSQ; Mathey, 2001).
Results: We found that high-risk (HR) infants experienced more sleep fragmentation at night than low-risk (LR) infants ($F(1, 107) = 5.368$, $p = .022$). However, this was not the case for sleep duration ($p > .05$). We did not observe significant group differences in the relationships between sleep fragmentation/sleep duration and any of the frontal theta powers measured during social and non-social stimuli (p's > .05). Linear regression analyses for the HR group showed that HR infants who slept shorter at nights showed increased attention (Frontal Theta_Central Electrodes) during the presence of social stimuli (ß = -7519.8, $p = .034$). Similarly, infants who woke up more during the night showed increased attention (Frontal Theta_Central Electrodes) during social stimuli (ß = 68.177, $p = .008$), and decreased attention (Frontal Theta_Central Electrodes) during non-social stimuli (ß = -68.011, $p = .008$).
Discussion: Findings from this study provide a better understanding of the altered neurophysiology and poor cognitive development in infants with later emerging autism. Contrary to the literature, sleep duration seemed to have a negative relationship with frontal theta powers during social attention, and sleep fragmentation did not correlate with frontal theta powers. It is important to consider the inter-individual variability and age-dependent changes of theta powers. Sleep fragmentation may be a clinical sign of ASD, however, impaired socioemotional competence could be a stronger indicator of this disorder in the first year of life. Shorter night-time sleep duration in at-risk children might stem from more severe ASD symptoms, or they might be the result of other contributing factors such as age and genetic risk.

M118. A LONGITUDINAL NEUROIMAGING STUDY OF ADOLESCENT GIRLS' MENTALIZING AND PERSPECTIVE-TAKING TENDENCIES

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Background: Research in developmental psychology suggests that self-concept formation and mentalizing capacities, along with their neural foundations, show significant developmental change during adolescence. Perspective-taking is also believed to increase in adolescence,

supporting the refinement of prosocial behavior and the demands of increasingly complex social relationships young people engage in as they mature. However, if perspective-taking tendencies increase with age, why would activity in mentalizing-related brain regions (such as dorsomedial prefrontal cortex (dmPFC)) decrease with age, as proposed in some prominent developmental social cognitive neuroscience accounts?

Methods: To explore this apparent conundrum, female adolescents (N=172) completed a self-report measure of perspective-taking tendencies (the Interpersonal Reactivity Index - Perspective Taking (IRI-PT) subscale), as well as a social self-evaluation fMRI task at two timepoints, approximately 18 months apart (mean age = 11.62 and 13.20, respectively). Previous work has found that adolescents spontaneously activate regions of the brain involved in mentalizing during social self-evaluation. We hypothesized that perspective-taking tendencies would be positively associated with age amongst early adolescent girls, and that greater perspective-taking tendencies would be associated with greater activation in mentalizing regions during social self-evaluation (dmPFC, vmPFC, rTPJ, lTPJ, precuneus). Analyses included multilevel models and a bivariate latent change score model including perspective-taking tendency and activity in mentalizing brain regions during social self-evaluation).

Results: Perspective-taking tendencies were positively associated with age and there was significant individual variability in this relationship. Additionally, we did not find evidence of decreased activity with age in mentalizing regions; in fact, dmPFC activation during social self-evaluation increased with age, although this did not survive our pre-registered correction for multiple comparisons. Finally, while perspective-tendency did not relate to activity in mentalizing brain regions during social self-evaluation, it was positively associated with a more prosocial, and less antisocial, self-concept. Our bivariate latent change score model revealed that lower perspective taking tendencies at timepoint 1 were associated with increased latent change in perspective taking across both timepoints; the same relationship was found for activity in mentalizing regions during social self-evaluation.

Discussion: Development of a stable, multifaceted identity and advancement of perspective-taking skills are associated with positive functional outcomes, ranging from academic and occupational success to social wellbeing (Crone et al., 2022). Indeed, successful development of these capacities allows adolescents to build strong relationships, and become effective, contributing members of our respective communities (Crone et al., 2022; Crone and Fuligni, 2020; Hollarek and Lee, 2022). Our study offers an important step towards understanding how perspective-taking and mentalizing processes relate to each other, change over time, and vary at an individual level among adolescent girls. Our findings suggest that self-reported perspective-taking tendencies among adolescent girls increase with age and are associated with increased self-evaluated prosociality and decreased self-evaluated antisociality. Moreover, there appears to be substantial individual variability in perspective-taking tendencies – a topic which warrants further research. Additional longitudinal research contextualizing brain-behavior interactions of perspective-taking tendencies—both within and outside of social self-evaluative contexts—across development could help us understand how these processes emerge and progress throughout adolescence.

M119. DEVELOPMENT AND VALIDATION OF THE PROSOCIAL ADOLESCENT RISK-TAKING QUESTIONNAIRE (PAR-Q)

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Background: Adolescence is a time in life associated with increased risk-taking. Previous research has mainly focused on negative aspects of risk-taking such as health related risk-taking. More recently, research focus has shifted towards more positive aspects of risk-taking. One topic that started to gain more attention is prosocial risk-taking behavior – defined as behavior where an individual takes a risk to help someone else. However, validated measures are still limited, which limits the opportunity to assess prosocial risk-taking behavior. Here we developed and validated a multifaceted questionnaire to assess prosocial risk-taking in adolescents.
Methods: An initial set of 29 items was based on literature review and co-created with focus groups of adolescents. An exploratory factor analysis to indicate initial factor structure was performed on data from a sample of 234 Dutch adolescents (149 girls) aged 14-17. A confirmatory factor analysis to confirm the initial factor structure was performed on data from a separate sample of 357 Dutch adolescents (208 girls) aged 14-17. Additionally, we tested convergent validity using questionnaires assessing different constructs including prososcial behavior and empathy, and assessed test-retest reliability.
Results: Results showed a two-factor structure with acceptable internal consistency and excellent test-retest reliability excellent. One factor represents social/reputational prosocial risk-taking, and the other factor represents financial/material prosocial risk taking. The subscales are comprised of respectively 6 and 5 items. The PAR-Q correlated positively with prosocial behaviors and empathy.
Discussion: In conclusion, the PAR-Q is a newly validated measure with good psychometric properties that can be used to assess prosocial risk-taking behavior in adolescents.

M120. SLEEP MODERATES THE INDIRECT LINK BETWEEN FOOD INSECURITY AND YOUTH'S NEGATIVE AFFECTIVITY VIA NEURAL REWARD PROCESSING

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Background: Food insecurity is a severe and pervasive form of early childhood adversity (ELA) that bears significant risk for the development of affective psychopathology in adolescence (McLaughlin et al., 2012). Neuroimaging research suggests that the effect of ELA on the development of affective psychopathology is mediated by reward processing deficits (Mclaughlin et al., 2017). However, the specific effects of food insecurity on reward processing that underlie risk for affective problems is unknown. This knowledge gap may stem from the fact that food insecurity is a multidimensional form of ELA that encompasses threat, deprivation, and unpredictability (Dush, 2020). In the current study, we examined the effect of food insecurity on function of the brain's reward circuitry during adolescence, and its attendant risk for negative affect. Because sleep is associated with neurocognitive vulnerabilities in adolescence and is related to neural reward processing (Boland et al., 2020), a second aim was to test sleep as a protective factor for this mediation effect.
Methods: Data were drawn from a longitudinal sample of 145 youth (Mage T1 = 12.9). At baseline, caregivers completed the household food insecurity scale. Sleep duration and efficiency at T1 were measured using actigraphy watches over a week. At T1 and T2 youth completed the Positive and Negative Affect Schedule (PANAS). Neural activation was elicited via the Monetary Incentive Delay (MID) functional MRI (fMRI) paradigm big win vs. neutral condition. The MID

task is designed to assess neural anticipation response to visual cues representing forthcoming monetary rewards or losses. Imaging data were collected on a General Electric Discovery 750 3Tesla scanner with a 32-channel head coil. fMRI processing and analyses was conducted with AFNI software. Four empirically defined ROIs, including the right insula, left insula, right thalamus, and left thalamus, were included in the analyses. Structural equation modeling was used to test direct, mediating, and moderated mediating effects.

Results: Food insecurity predicted blunted reward anticipation activation in the right insula ($\beta = -.216$, $p < .05$), left insula ($\beta = -.139$, $p < .05$), and left thalamus ($\beta = -.238$, $p < .01$). There were no significant indirect effects between food insecurity and negative affect (NA) via reward anticipation. Moderated mediation analyses revealed that sleep efficiency significantly moderated (attenuation and intensifying effect) the link between food insecurity and youth NA via the right insula and left insula. Specifically, in the context of high sleep efficiency, the effect of blunted ROI activation on NA is decreased. In contrast, in the context of low sleep efficiency, the effect of blunted reward anticipation on NA is increased.

Discussion: Food insecurity bears a significant effect on blunted reward anticipation, and later increases in negative affect. This link may be dependent on the efficiency of sleep. The Results: inform prevention and intervention efforts that aim to reduce the deleterious influence of food insecurity and the development of psychopathology.

M121. PARENT-CHILD NEURAL DYNAMICS DURING A STRESSFUL TASK: PROBING ASSOCIATIONS WITH TEMPERAMENT AND ANXIETY

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Background: Anxiety disorders affect 19% of U.S. adults and often start in childhood, with 9.4% of children aged 3-17 diagnosed. Despite extensive research, these disorders remain under-treated in youth. Intergenerational transmission from parents is a potential intervention target, though mechanisms are unclear. Genetic factors significantly contribute to anxiety, but dynamic social interactions also play a key role.

Advancements in neuroimaging, such as functional near-infrared spectroscopy (fNIRS), allow studying parent-child neural synchrony. fNIRS hyperscanning records simultaneous brain activity, providing insights into social interactions. This study examined parent-child neural synchrony in relation to parental anxiety, child anxiety, and temperament during interactions across Baseline, Stressful, and Recovery contexts. It focused on the PFC, DLPFC, and VLPFC, showing how synchrony shifts before, during, and after stress, moderated by temperament traits and anxiety levels.

Methods: The study involved 109 children (4-8 years old) and their caregivers (66 mothers, 43 fathers) between December 2021 and March 2023. Children's temperament and anxiety were assessed using the Children's Behavior Questionnaire (CBQ) and the MacArthur Health and Behavior Questionnaire–Parent (HBQ-P), while parental anxiety was measured using the State-Trait Anxiety Inventory (STAI). Dyads engaged in three conditions of the DBDOS-biosync task: baseline, stressful, and recovery, wearing functional near-infrared spectroscopy (fNIRS) caps to measure neural synchrony. Multilevel models examined relationships between parent-child neural synchrony, anxiety, and temperament. Key variables included child age, sex, and temperament

scores (fear and effortful control). The study aimed to understand how these factors interact to influence parent-child neural synchrony during different tasks.

Results: This study explored moment-to-moment neural synchrony in parent-child dyads during cooperative tasks with varying stress levels. Neural synchrony increased significantly during the stressful task, indicating the need for more coordinated interactions. Children with higher effortful control showed even greater synchrony during stress, suggesting this trait aids in adaptive dyadic behavior. Conversely, children with higher fearful temperament exhibited less synchrony during stress and higher synchrony during recovery, indicating reliance on neural connection with parents for stress regulation. There were no significant associations between parental and child anxiety and neural synchrony beyond initial correlations.

Discussion: This study provides initial evidence that neural synchrony in parent-child dyads varies with stress and child temperament, highlighting the importance of considering individual differences embedded within emergent social relations in understanding the intergenerational transmission of anxiety. The pattern of synchrony noted here is also suggestive of the ways in which dyadic partners come together to confront in-the-moment demands as a linked unit. Heightened synchrony during activities with an expected higher social engagement was associated with individual factors (effortful control) linked to more adaptive developmental profiles, while a known risk factor (fear) was associated with synchrony in the aftermath of the task. While we focused on neural measures here, future research should incorporate variation in behavior to provide a more comprehensive understanding of these interactions, particularly as they evolve over time. The current work supports and extends prior research showing stable mean-level relations between the variables of interest by capturing how they impact the moment-to-moment interactions of daily life. Addressing open questions in the literature at varying time scales will help build a more complete picture of the complex dynamics between parent-child interactions and the risk for anxiety, ultimately informing better intervention strategies.

M122. IMPACT OF DISGUSTING ODOR ON MORAL DECISIONS IN AUTISTIC YOUTH

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Background: Exposure to disgusting odors, whether intrinsic or extrinsic, shapes moral evaluations, particularly in individuals with heightened interoceptive awareness. Here, we investigated how disgust processing impacts moral decisions in autistic children and we aimed to understand if similar patterns to those in typically-developing (TD) youth would be found in autism (ASD). This is particularly relevant, given that autistic individuals are more likely to give harsher moral evaluations and attribute blame in accidental situations than non-autistic peers. Further autistic individuals may have differences in interoception, disgust, and sensory processing, and have co-occurring alexithymia, all of which may impact moral judgements. Exploring the intricate interplay of these factors can deepen our understanding of how sensori-emotional environmental stimuli may impact moral judgments in autism.

Methods: Participants (17 TD; 13 ASD; aged 8-17) completed a behavioral task involving moral decision-making using vignettes (3 types: morally disgusting, physically disgusting, neutral negative), either in a room with a disgusting smell or a neutral smelling room. All participants

rated feelings of perceived wrongness for all vignettes, and rated how much punishment the actor deserved and the impermissibility of the action. In a separate neutral environment, participants completed: Disgust Propensity and Sensitivity Scale (DPSS-R), Sensory Experiences Questionnaire (SEQ), Alexithymia Questionnaire for Children (AQC), Autism Spectrum Quotient (AQ), and a heartbeat counting task. Statistical analysis included Spearman's correlation and mixed-effects ANCOVA. Results aim to explore the influence of smelly odors on moral decisions in ASD and TD children.

Results: The study revealed significant differences between TD and ASD groups in IQ, Disgust Propensity (DP), SEQ scores, AQ, and AQC 2-factor score (total of Identification and Communication). In the autism group, odor priming influenced wrongness ratings, with moral/purity violations rated highest when in the disgust smelling room. Additionally, ASD > TD significant differences were found for disgust propensity, SEQ, AQ, and AQC scores. Disgust propensity was higher in ASD, correlating with SEQ, AQ, and AQC. Wrongness and punishment ratings correlated with disgust propensity across conditions, especially for moral and purity violations.

Discussion: In conclusion, this study explored the intricate relationship between sensory sensitivity and disgust and moral decision-making in youth with autism. Significant associations were found between disgust propensity, sensory sensitivity, and ratings of wrongness and punishment for moral and purity violations. Disgust priming further influenced ratings in the ASD group, highlighting the complex interplay of sensory factors in moral judgments. Limitations include small sample sizes and potential biases, warranting further research for a comprehensive understanding of these relationships in diverse populations.

M124. INVESTIGATING BRAIN IMAGING OUTCOMES AND TOXICANT EXPOSURES IN 1990-1991 GULF WAR VETERANS

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Background: Gulf War Illness (GWI) is a chronic multi-symptom disorder affecting veterans of the 1990-1991 Gulf War, with symptoms including fatigue, pain, cognitive impairments, and sleep disturbances. The underlying neural mechanisms connecting GWI and brain structure changes are not well understood. MRI volumetric data provided insight into the structural brain changes associated with GWI. In addition, the study aims to investigate the association between exposure factors, shedding light on potential risk factors underlying the disorder. The study involves a cohort of veterans with GWI cases and healthy GW veteran controls from the Boston Biorepository and Integrative Network (BBRAIN) for Gulf War Illness. BBRAIN includes brain MRI, cognitive and environmental exposures during the war. Using statistical methodologies, the interrelationships between brain volumetric, exposure data and GWI case status were examined.

Methods: Data from the BBRAIN biorepository was used for this study. A total cohort of 71 veterans (59 men; 12 women) from the Gulf War was included in the study. Brain volumetric studies using MRI and post-processed with Freesurfer was used to determine total volume of key brain regions and brain lobes. The Kansas GWI case criteria were used to determine cases and controls. Cognitive assessments were performed and environmental exposure surveys were completed by all veterans. MANOVA was employed to assess the impact of brain volumes and exposure levels on group status (GWI case/control).

Results: Results found that GWI cases (n=58) showed significant differences ($p < 0.05$) in the frontal lobe, limbic cortex and ventricles compared with GW veteran controls (n=13). In addition, changes in brain volumes including the limbic cortex, frontal lobe and temporal lobe were also significantly lower in veterans reporting exposure to chemical weapons and using pesticides on their uniforms during the war.
Discussion: The overall findings from the analysis suggest that veterans with GWI are showing lower brain lobe volumes in the frontal lobe and limbic cortex. Given that these are areas of concern for risk of neurodegenerative disorders, GW veterans should be monitored for risk of mild cognitive impairment and targeted for treatment intervention strategies in those screening at risk for accelerated age-related disorders.

M125. FUNCTIONAL BRAIN NETWORK TERRITORY DIFFERENCES BETWEEN CHILDREN AND ADULTS IN A PRECISION FMRI SAMPLE

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Background: The territory occupied by functional brain networks varies across individuals (Gordon et al. 2017a) and may associate with mental health risk (Lynch et al. biorxiv.org). However, despite the importance of putting features in a developmental context, our understanding of how territories change across development remains limited (Cui et al. 2020, Tooley et al. 2022). Using group-level territory definitions, Tooley et al. (2022) found shifts in territorial assignment between adult and child samples that were most prominent in default mode, limbic, somatomotor and ventral attention networks. These developmental patterns have yet to be replicated in individual child and adult participants, in part because reliably defining network borders for individuals requires relatively large amounts of data (Seitzman et al. 2019). Here, we use a precision fMRI sample of adults and children to replicate and extend previous findings and consider effects of sex and head motion alongside effects of age.
Methods: fMRI data were collected from 24 children (mean age 7.9y, sd 0.7, 13 female) and one of their parents (mean age 41.6y, sd 3.7, 11 female). All participants provided a total of ~160 minutes of multi-echo fMRI data across four sessions, using three passive viewing conditions. Preprocessing included noise mitigation with tedana denoising, volume censoring and confound regression. Children had 73-160 min (average = 116 min) of post-censored data, while adults had 60-161 min (average = 136 min) ($p < 0.001$). Data were projected to the cortical surface, functional connectivity was calculated as the Pearson correlation between each pair of vertices and template matching (Gordon et al. 2017b) was used to assign each vertex to one of 14 functional networks (Dworetzsky et al. 2021). Network territory was calculated as the % of vertices belonging to each network. Data were modeled using linear mixed effects models accounting for family, and included age, sex and head motion (censored volumes). P-values were adjusted for multiple comparisons using the false-discovery rate.
Results: In adults, relative to children, the dorsal somatomotor network was expanded (Bstd=1.27, $pFDR < 0.05$), while the lateral somatomotor network was contracted (Bstd=-0.8, $pFDR < 0.05$), the cingulo-opercular network was expanded (Bstd=0.78, $pFDR < 0.05$) while the salience network was contracted (Bstd=-0.6, $pFDR < 0.05$) and the default mode network was expanded (Bstd=1.1, $pFDR < 0.05$). Only the default mode and posteromedial network territories showed

significant associations with head motion (ps < 0.005). We found no significant associations with sex.

Discussion: Describing network territories at different developmental stages is important for establishing references for clinical studies and for a fulsome understanding of typical developmental changes in functional connectivity across the lifespan. Our work suggests stability in some functional networks alongside exchanges in territory between pairs of functional networks, as well as suggests that network territories in regions prone to signal dropout can be significantly influenced by head motion.

M126. FAMILY CONFLICT MODERATES PREADOLESCENT NEURAL MARKERS OF FAMILIAL RISK FOR DEPRESSION TO PREDICT ADOLESCENT PSYCHOPATHOLOGY IN THE ADOLESCENT BRAIN COGNITIVE DEVELOPMENT (ABCD) STUDY

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Background: Youth whose parents have depression histories are at elevated risk for psychopathology. A combination of alterations in neural circuitry and environmental stress (e.g., family conflict) may contribute to heightened risk. However, knowledge remains limited due to few studies, small sample sizes, and primarily cross-sectional designs. We sought to identify how preadolescent neural markers of familial risk for depression interact with family conflict to predict adolescent psychopathology.

Methods: Participants included healthy (i.e., no lifetime psychiatric diagnoses) youth at high familial risk for depression (HR, n=888; at least one parent with a depression history) and low familial risk (LR, n=1,742; no parental history of psychopathology) aged 9-10 from the Adolescent Brain Cognitive Development (ABCD) Study. We examined group differences in resting-state functional connectivity (FC) among 12 Gordon networks at ages 9-10 and tested whether FC interacted with family conflict to predict Child Behavior Checklist symptoms at ages 12-13.

Results: HR youth exhibited higher baseline cingulo-parietal network (CPN) FC compared to LR youth (pFDR=0.015). Risk status interacted with family conflict and CPN FC at ages 9-10 to predict total problems at ages 12-13 (pFDR=0.018). Specifically, for HR youth with low family conflict, there was a negative association between CPN FC at ages 9-10 and total problems at ages 12-13 (p=0.020), whereas this association was positive for LR youth with low family conflict (p=0.017).

Discussion: Alterations in the CPN during preadolescence, in tandem with family conflict, may represent key mechanisms underlying heightened familial risk for psychopathology during adolescence.

M127. DECREASED REWARD NETWORK CONNECTIVITY AMONG INDIVIDUALS AT-RISK AND WITH BIPOLAR SPECTRUM DISORDERS

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Background: Previous research indicates that individuals with Bipolar Spectrum Disorder (BSD) exhibit heightened reward sensitivity and processing. In line with the Reward Hypersensitivity Model of BSD, fronto-striatal connectivity, implicated in reward anticipation and receipt, may contribute to the altered reward sensitivity profile. Prior work in this area has primarily assessed reward sensitivity retroactively, raising the question of whether abnormal reward functioning precedes or follows BSD diagnosis. In the current study, we utilize a behavioral high-risk study design to investigate profiles of reward related connectivity in individuals at low-risk, high-risk, and with BSD.

Methods: 128 young-adults (53.1% female, mean age 21 years) were recruited from the longitudinal project-TEAM study, which sought to prospectively assess risk for the onset of BSD. The sample included moderately reward sensitive individuals considered low risk for BSD (MReward, N = 42), highly reward sensitive individuals at high risk for BSD but without a BSD diagnosis (HReward, N = 51) and highly reward sensitive individuals with a BSD (HReward+BSD, N = 35). Participants completed a ten-minute resting state MRI scan to assess resting state functional connectivity, and we extracted the SOFA Network, which involved connections between the ventral striatum (VS), orbitofrontal cortex (OFC), and amygdala. Group differences were analyzed using Fisher's protected t tests, which require a significant omnibus ANOVA F test to proceed to pairwise comparisons to minimize familywise error rate. If a significant SOFA network result was obtained, we proceeded to region-to-region analyses. All analyses adjusted for the effects of age, biological sex, and mood-stabilizing medication.

Results: There was a main effect of group on SOFA-network connectivity ($F(2, 120) = 4.00$, $p = .021$, $\eta^2 = .06$). Follow-up analyses indicated that the MReward group had significantly greater connectivity in the SOFA network than both the HReward ($F(1,88) = 6.76$, $p = .011$, $\eta^2 = .07$) and HReward+BSD groups ($F(1,69) = 4.42$, $p = .039$, $\eta^2 = .06$). There was no significant difference between the HReward and HReward+BSD groups ($F(1,80) = 0.04$, $p = .833$, $\eta^2 = 0$). There was no relationship between reward connectivity and age, sex, or medication status.

Follow up analyses indicated there was a main effect of group on VS-OFC connectivity ($F(2,122) = 3.49$, $p = .034$, $\eta^2 = .05$). Pairwise comparisons revealed increased VS-OFC connectivity in the MReward group than the HReward group ($F(2,122) = 4.53$, $p = .036$, $\eta^2 = .05$) and the HReward+BSD group ($F(2,122) = 4.93$, $p = .029$, $\eta^2 = .06$). There was no significant difference between the HReward and HReward+BSD groups ($F(2,122) = 0.01$, $p = .91$, $\eta^2 = 0$). There was a main effect of group on Amygdala-OFC connectivity ($F(2,122) = 2.99$, $p = .05$, $\eta^2 = .05$). Individuals in the MReward group had greater amygdala-to-OFC connectivity than the HReward+BSD group ($F(1,70) = 5.18$, $p = .03$, $\eta^2 = 0.07$). There was no significant difference between the MReward group and the HReward group ($F(1,90) = 3.05$, $p = .08$, $\eta^2 = 0.03$ or the HReward and HReward+BSD groups ($F(1,81) = 0.60$, $p = .44$, $\eta^2 = 0$). By contrast, there were no significant differences between groups for VS-Amygdala connectivity ($F(2,122) = 0.69$, $p = .503$, $\eta^2 = .01$). All Results: were maintained when adjusting for self-reported reward responsivity.

Discussion: These results suggest that decreased reward network connectivity may be a pre-existing vulnerability for BSD diagnosis and that, weak, top-down regulation as opposed to sub-cortical connectivity may be an important neurobiological mechanism underpinning BSD. These findings have implications for understanding both mechanisms underlying BSD and possible interventions. Mechanistically, they highlight the important role of top-down regulation.

Regarding treatment, working to increase prefrontal regulatory control over subcortical reward systems may be a successful prevention and intervention strategy for BSD risk.

M128. MAPPING THE CORTICAL LANGUAGE NETWORK ACROSS DEVELOPMENT VIA SIMULTANEOUS FMRI-FNIRS

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Background: Computations involved in language comprehension in the adult brain are supported by a left-lateralized fronto-temporal system. Little is known about how these language regions develop and what type of structural and functional developmental changes lead to the mature language system. Partly, this is due to the challenges of conducting longitudinal functional magnetic resonance imaging (fMRI) studies with pediatric samples. A more versatile tool to study brain function in young children is functional near-infrared spectroscopy (fNIRS) due to its portability, ease of implementation in naturalistic settings and robustness to motion relative to fMRI. However, there are no studies assessing the extent to which fMRI, the "gold-standard" method to image the adult brain, compares to fNIRS using traditional language localizers. To address this gap, we report two studies that assess the correspondence of fMRI and fNIRS signals collectedly simultaneously from the same subjects using child-friendly language localizer paradigms. The goal is to assess the feasibility of implementing fNIRS to probe the language system in infants and young children.
Methods: Study 1 (data collection complete): We collected simultaneous fMRI (Siemens 3T PRISMA) and fNIRS (NIRx NIRScout-XP) signals in 40 young adults (18- to 35-year-olds) using a previously-validated language localizer task (Binder et al., 2011). Study 2 (ongoing): Simultaneous fMRI-fNIRS signals are currently being collected from a group of young children (5- to 7-year-olds) (target n=25) using a naturalistic language localizer task. This naturalistic paradigm consists of 20-sec child-friendly clips that contrast native versus non-native speech conditions. Data preprocessing: The fNIRS data are preprocessed using NeuroDOT (Eggebrecht and Culver, 2019) to create anatomically registered maps of cerebral hemodynamics. Image reconstruction steps include mapping fNIRS optode locations to the individual anatomical MR images, implementing the light model, and running 3D image reconstruction on CIFTI surface maps. In addition, we used eight short-separation fNIRS channels to measure and remove extracerebral signals. The fMRI data are preprocessed via Human Connectome Project (HCP) pipelines (Glasser et al., 2013). For scalp-to-anatomy co-registration of the fNIRS signal, we use a direct mapping of optode locations to the T1w image via vitamin E capsules on the fNIRS caps at each optode location. A key innovation is co-registration of fNIRS channels to each individual's cortical surface (i.e., a CIFTI surface map), and co-registration of fMRI voxels using the HCP MMP 1.0 atlas (Glasser et al., 2016) and subsequent cortical parcellation, which consists of 180 cortical areas per hemisphere.
Results: Results from the adult sample (Study 1) show that, similar to fMRI, fNIRS signals recruit canonical language regions in fronto-temporal cortices with lateralization to the left hemisphere. We show that decreases in deoxygenated hemoglobin in image reconstructed fNIRS signals coincide with BOLD-positive regions in language cortex areas. Ongoing quantitative analyses of the two signals consist of assessing the timeseries temporal correlation across fMRI and fNIRS as a function of cortical region, location of the fNIRS probes, and implementation of different

smoothing parameters during fMRI data preprocessing. Data collection of the developmental sample (Study 2) is ongoing and will be preprocessed following the same workflow as described for the adult sample in Study 1.

Discussion: Our study provides a comparison of fMRI and fNIRS signals collected simultaneously from the same subjects and shows that fNIRS can be used to investigate cortical activations underlying speech processing during a traditional language localizer task. Ongoing data collection with a developmental sample will shed light on the feasibility of implementing fNIRS and naturalistic imaging paradigms to study the language system in young children.

M129. STRUCTURAL ALTERATIONS ASSOCIATED WITH EMOTION REGULATION DEFICITS IN CHILDREN WITH AND WITHOUT ADHD

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Background: Emotion regulation (ER) deficit is the inability to exercise modulatory processes involved in emotion regulation and Results: in impaired emotional functioning (Bunford, Evans, and Wymbs 2015). Attention-deficit/hyperactivity disorder (ADHD), although traditionally characterized by inattention, hyperactivity, and impulsivity, is often associated with ER deficits (Wehmeier, Schacht, and Barkley 2010). Neuroimaging studies have identified altered brain structure in children with ADHD, such as increased gray matter volume (GMV) in bilateral frontal regions (Wu et al. 2019) and reduced GMV in posterior cortical regions and the cerebellum (Stoodley 2014), which includes regions previously implicated in ER processing (Kohn et al., 2014). However, studies have yet to examine the relationship between GMV, ER, and ADHD. Thus, in the current study we examined: the relationship between cortical and cerebellar GMV and ER measures in children with ADHD and typically developing (TD) children, as well as whether differences in GMV are differentially associated with ER in children with and without ADHD.

Methods: We used data from 54 children (26 TD children and 28 children with ADHD) between the ages of 8 and 12 years. Parents completed the Diagnostic Interview Schedule for Children Version IV (Shaffer et al. 2000) and Conners 3rd Edition (Conners 2008) to assess symptoms of ADHD, and the Child Behavior Checklist (CBCL; Achenbach and Rescorla 2001) to assess ER. T1-weighted images were reoriented to the anterior commissure, co-registered, and segmented (grey matter, white matter, and CSF). We then normalized our study specific DARTEL template to MNI space. CAT12 was used to calculate total intracranial volume (TIV) and to check for noise outliers. We tested the associated between GMV and ER (modelled as a one-way t-test in SPM12 with ER as a covariate of interest and TIV as a covariate of no interest). Next, we performed a two-sample t-test dummy coding for group to test for different relationships between ER and GMV in TD children and those with ADHD.

Results: Children with ADHD exhibited significantly higher ER scores on the CBCL, indicating poorer emotion regulation relative to TD children. Across all children, whole-brain analysis revealed that increased GMV in left inferior temporal gyrus and left subcallosal cortex, as well as decreased GMV in left middle frontal cortex, was associated with poorer ER as assessed by the CBCL. Additionally, poorer ER was associated with increased GMV in right supramarginal gyrus as well as decreased GMV in left superior parietal lobule, cingulate gyrus, and right middle temporal gyrus. When comparing between groups, we found a differential relationship between GMV and ER such that more GMV in left temporal pole was associated with lower ER scores

(indicating better ER) in TD children, while more GMV in the same region was associated with higher ER scores (indicating poorer ER) in children with ADHD.

Discussion: Our study reinforces extant literature indicating that children with ADHD exhibit greater difficulties regulating their emotions relative to TD children, and demonstrates that cortical GMV is associated with ER in children. Additionally, several regions identified in these analyses have been implicated in the emotion regulation process (Laxton et al. 2013), and have connections with cortical regions important for positive emotion regulation strategies (Scharnowski et al. 2020). In total, our study provides evidence of structural alterations associated with ER in children with ADHD and TD children, as well as a differential relationship between these structural alterations and ER across these two groups.

M130. ASSOCIATIONS BETWEEN PRENATAL MATERNAL DISTRESS AND CHILDREN'S BRAIN WHITE MATTER AND EXPRESSIVE VOCABULARY AT 2 YEARS

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Background: Psychological distress (anxiety and/or depression) during pregnancy can impact children's brain and neurodevelopmental outcomes via altered fetal development. Higher distress during pregnancy is associated with altered brain white matter microstructure and poorer cognitive outcomes in young children. However, the relationship between prenatal maternal distress and language development is poorly understood, as are the potential mechanisms underlying this relationship. Microstructural changes in brain white matter can be analyzed with the fixel-based analysis framework, an advanced diffusion model to assess fibre-specific properties of white matter tracts. Here, we investigate the relationship between prenatal maternal distress, whole-brain fibre-specific properties of white matter, and expressive vocabulary in children at age 2 years. We hypothesize that higher levels of prenatal distress are associated with reduced white matter microstructure and lower vocabulary scores.

Methods: Participants were drawn from a sub-sample of mother-child dyads from the Pregnancy during the COVID-19 Pandemic study (Giesbrecht et al., 2021). 36 children (11 females; mean age 29.5±1.4 months) completed a magnetic resonance imaging (MRI) scan and had maternal distress and expressive vocabulary measures. Maternal distress during pregnancy was measured as a composite score of the Patient-Reported Outcomes Measurement Information System Anxiety scale and the Edinburgh Postnatal Depression Scale. Expressive vocabulary at age 2 was parent-reported via the MacArthur Bates Communicative Development Inventories (CDI) English Words and Sentences short-form questionnaire. The fibre-specific metrics, fibre density (FD) and fibre cross-section (logFC), were obtained from diffusion MRI scans acquired on a 3T GE MR750w scanner with a 32-channel head coil (TR = 6000 ms, TE = 88.3 ms, 45 directions at b = 2000 s/mm2, with 5 interleaved b = 0 s/mm2 images). A whole-brain fixel-based analysis was conducted to test associations between fibre-specific metrics and prenatal maternal distress and expressive vocabulary. A 'fixel' refers to a specific fibre population within a given voxel, thus fixel-based analysis is akin to voxel-based analysis, but with enhanced specificity of modelling multiple fibre populations within a given voxel. Multiple linear regression models were run to assess associations between 1) prenatal maternal distress and CDI vocabulary scores, 2) prenatal maternal distress and

FD/logFC, and 3) FD/logFC and CDI scores, controlling for child age and sex. Threshold-free cluster enhancement was used to account for multiple comparisons, using an alpha level of $p < .05$.

Results: Higher prenatal maternal distress was significantly associated with higher fibre cross-section (logFC) in clusters of fixels within the forceps minor (p-FWE < .05). We did not find significant associations between CDI scores and prenatal maternal distress or white matter fibre-specific metrics.

Discussion: Our results suggest that elevated prenatal maternal anxiety and/or depression may contribute to increased fibre diameter within the forceps minor at age 2. Higher fibre cross-section is associated with more mature white matter, and possibly indicates earlier or more rapid development, which is contrary to our hypothesis. However, previous studies have hypothesized that adverse perinatal experience may result in more rapid and earlier maturation of white matter, known as the hypermaturation hypothesis (Lean et al., 2022). Our findings support this hypothesis in the forceps minor, an anterior white matter tract that connects frontal regions bilaterally. Although we did not find significant associations with expressive vocabulary, these alterations may be associated with changes in other neurodevelopmental and cognitive outcomes, perhaps at later ages. Our study highlights the importance of mental health during pregnancy, and the potentially long-lasting effects of prenatal distress on children's brain development.

M131. ASSOCIATIONS BETWEEN HAIR CORTISOL AND PERCEIVED STRESS DURING PUBERTY

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Background: Physiological and psychological stress responses exhibit marked changes across the pubertal developmental transition. Of note, self-reported stress is often not predictive of concurrent neuroendocrine responses, though this phenomenon remains poorly understood, especially within developmental contexts.

Methods: The current analysis assessed the associations between indices of chronic stress levels and pubertal development in adolescents (n=100) ages 11-14 years old. Physiological stress was indexed by hair cortisol concentrations (HCC; 3 cm samples, log-transformed). Self-reported stress was measured using the Perceived Stress Scale (PSS; subjective stress) and Life Events Questionnaire for Adolescents (objective stress). Averaged parent and youth self-reports (Udry) were used to measure pubertal development.

Results: Preliminary analyses were conducted to examine whether cortisol, perceived stress, and/or their relationship were related to pubertal developmental stage. Objective measures of chronic stress showed positive relationships with pubertal development, where hair cortisol levels and total endorsed life events were higher with more advanced maturity. Perceived stress was not related to puberal stage. Perceived stress was not associated with HCC, though within a subsample, a trending interaction between perceived stress, physiological stress, and pubertal development (n=30) suggested that higher PSS scores were related to lower HCC with higher pubertal stage, while the opposite trend was observed in less mature adolescents.

Discussion: These preliminary findings suggest the interplay between different stress responses likely changes throughout pubertal development, and unique patterns in these subjective and objective stress responses may relate to other stress-and health-related implications across the

adolescent sensitive period. These findings also stimulate Discussion: into using various Methods: and indices of stress (e.g., HCC, self-report) to study the heterogeneity in stress responsivity. Data collection is ongoing.

M132. MORPHOMETRIC INTEGRATION OF BRAIN NETWORKS IN YOUNG CHILDREN EXPOSED TO MATERNAL DEPRESSION

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Background: Perinatal maternal depression is a mental health concern that disproportionately impacts children in low- and middle-income countries. Altered morphometry of frontolimbic brain regions has been recorded in exposed children, however mostly in higher-income settings. The present study examined morphometric integration as an index of structural brain connectivity in frontolimbic networks following maternal depression exposure in two-to-three year old children from a South African birth cohort.

Methods: T1-weighted MRI scans were obtained in 146 children with antenatal and/or postpartum maternal depression assessments from the Beck Depression Inventory II and Edinburgh Postnatal Depression Scale. Cortical thickness was extracted for regions from the Gordon atlas using FreeSurfer software. Anatomical imbalance mapping scores for the frontoparietal and cingulo-opercular network were compared in children exposed to maternal depression (n=20 antenatal, n=20 postpartum, n=16 both) relative to unexposed children (n=63) in general linear models.

Results: Children that were exposed to both antenatal and postpartum maternal depression showed weaker morphometric integration in the frontoparietal network (t=2.278, p=0.025) compared to unexposed children. However, no group differences were found following only antenatal or postnatal exposure, and no differences were recorded in the cingulo-opercular network. Post-hoc analyses identified the medial superior frontal gyrus, middle frontal gyrus and frontopolar cortex as important nodes for the observed anatomical imbalance after persistent maternal depression exposure.

Discussion: Persistent depression across pregnancy and the postpartum period may impact early development of child frontolimbic brain networks, more than antenatal or postpartum exposure

alone. Prevention of persistent depression in new mothers may possibly benefit child neurodevelopment.

M133. ASSOCIATIONS BETWEEN THALAMIC NUCLEI VOLUMES AND SPATIAL WORKING MEMORY PERFORMANCE IN ADOLESCENTS AND YOUNG ADULTS

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Background: Complex cognition is increasingly appreciated to be supported by neural networks spanning cortical and subcortical brain structures. A crucial structure within these networks is the thalamus, a bilateral, subcortical brain structure characterized by internally differentiated cytoarchitecture and discrete sub-nuclei. Some thalamic nuclei support functions traditionally thought to be cortically driven, such as spatial working memory (SWM). To date, research assessing these associations during human development is sparse. In this study, we tested associations between thalamic nuclei volumes and performance on two SWM tasks in a sample of adolescents and young adults.

Methods: Participants (n=157: mean age = 18.34; 55% female) ages 11-25 years old enrolled in a longitudinal study of adolescent brain and behavioral development were included in the present study. Participants completed two SWM tasks: a Delayed Response Task (DRT) and the Cambridge Neuropsychological Test Automated Battery Spatial Working Memory task (CANTAB SWM). Performance metrics included efficiency (reaction time x error) on 0 delay, 500 ms delay, and 8000 ms delay trials of the DRT as well as strategy and total between-search errors on the CANTAB SWM. For each metric, a lower score reflects better SWM performance. Whole brain volumes and diffusion-weighted images were acquired on a 3-Tesla Siemens Trio/Tim Trio Scanner. Thalamic nuclei were segmented using the python script mri_segment_thalmic_nuclei_dti_cnn.sh in FreeSurfer version 7.4.1. It uses a convolutional neural network combining information from T1- and diffusion-weighted MRI scans. Thalamic nuclei were combined to create five groups per hemisphere: lateral-caudal, anterior-lateral, medial, intralaminar, and posterior. For the developmental aim of this study, associations between participant age and thalamic nuclei volumes were examined using a hierarchical modeling strategy with linear age added in the first step and volume of the whole thalamus added in the second step. To evaluate associations between thalamic nuclei and SWM, hierarchical regressions predicting SWM performance were conducted, entering linear age, the relevant sub-nucleus, whole thalamic volume, and the age x nucleus interaction.

Results: Volumes of the left anterior-lateral group ($p = .011$) and left lateral-caudal group ($p = .040$) were positively predicted by age. Volume of the left posterior nucleus negatively predicted efficiency scores on the no-delay ($p = .030$) and 500ms ($p = .012$) conditions of the DRT. There was a significant age-by-nucleus volume interaction when predicting efficiency on the DRT 500ms condition for the right anterior lateral group ($p = .004$) and the lateral caudal group in the left ($p = .015$) and right hemispheres ($p = . 032$). For the DRT 8000ms condition, there was one significant interaction suggesting that the relationships between the left anterior-lateral nuclei with performance efficiency varies by age ($p = .047$). Strategy scores on the CANTAB SWM were negatively predicted by the lateral-caudal group in both the both the left ($p = .022$) and right ($p = .021$) hemispheres as well as the left posterior group ($p =.041$). CANTAB SWM total error was negatively predicted by the right lateral caudal ($p =.008$) and left lateral caudal ($p = .004$) groups.

Discussion: This study is among the first to identify age and behavioral correlates of thalamic nuclei microstructure in participants spanning late childhood to early adulthood. Findings suggest that volumes of the bilateral lateral-caudal, anterior-lateral, and posterior sub-nuclei are predictive of various aspects of SWM performance. In most cases, these associations suggested that higher volume is associated with better SWM performance. Moreover, associations between volumes of the bilateral anterior-lateral and lateral-caudal nuclei and behavior vary by age. Functional implications, as well as applications to clinical disorders, will be discussed.

M134. INDIVIDUALIZED FUNCTIONAL BRAIN FINGERPRINTS OF NORMATIVE DEVELOPMENT (USING AN AI-DRIVEN BRAIN AGE ESTIMATION MODEL)

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Background: Understanding individual differences in brain development is crucial for identifying developmental delays and disorders early, potentially leading to more effective interventions. The brain age gap—the difference between estimated brain age and chronological age—has emerged as a valuable biomarker for this purpose. However, most studies have relied on structural MRI data (1,3), overlooking the rich information contained in functional MRI (fMRI) data. The few studies using fMRI (2) have typically employed static functional connectivity measures, which fail to capture the dynamic nature of brain function. To address these limitations and provide a more comprehensive understanding of brain development, we develop a spatiotemporal deep neural network (stDNN)-based reference model to estimate brain age using fMRI data, determine the brain age gap, and link the gap to clinical measures.

Methods: We utilized resting-state fMRI data from a diverse cohort of 1251 healthy participants (492M/759F; age range 6-85 years) from the Nathan Kline Institute-Rockland Sample (NKI-RS) (4). Our innovative spatiotemporal deep neural network (stDNN) model estimates brain age using fMRI timeseries data from 246 regions of interest defined by the Brainnetome Atlas (5). To ensure generalizability, we externally validated our model on the Human Connectome Project Development (HCP-Dev) dataset (n=632, 293M/339F; age range 8-22 years).

To provide interpretability and identify individualized brain signatures of normative development, we applied integrated gradients, an explainable AI (XAI) method, to our model (5). This approach assigns importance scores to each brain region based on its contribution to age prediction. Finally, we correlated the brain age gap with various clinical measures to investigate how deviations from typical brain age trajectories relate to individual differences in behavior and cognition.

Results: Model performance: Our stDNN model achieved high accuracy in brain age estimation, with a mean absolute error (MAE) of 0.29 years in the NKI-RS cohort and an MAE of 0.24 years in the independent HCP-Dev cohort, outperforming previous methods.

Key brain regions: XAI analysis identified the posterior cingulate cortex and angular gyrus – key nodes of the default mode network – as the top 5% brain features underlying age prediction in both the NKI-RS and HCP-Dev cohorts. Other key features included the thalamus, putamen, hippocampus, superior parietal lobule, and fusiform gyrus.

Behavioral correlations, Brain Age Gap: We found a strong negative correlation between the brain age gap and risk-taking behaviors on the Domain-Specific Risk-Taking Scale ($r = -0.9$, $p = 0.001$)

in the NKI-RS cohort. We found a positive correlation between the brain age gap and negative emotion on the Beck's Depression Inventory Scale ($p = 0.65$, $p = 0.02$).

Behavioral Correlations, Brain Fingerprints: We found a positive correlation between brain features and impulse control on the Urgency-Premeditation-Perseverance-Sensation Seeking-Positive Urgency Scale ($r = 0.43$, $p = 0.0008$) in the NKI-RS cohort.

Discussion: Our study presents a significant advance in brain age estimation by leveraging dynamic fMRI data and sophisticated AI techniques. The high accuracy and replicability of our model, coupled with its ability to identify individualized functional brain signatures, offer a powerful tool for understanding normative brain development. The strong correlations between brain age gap, brain fingerprints and behavioral measures underscore the model's potential clinical utility. By capturing the complexities of brain development, our approach could enable earlier and more accurate identification of individuals at risk for developmental delays or disorders.

(1) Chang et al., Neuroinformatics (2023)
(2) Joo et al., Sci Rep 13 (2023)
(3) Griffiths-King et al., Sci Rep 13 (2023)
(4) Van Dam et al., Biol. Psych (2017)
(5) Ryali et al., PNAS (2024)

M135. POSITIVE AND NEGATIVE EMOTION REGULATION AND BRAIN STRUCTURE IN CHILDREN

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Background: Emotion dysregulation is a transdiagnostic symptom of psychopathology and one of the most frequent reasons for mental health referrals in pediatric populations (Peterson et al., 1996). To date, the majority of this research in pediatric populations has focused on dysregulation of negative emotions (e.g. anger, sadness, frustration), however, selectively researching regulation of negative affect may lead researchers to miss out on critical information relevant to the experience and maintenance of emotion dysregulation more generally. Specifically, much less is known about dysregulation of positive emotions (e.g. happiness, excitement) and their neural correlates (Vogel et al., 2023). There is evidence that pediatric populations who experience emotion regulation impairments (e.g. ADHD, severe irritability) exhibit altered cortical thickness, gray matter volume, and resting state functional connectivity compared to healthy controls (Valera et al., 2007; Shaw et al., 2010; Gold et al., 2016; Adelman et al., 2012). Additionally, two studies of adolescents provide evidence for the relationship between brain structure and levels of irritability, albeit mixed, with larger regional volumes and thinner cortex being associated with greater irritability (Dennis et al., 2019; Jirsaraie et al., 2019). However, few studies have examined how continuous measures of positive emotion dysregulation are specifically related to brain structure. The present study aims to fill this gap by investigating the neural correlates of positive and negative emotion dysregulation in children with a range of normative emotion regulation and emotion regulation difficulties (e.g. ADHD, severe temper outbursts).

Methods: The present study examined hemispheric cortical thickness in relation to emotion regulation in a sample of young children (5-9 years old; N = 151; 73.5% male, 50.3% White,

27.8% Hispanic) with and without ADHD. A subset of the sample also had clinically significant irritability in addition to their diagnosis of ADHD (N = 64). Emotion regulation was assessed via parent report using the Emotion Regulation Checklist (ERC; Shields and Cicchetti, 1997). Positive and negative emotion regulation subscales were calculated based on the revised ERC factor structure recommended by Silverman et al. (2022). Children completed both structural and resting state functional magnetic resonance imaging scans. ERC subscales were entered into multiple linear regressions to examine associations between cortical thickness of the left and right hemispheres. For the final poster, ERC subscales will also be entered into general linear models to examine associations with resting state functional connectivity.

Results: Preliminary correlational analyses revealed that parent-reported positive and negative emotion regulation were highly correlated ($r = 0.62$, $p < 0.001$). In terms of brain structure, parent-reported measures of positive and negative emotion regulation did not predict cortical thickness of either the right or left hemispheres, controlling for age, sex, and intracranial volume. Age significantly predicted cortical thickness in all models (p's < 0.05).

Discussion: Overall, our findings do not support the notion that positive or negative emotion regulation is related to hemispheric cortical thickness in young children (ages 5 to 9). While facets of emotion regulation may not be related to global measures of brain structure in young children, future studies should examine the structure of specific regions of the brain implicated in relation to positive and negative emotion regulation, perhaps at a later stage of development. Additionally, task-based functional MRI studies may be better suited for examining the neural correlates of emotion dysregulation given that brain function during the experience of emotion dysregulation may be more closely related to specific behavioral outcomes.

M136. GREATER NEURAL DISSIMILARITY TO EMOTIONAL STIMULI IN EARLY VISUAL AREAS IS ASSOCIATED WITH SYMPTOMS OF PSYCHOPATHOLOGY IN ADOLESCENTS

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Background: Adolescence is a period of heightened risk for psychopathology, affecting as many as 1 in 5 youth. Prior research has focused on specific psychiatric disorders to identify their neural basis. More recent studies suggest shared underlying neural correlates across disorders, especially in frontolimbic networks implicated in emotional processes. Yet, early visual areas – crucial for extracting and processing sensory emotional information – are often overlooked in studies of psychopathology. In this study, we take a transdiagnostic approach with a focus on early visual processing regions to investigate how individuals with higher symptoms of psychopathology perceive their emotional world compared to those with lower symptoms. Specifically, how do they represent and differentiate between emotional categories? We hypothesized that youth with more symptoms would exhibit greater dissimilarity in neural representations between emotional versus neutral stimuli within the visual network.

Methods: To test our hypothesis, we utilized imaging and questionnaire data from 11-12 year old youth from the Adolescent Brain Cognitive Development StudySM (ABCD Study®), NDA Release 4.0 Time 2 (n=4953 for whom data passed QC). Participants were divided into those with lower and higher symptoms of psychopathology based on the 1st and 4th quartiles of Child

Behavior Checklist (CBCL) total problem raw scores. While undergoing fMRI, participants performed an emotional n-back working memory task with three emotional categories (happy, fearful, and neutral faces), presented in two memory load conditions (0-back and 2-back). Representational similarity analysis was used to examine dissimilarity in neural representations of different emotional face categories by memory load and group (low or high symptoms of psychopathology) across seven functional brain networks. Dissimilarity was calculated by Pearson correlation of the parcellations within each functional network. The association of dissimilarity and working memory performance was tested with a linear model.

Results: We found that greater neural dissimilarity between emotional face categories was most prominent in limbic and visual networks (R marginal squared = 0.17 for vision and 0.15 for limbic network in the 0-back condition; R marginal squared = 0.08 for vision and 0.22 for limbic network in the 2-back condition). Greater dissimilarity in representation of emotional categories (emotional faces versus neutral face) was associated with diminished working memory performance - a finding that was most robust for the visual network across all participants. Consistent with our hypothesis, greater dissimilarities in the representation of different emotional faces were observed in the higher symptom group in comparison to the lower symptom group for the visual network (and the limbic network), but only in the high memory load condition.

Discussion: Together, our findings suggest distinct patterns of emotional information processing in early visual areas in adolescents with higher symptoms of psychopathology that are associated with emotional working memory performance. Our results illustrate the importance of early visual regions in the processing of emotional information in psychopathology during development.