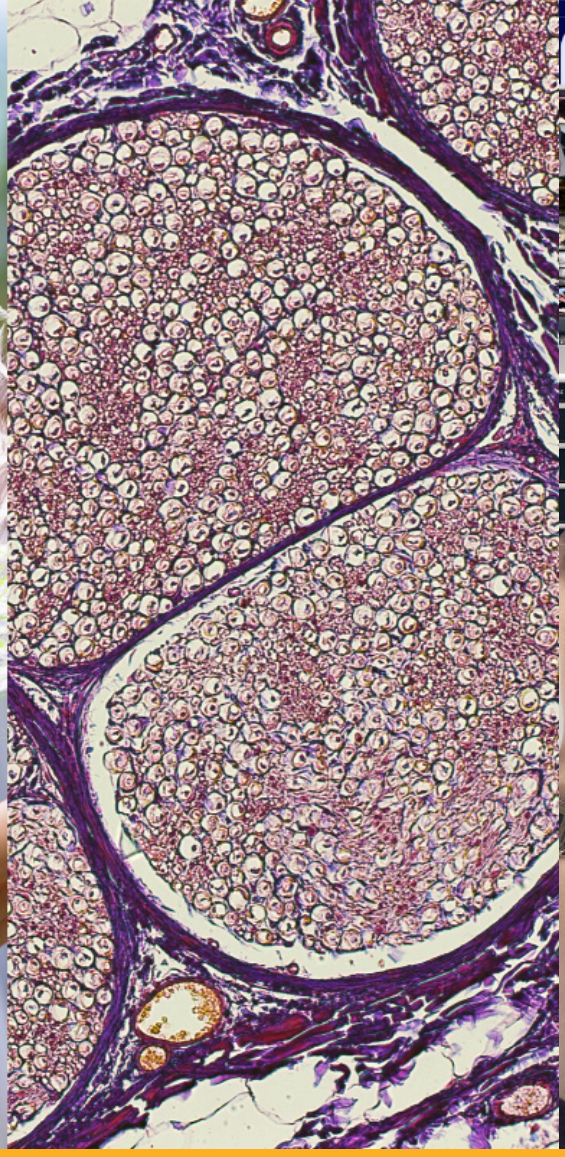

8th Annual

Flux Virtual Congress

September 9 - 12, 2020

Abstract Book

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Cognitive Neuroscience

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Contents

Flux Congress Oral Presentations

Thursday September 10, 2020

Symposium: Stress exposure during pre- and postnatal development – Elucidating mechanisms underlying consequences for neurodevelopment

Chairs:
Dima Amso, *Columbia University*
Kevin Bath, *Brown University*
Claudia Buss, *Charité – Universitatsmedizin Berlin*

Biological embedding of prenatal depression: relevance for neonatal brain structure
Kieran O'Donnell[1]
[1]Yale University
Background: Maternal prenatal depression produces individual differences in a range of child outcomes, including measures of brain structure and function. We currently lack biomarkers that reflect such individual differences and could be used to identify children at greatest risk for adverse outcomes. We investigated the association between maternal prenatal depression, offspring genome-wide DNA methylation and variation in measures of neonatal brain structure. **Methods:** We collected data on maternal symptoms of prenatal depression and offspring genome-wide DNA methylation in buccal cells collected at birth and at 12 months of age (n=136). Paired imaging data provided measures of neonatal hippocampal volume (n=86). **Results:** DNAm shows marked change from birth to one year of age at the majority of sites we tested. Maternal prenatal depression predicted DNA methylation at approximately 72,000 sites (unadjusted/nominal $p<0.05$) and 2417 CpGs following adjustment for multiple testing. Prenatal depression associated CpGs were enriched for glucocorticoid sensitive sites (OR = 1.76, $p<0.01$). Maternal prenatal depression associated with a DNA methylation-based biomarker of glucocorticoid exposure, which predicted measures of neonatal hippocampal volume. **Conclusions:** Maternal prenatal depression associates with stable changes in DNA methylation at a number of glucocorticoid sensitive sites across the genome. Our results further emphasize the importance of maternal mental health for child neurodevelopment and highlight the potential of epigenetic biomarkers to understand individual difference in such effects.

Maternal stress influence on placental differentiation and transplacental neurodevelopmental signals
Tracy Bale[1], Kylie Rock[1], Bridget Nugent[1], Qiuying Zhao[2], Alex Bonnin[2]
[1]University of Maryland School of Medicine, [2]University of Southern California
BACKGROUND AND AIM: Parental lifetime exposures to perturbations such as stress, infection, malnutrition, and advanced age have been linked with an increased risk for offspring disease, including a strong association with neurodevelopmental disorders. In our mouse model of early prenatal stress (EPS), stress exposure during the first week of gestation imparts long-term developmental programming deficits in male, but not female, offspring resulting in hypersensitivity to stress, cognitive impairments, and alterations in metabolic programming. The placenta reflects fetal sex chromosome complement and acts as an arbitrator between the mother and fetus, providing necessary factors for fetal development. In addition, these transplacental signals provide clues to the developing fetal brain as to the external environment it will be born into. Therefore, identification of cellular mechanisms by which maternal

stress alters placental differentiation and maturation and the subsequent production of proteins and metabolites may yield novel insight into factors critical for neurodevelopment. **METHODS:** Using our mouse model of EPS and genetic tools to produce placenta-specific reduction of OGT, we examined the cellular and molecular mechanisms and transplacental signals relayed to the developing fetal brain. Using RNA-sequencing, we also examined the influence of placental OGT on the fetal hypothalamus. In addition, studies in which whole live placentas were perfused ex vivo, we have performed proteomic and transcriptomic analyses on the proteins and extracellular vesicles isolated from the perfusate. **RESULTS:** We identified the X-linked, stress sensitive, nutrient sensor O-linked-N-acetylglucosamine (OGT) as a placental biomarker of prenatal stress. Levels of OGT were significantly higher in female tissue compared to males, and EPS further reduced OGT to very low expression in the male placenta. Genetic placental-specific reduction of OGT recapitulated the developmental and metabolic impairments associated with our EPS mouse model. We found that OGT determined genome-wide sex differences in levels of the histone repressive mark, H3K27me3, in placental trophoblasts, where males have substantially lower levels than females. Further, RNA-Seq of the fetal hypothalamus revealed that genetic reduction of OGT in the female placenta to male levels of expression erased nearly all of the sex differences detected at this stage, suggesting that placental OGT contributes to sex differences in brain development and lasting impacts on hypothalamic function. **CONCLUSIONS:** Overall, these studies demonstrate that OGT is a key regulator of placental cellular mechanisms important in key transplacental signals and impact on neurodevelopment. OGT is altered by maternal stress and maternal glucose, and may therefore offer novel insight into maternal metabolic and environmental influences on offspring disease risk and resilience. Studies were funded by NIMH, NICHD and NIEHS.

Sex-dependent impairments in hippocampal plasticity following neonatal paternal deprivation

Erica R. Glasper[1]

[1]*University of Maryland*

BACKGROUND AND AIM: Early-life adversities, such as trauma, neglect, or abuse, experienced during postnatal development results in disruptions in neuroplasticity, with these effects lasting well into adulthood. Women are twice as likely as men to develop stress-related disorders, like depression and anxiety, as a result of early-life adversity. Most investigations of early-life adversity use uniparental rodent models (e.g., Rattus, Mus) that disrupt mother/offspring interaction (e.g., maternal separation/deprivation models; limited bedding and nesting model); however, these models either depict a vulnerable male phenotype or do not recapitulate the female sex bias in susceptibility to early-life adversity observed in humans. While less commonly studied, father absence is a high predictor of anxiety in children and also decreases resilience to psychological distress later in life. Empirical studies of disrupted father/offspring interaction suggests that females are more susceptible to father absence, resulting in deficits in stress-related behaviors. **METHODS:** Using the biparental California mouse (Peromyscus californicus), our goal was to replicate the commonly observed sex bias following early-life adversity in humans via the use of a unique early-life adverse experience, namely neonatal paternal deprivation. In a series of experiments, we investigated the effects of neonatal paternal deprivation on sex dependent 1) new neuron survival, 2) microglial proliferation, 3) dentate gyrus volume, 4) stress-axis activation, and 5) pro-inflammatory cytokine concentration in the hippocampus of adult, biparentally-reared or paternally-deprived (i.e., paternal male permanently removed on postnatal day one) mice.

Additionally, the relationship between the aforementioned parameters and stress-related behaviors (i.e., anxiety and depression), as well as cognitive and social behaviors, were investigated. **RESULTS:** Collectively, the findings from this series of investigations reveal that paternal deprivation produces a female-specific hippocampal plasticity phenotype that may underlie stress-related behaviors. **CONCLUSIONS:** Importantly, this paternal deprivation model has the potential to inform sex-selective risk for the development of stress-induced mental illness that is observed in humans.

Impact of differing forms of early life adversity on neural and behavioral development in a mouse model

Kevin Bath[1], Camila Demaestri[1]

[1]Brown University

Early life adversity (ELA) increases risk for negative health outcomes, with sex disparities in prevalence and form of ELA experienced and risk for neuropsychiatric pathology. ELA comes in many forms (e.g. parental neglect/ loss, limited access to resources) but whether disparate forms of ELA have common effects on outcomes, and if males and females are equally affected, remains unknown. Epidemiological studies often fail to accurately ac- count for differences in type, timing, and duration of adversity experienced. Rodent models allow precise control of many of these variables. However, differences in the form of ELA, species, strain, housing, and testing paradigms used may contribute to differences in outcomes leading to questions of whether differences are the result of the form of ELA or these other variables. Here, we directly compared two mouse models of ELA, maternal separation (MS) and limited bedding (LB) in males and females on development of the body, motor and visual milestones, stress physiology, and anxiety-like behavior. LB affected timing of early milestones, somatic growth, and stress physiology in both sexes, yet only females showed later anxiety-like behaviors. MS rearing affected males and females similarly in early milestone development, yet only males showed changes in stress physiology and anxiety-like outcomes. These studies provide a platform to directly compare MS and LB models within one lab. The current work advances our understanding of the unique features of ELA that shape early neurodevelopmental events and risk for later pathology, increasing the translational relevance of these ELA models.

Symposium: Sample size, representation, or both? Current debates in developmental population neuroscience

Chair: Arianna Gard, *University of Maryland*

Selection bias in population-based and nationally-representative samples

Henning Tiemeier[1], Lorenza Dell?Aglio[2], Ryan Muetzel[2], Hannah Kim[1]

[1]Harvard T.H. Chan School of Public Health, [2]Erasmus Medical Center

BACKGROUND AND AIM. Neuroimaging studies are typically not designed within an epidemiological framework. This can impact internal validity and generalizability. In this talk I will illustrate how two important forms of bias, selection bias and confounding, can impact the validity of associations observed between behavioral traits and neuroimaging characteristics. **METHODS**. Data from the population-based Generation R Study and the nationally representative ABCD youth study are used to

illustrate the extent of possible bias in imaging analyses. Generation R has a response rate of 61% at baseline in well-defined city limits, it oversampled ethnic minorities by design. Neuroimaging data are available in more than 5000 children aged 9-14 in Generation R and in more than 10,000 children aged 9-11 in ABCD. The present vertex-wise analyses run in QDECR focus on cortical surface area and volume, quantified brain-wide with FreeSurfer. In Generation R, behavioral data were obtained from children, parents and teachers, in ABCD from parents and children using questionnaires. Teacher-reported data of children with missing parent-reported data allowed for an evaluation of the impact of loss to follow-up, while stepwise control for confounding in linear regression, and inverse probability weighting could show the extent of confounding. **RESULTS.** We illustrate selection and confounding bias based on the association of attention problems with cortical surface area and volume. More than 40% of children have been lost to follow-up since the study was initiated (10-year follow-up) in Generation R. The association between attention problems and cortical surface area did not change materially after inverse probability weighting. However, using teacher data to estimate the bias in associations obtained with parental data suggests that selection bias leads to some spurious findings. Stepwise analyses from a sex, age and race/ethnicity adjusted model to a fully adjusted model including socio-economic variables, maternal psychopathology, smoking and cannabis use during pregnancy, showed that the number of significant associations between inattention and surface area decreased about 80% in Generation R and 60% in the ABCD Study. Results for volume followed the same trend although the extent of the associations across the cortex was smaller. Additional adjustments for co-occurring psychiatric problems such as aggression or for IQ suggested that the observed associations are also not very specific to attention problems. **CONCLUSIONS.** Discussions in Population Neuroscience have focused on representativeness of the study sample and size. The present analyses suggest that selection bias during follow-up and, arguably, during inclusion, as well as confounding are key as they can invalidate findings and impact generalizability. To advance our etiological understanding and ultimately public health, neuroimaging studies must address these threats to internal validity carefully.

Current methodological practices in human neuroimaging studies: A consideration of sampling

Arianna Gard[1], Luke Hyde[2], Jeffrey Morenoff[2], Colter Mitchell[2]

[1]University of Maryland, College Park, [2]University of Michigan, Ann Arbor

Structural and functional neuroimaging has become a powerful and widespread tool to study human behavior, particularly in the developmental literature. Ostensibly, this research is intended to study population-level processes - memory formation, language development, the propagation of physiological stress responses. In recent years, developmental neuroscientists have heeded calls for larger sample sizes (Button et al., 2013). But do larger sample sizes alone lead to population-level inference (Falk et al., 2013)? This talk examines issues of sampling and representation in developmental neuroscience. First, the results of a structured review of human neuroimaging studies from top-ranked journals in 2019 that documents current methodological practices in our field will be presented. In addition to describing the proportion of studies that report participant race and ethnicity, gender, age, geographical location, and socioeconomic (dis)advantage, we investigate the extent to which studies report recruitment procedures, MRI inclusion and exclusion criteria, and sources and demographic predictors of data loss. Second, borrowing methods from survey methodology, we investigate the influence of sampling weights on associations between demographic variables and brain structure and

function, using two population-based studies of youth brain development. Finally, I conclude with recommendations for future research and discuss how population-based studies can inform the generalizability of developmental neuroscience research.

Population neuroscience: Past, present and future

Tomas Paus[1]
[1]University of Toronto

I will begin this talk by introducing the concept of population neuroscience: an intersection between genetics, epidemiology and neuroscience. I will discuss motivations for using this approach (e.g., complexity requires large n), design features (e.g., breadth vs. depth), and key challenges associated with participant recruitment (e.g., ascertainment), data collection (e.g., time constraints) and their interpretation (e.g., causality). Throughout the talk, I will use examples from various large datasets, such as CHARGE, ENIGMA, ABCD Study, to illustrate potential of this field for generating new knowledge about the human brain, and for identifying forces shaping the brain from conception onwards.

Populations and sub-populations

Hugh Garavan[1]
[1]University of Vermont

BACKGROUND AND AIM: The existence of large demographically diverse datasets provides many new opportunities including the increased statistical power to detect small, but true, effects and the ability to covary for potential influences that frequently confound human research. However, covariates such as sociodemographic variables need to be applied judiciously as they can chip away at the small effects that large-sample studies are showing to be more reliable than the inflated effects that tend to be detected in smaller studies. Another approach would be to study subgroups separately. A straightforward example would be not to treat sex as a nuisance covariate but instead to assess the effect of interest separately for males and females. With a large and diverse sample, it might be possible to extend this to other pertinent demographic or phenotypic variables leading to stratified analyses. **METHODS:** We offer examples from IMAGEN, a ten-year longitudinal study of approximately 2,000 adolescents and ABCD, a longitudinal study of approximately 12,000 adolescents. **RESULTS:** We show that predictive profiles (of future drug use, of weight gain) differ between boys and girls suggesting differences in etiologies. Beyond demographics, we show that "subtypes" can be identified within large populations based on patterns of brain activity and that analyses run separately for each subtype explain more variance in the outcome of interest than analyses run on the full sample that ignores the subtype distinction. **CONCLUSIONS:** We conclude that a population neuroscience approach encourages us to address the heterogeneity (in causes, in outcomes) that exists beyond small, highly ascertained samples.

Symposium: Jacobs Foundation Science of Learning

Chair: Bruce McCandliss, *Stanford University*
Sponsored by Jacobs Foundation

Directed functional connectivity during adolescent social learning: An example using sibling dyads

Christy Rogers[1], Kathleen Gates[2], Cassidy Fry[3], Tae-Ho Lee[4], Eva Telzer[2]

[1]Texas Tech University, [2]University of North Carolina at Chapel Hill, [3]Pennsylvania State University, [4]Virginia Polytechnic Institute and State University

OBJECTIVE: Adolescent risk taking is associated with older sibling risk behaviors (e.g., risky sexual behavior; Whiteman et al., 2014), particularly when dyads are same-sex and closer in age, and when older siblings are perceived as a valuable model and adolescents do not try to differentiate from them. Based on functional brain connectivity during adolescent social cognition (McCormick et al., 2018), we investigated connectivity patterns that may underlie how adolescents learning risky behavior from older siblings based on dyad sex, age spacing, older sibling modeling, and adolescent differentiation. **METHODS:** Participants included 44 adolescents (Mage=12.2 years; 23 females), and their older sibling (Mage=14.6 years; 20 females) who completed a risk-taking task (Op de Macks et al., 2018) while their performance was recorded. During an fMRI scan, adolescents observed their older sibling's performance on the risk-taking task. We used group iterative multiple model estimation (GIMME; Gates & Molenaar, 2012) to examine patterns of directional brain region connectivity that underlie adolescent social learning of risky decision-making. **RESULTS:** Group-level paths included associations between all bilateral brain regions in the model (i.e., left and right ventral striatum, medial prefrontal cortex. Adolescents who were hypothesized to be more heavily influenced by their older siblings (i.e., same sex dyads, close in age, high older sibling modeling, low differentiation) exhibited connections from the amygdala to the anterior insula (AI), and from the AI to the temporal pole. **CONCLUSION:** These results suggest that the AI, a brain region associated with integrating affective and cognitive processes during decision-making, plays a role in disseminating input during observation of risky social learning in adolescents who are more inclined to engage in social learning. Findings identify pathways specific to adolescents more motivated to engage in social learning.

Are reading and math inter-related in the brain? An fMRI study on reading and math following reading intervention in children with learning disabilities

Anna Matejko[1], Nicole Schlosberg[1], Melanie Lozano[1], Guinevere Eden[1]

[1]Georgetown University

Prior research has shown connections between reading and math: (1) reading and math disability are highly comorbid learning disabilities (LD), and (2) both skills activate inferior parietal and frontal cortices. Determining whether reading and math are bound together at the neural level is important for understanding LD. Here we studied 53 children (age 8-12) with LD before and after a successful reading intervention to test whether behavioral and neural changes underlying reading are yoked to behavioral and neural changes underlying arithmetic (addition and subtraction). If the two are inter-related, one would expect improved reading ability to affect math ability and brain activity during arithmetic. Intervention-related gains in word decoding correlated with fMRI signal decreases during a reading task in the bilateral temporo-parietal cortices, parahippocampal gyri, and cerebellum. Math performance, however, declined during the reading intervention, suggesting that math skills had been neglected or that the intervention was detrimental to math (possibly competing at the neural level). To test the latter, we used the aforementioned regions that correlated with reading gains to examine whether (i) intervention-induced changes in reading and arithmetic (addition or subtraction) activity were

correlated, and (ii) whether changes in math performance corresponded to changes in activity during arithmetic (addition or subtraction). Bayesian and frequentist analyses revealed no relationship between intervention-induced changes in reading and arithmetic activity (BF01 1.9-4.7). Further, there were no correlations between math performance and fMRI signal change during either arithmetic task in these regions (BF01 2.3-5.8), nor any other brain region (determined by a whole-brain analysis). These results of independent and unrelated brain-based outcomes after reading intervention indicate that reading and math are not intertwined at the neural level in LD.

Combining multiple learning tasks and computational models to isolate factors contributing to cognitive development between age 8-30

Maria Eckstein[1], Liyu Xia[1], Sarah Master[2], Ronald Dahl[1], Linda Wilbrecht[1], Anne Collins[1]
[1]University of California, Berkeley, [2]Max Planck Institute for Biological Cybernetics

Computational modeling has the promise to quantitatively isolate the processes that change in human cognitive development. However, early results using computational modeling have been contradictory. This may be driven by typical sample variation as well as the environmental statistics of experimental tasks and the distinct computational models applied. In an effort to understand this variability and reconcile previous findings in the reinforcement learning domain, we conducted a large-scale developmental study on 291 participants aged 8-30 years. Participants completed four learning tasks that varied on two experimental dimensions (stochastic / deterministic feedback, stable/volatile environment). We analyzed behavior and fitted computational models independently on each task, ensuring quantitative and qualitative fit, then compared the results across tasks. We found that performance (accuracy, response times) was highly consistent across tasks, and showed a stereotypical developmental trajectory: Performance increased steeply in the youngest age range 8-12, slowed down around age 12-17, and reached a stable plateau in mid-to-late adolescence/early adulthood ~18-25. This was mirrored by models' noise and forgetting parameters. However, other model parameters showed large variability across tasks: Most notably, the relationship of age and learning rate varied widely across tasks, where we observed stable, increasing, U-shaped, and inverse-U developmental trajectories. We used principal component analysis to identify which common factors underlie developmental differences between tasks, and support vector machines to determine what information different tasks contained about each other. Our research clarifies contradictions in the previous literature by assessing within-participant differences between tasks and models and identifying sources of difference. It also establishes stable across-task developmental factors.

Flash talks 1

Higher executive control network coherence buffers against puberty-related increases in internalizing symptoms during the COVID-19 pandemic

Rajpreet Chahal[1], Jaclyn Kirshenbaum[1], Jonas Miller[1], Tiffany Ho[2], Ian Gotlib[1]
[1]Stanford University, [2]University of California, San Francisco

Early pubertal maturation has been posited to be a biopsychosocial risk factor for the onset of internalizing psychopathology in adolescence; further, early-maturing youth exhibit heightened reactivity to stressful events even in post-puberty. School closures and enforced social distancing, as

well as health and financial uncertainties, during the COVID-19 pandemic are expected to adversely affect mental health in youth, particularly adolescents who are already at risk for experiencing emotional difficulties. The executive control network (ECN) supports cognitive processes required to successfully navigate novel challenges and regulate emotions in stressful contexts; it may buffer against stress-related internalizing symptom increases. We examined whether functional coherence of the ECN, measured via resting-state fMRI 5 years before the pandemic (at T1; Mage=11.29), is a neurobiological marker of resilience to increases in the severity of internalizing symptoms during COVID-19 (relative to 3 months prior; Mage=16.54) in adolescents who were in more advanced stages of puberty at T1 relative to their same-age peers (N=85; 49 F). Covariates included age at both time-points, early life stress, SES, and internalizing symptoms at T1. On average, participants reported an increase in symptoms from the 3 months prior to pandemic to the 2 recent weeks during the pandemic (t(84)=6.00, p<.0001). We found that early-maturing youth exhibited greater increases in internalizing symptoms during the pandemic if their ECN coherence was low (B=0.49, T=3.21, p<.001); in contrast, relative pubertal stage was not associated with changes in internalizing symptoms in adolescents with higher ECN coherence at T1 (B=-0.06, T=-0.49, p=.630). These findings highlight the role of the functional architecture of the brain that supports executive functioning in protecting against risk factors that may exacerbate symptoms of internalizing psychopathology during periods of stress and uncertainty.

What is an adaptive pattern of brain activity? It depends on one's environment

Monica Ellwood-Lowe[1], Susan Whitfield-Gabrieli[2], Silvia Bunge[1]
[1]University of California, Berkeley, [2]Northeastern University

Prior research indicates that certain patterns of functional connectivity are more adaptive--for example, associated with better cognitive test scores. One such pattern thought to be adaptive is an anti-correlation between lateral frontoparietal network (LFPN; supports executive functions), and Default Mode Network (DMN; supports internally-directed thought). Lower LFPN-DMN connectivity has been linked to higher cognitive test performance, leading to a view that it in order to focus on a cognitively demanding task, the LFPN must operate independently of the DMN. However, most studies are based on non-representative samples of individuals from higher-socioeconomic status backgrounds. Children living in poverty are at the greatest risk of low performance on cognitive tests, yet we know little about the neural underpinnings of success for them. In a pre-registered study, we analyzed 1034 children ages 9.0-10.9y (M=9.9y) living below poverty, identified from a larger sample (ABCD study). We did not find this expected relation. Further testing confirmed an interaction (p=0.003), such that for children in the larger sample living above poverty (N=5805), high test performance was related to lower LFPN-DMN connectivity (B=-1.41, p=0.002), replicating prior studies, whereas for children living below poverty, this relation trended in the opposite direction (B=2.11; p=0.060). Follow-up cross-validated predictive analyses revealed that the relation between LFPN-DMN connectivity and test performance varied systematically depending on children's environments. For children living in dangerous neighborhoods, for example, more positive LFPN-DMN connectivity was linked to better test performance; for children living in safe neighborhoods, this relation was in the expected, negative, direction. This pattern indicates that adaptive brain function depends crucially on adolescents' environments, highlighting the need for more diverse representation in developmental cognitive neuroscience.

Childhood sleep problems, mental health, and brain structure: Phenotypic and genetic associations in the ABCD baseline cohort

Leanna Hernandez[1], Minsoo Kim[1], Cristian Hernandez[1], Wesley Thompson[2], Adriana Galván[1], Mirella Dapretto[1], Susan Bookheimer[1], Andrew Fuligni[1], Michael Gandal[1]

[1]University of California, Los Angeles, [2]University of California, San Diego

Objective: Sleep problems are common in children and may precede the onset of psychiatric disorders. However, little is known about how sleep is related to brain development. Here we examine: 1) how individual variability in sleep disturbances (SDs: insomnia, arousal, breathing, somnolence, hyperhidrosis, sleep-wake transitions) are related to heterogeneity in psychiatric symptoms (PS) and brain structure in 9-10-year-old youth, and 2) the extent to which childhood SDs are heritable and demonstrate shared genetic etiology with PS and brain size. **Methods:** Data for >10,000 9-to-10-year old youth were obtained from the Adolescent Brain and Cognitive Development study. Linear mixed-effects models were used to examine the relationship between SDs, PS, and MRI measures of brain volume (VOL), surface area (SA), and cortical thickness (CT) in the split-sample for discovery and replication. Genome-wide Complex Trait Analysis was used to compute heritability and genetic correlations. **Results:** SDs broadly predicted higher levels of PS; however, only insomnia showed replicable associations with both PS and brain size. More frequent insomnia was associated with higher PS, and smaller VOL and SA. SNP-heritability was moderate for insomnia (h2=0.16) and sleep-hyperhidrosis (h2=0.16), low-to-moderate for PS (h2=0.03-0.25), and highest for VOL, SA, and CT (h2=0.25-0.37). Insomnia was genetically correlated with multiple PS (i.e., total problems, externalizing, ADHD), but not with brain structure. **Conclusions:** These findings indicate that, among commonly occurring childhood sleep problems, insomnia is uniquely associated with smaller brain size in middle-childhood. Results further suggest that a moderate proportion of variability in pediatric insomnia is due to genetic factors, and that the genetic influences underlying childhood insomnia and mental health are in-part shared. Longitudinal data is required to elucidate temporal causality between poor sleep and psychiatric symptoms.

The development of corticostriatal connectivity and goal-directed learning across adolescence

Gail Rosenbaum[1], Pablo Ripolles[1], Catherine Hartley[1]

[1]New York University

During adolescence, individuals must learn to make autonomous choices that are likely to yield rewarding outcomes. Accordingly, prior work has demonstrated age-related increases in goal-directed learning across adolescence, which involves a "model-based" consideration of the reward structure of the environment. In adults, model-based learning is thought to rely on the caudate nucleus in the striatum, which is a hub with overlapping projections from multiple cortical regions. Further, some have proposed that the degree to which these corticostriatal projections converge may facilitate goal-directed behavior. However, little is known about how patterns of corticostriatal connectivity change over development or how they relate to behavior. In the present study, we examine how age-related changes in the strength and localization of cortical projections to caudate relate to age differences in model-based learning. Participants ages 8-25 underwent a diffusion weighted imaging scan and completed a two-step reinforcement-learning task. Consistent with prior research, engagement in model-based strategies increased with age, reflecting increases in goal-directed choices across adolescence. Although connectivity between medial striatum and ventromedial and dorsolateral

prefrontal cortex did not significantly change with age, increased corticostriatal connectivity predicted model-based learning independently from age. In forthcoming analyses, we will compute DICE coefficients to measure the convergence of cortical projections on caudate. We will subsequently test the hypothesis that cortical projections increasingly overlap on the caudate across adolescence, which may drive age related increases in model-based learning.

Complex emotional processing in young children

M. Catalina Camacho[1], Elizabeth Williams[1], Susan Perlman[1]
[1]Washington University

Early childhood is marked by rapid and nonlinear emotional development, however the neurodevelopment that gives rise to this maturation is not understood. Most work in mapping emotional neurodevelopment has relied upon un-naturalistic paradigms, presenting emotional stimuli in the absence of social context. The present study seeks to characterize how young children process complex emotional stimuli--contextualized in social content--and examines how this circuitry may shift across age. Forty-five 4-7-year-old children watched a 21-minute episode of a children's TV show during multi-echo fMRI scanning. An independent cohort of adults rated this episode on a continuous basis for positive and negative content. This regressor was used to examine neural activation in children. Children demonstrated widespread activation in response to each increasing negative and positive content. Of note, in response to increasing negative content, children demonstrated increased activation of the dorsolateral prefrontal cortex (DLPFC) and decreased activation of the inferior parietal lobule (IPL) and orbitofrontal cortex (OFC). In response to increasing positive content, children demonstrated increased subgenual anterior cingulate and medial OFC as well as decreased DLPFC activation. Temporal and precuneus cortex activation during negative content decreased with age. These results suggest frontoparietal, limbic, and default mode network activation in processing complex emotional stimuli, providing insight to how young children process emotional information and how this activation may shift across development. Further analysis of the network dynamics underlying this processing will be conducted.

Neural predictors of psychosocial outcomes associated with the COVID-19 pandemic in children with autism spectrum disorder

Celia Romero[1], Adriana Baez[1], Lauren Kupis[1], Bryce Dirks[1], Meaghan Parlade[1], Michael Alessandri[1], Jason Nomi[1], Lucina Uddin[1]
[1]University of Miami

The 2019 novel coronavirus disease (COVID-19) has resulted in significant restrictions of everyday functions and abrupt changes in behavioral patterns. Children with autism spectrum disorder (ASD) have difficulties with flexibility in daily life and are at increased risk for anxiety and depressive symptoms. Children with ASD experiencing disruptions in daily routine and services as a result of shelter-in-place orders are expected to be especially impacted. Here, we aim to explore the neural predictors of quarantine mental health outcomes by examining brain-behavior relationships across a sample of typically developing (TD) children and children with autism. Data collected during quarantine will include behavioral measures of anxiety and depressive symptoms assessed by the Screen for Child Anxiety and Related Emotional Disorders (SCARED) and Mood and Feeling Questionnaire (MFQ) collected from approximately 70 children with ASD and 70 TD children who previously participated in neuroimaging

studies in our laboratory. Functional MRI data will consist of 295 volume (TR=2) resting-state scans collected pre-quarantine and preprocessed using the DPABI toolbox. Independent component analysis (ICA) and dual regression in FSL will be used to identify large-scale executive control networks. Within-network functional connectivity (FC) strength will be associated with anxiety and depression outcomes in both ASD and TD children groups. We hypothesize that children with ASD will show negative associations between FC strength and depression/anxiety symptoms within executive control networks compared to TD children as disruptions to routine typically have a greater impact on children with ASD and in those with lower executive control network integrity. Knowledge and understanding of quarantine outcomes in children with autism is crucial to promote community recovery and maximize clinical preparedness to offer additional support for those at increased risk for adverse consequences.

Symposium: Advances in analytics for developmental cognitive neuroscience

Chair:
Ted Satterthwaite, *University of Pennsylvania*
Deanna Greene, *University of California San Diego*

Best practices for reproducible neuroscience
Russell Poldrack[1]
[1]Stanford University
There is increasing concern that the methods used by many researchers in neuroscience may lead to a high rate of false findings. I will discuss several factors that can drive false results, such as low statistical power and analytic flexibility, and describe a set of practices that can help reduce the likelihood of false discoveries.

Methods for longitudinal studies of neurodevelopment
Catherine Lebel[1]
[1]University of Calgary
Longitudinal neuroimaging data allows for measurement of brain development (i.e., changes over time) rather than providing a snapshot of the brain at a single time point. Longitudinal data allows us to detect deviations from typical trajectories within individuals, and thus can be more informative than cross-sectional data. Over the past several years, the number of longitudinal studies has grown considerably, along with publicly available longitudinal data, offering rich possibilities for enhancing our understanding of brain development. However, longitudinal data also provides analysis challenges, especially for growing brains, such as statistically accounting for repeated measures, appropriately registering images from the same individual, and scanner upgrades. In this talk, I will highlight some of the advantages of longitudinal neuroimaging analysis as well as discuss potential ways to overcome some of the challenges. I will also provide some examples of recent longitudinal neuroimaging analyses that have informed our understanding of both typical and atypical brain development in children and adolescents.

Methodological confounds in developmental neuroimaging
Jonathan Power[1]
[1]Weill Cornell

BACKGROUND AND AIM: Functional magnetic resonance imaging (fMRI) is a challenging methodology to use in the best of times, and developmental populations are an especially challenging population to image. In this talk, I will cover some of the main confounds that occur functional neuroimaging, and how these confounds manifest in different acquisition protocols and at different stages of the lifespan. Special attention will be given to head motion, which occurs in multiple forms. Special attention will also be given to breathing effects on cerebral blood flow, which occurs in multiple forms, some of which also display lifespan biases especially early in development. **METHODS:** I will show individual scans across the lifespan illustrating both typical and atypical cases of confounds, and I will also show group results related to the individual scans. **RESULTS:** Several different, known confounds exist in developmental data. **CONCLUSIONS:** A multi-faceted approach to understanding and evaluating confounds is needed in virtually all functional neuroimaging studies. Two of the most influential confounds in imaging are motion and breathing, each of which has different signal characteristics. Different approaches are needed to isolate and control for these different kinds of confound, and further work is needed in this area, especially early in the lifespan.

Feasibility of precision functional mapping in developmental samples

Deanna Greene[1]

[1]*University of California San Diego*

BACKGROUND AND AIM: Capturing individual differences in developmental trajectories is a major goal for developmental cognitive neuroscience. However, much of the brain imaging work in our field relies upon group averaged data. Precision functional mapping is an approach that can delineate an individual's specific functional anatomy by acquiring large amounts of neuroimaging data from an individual participant. Previously, our group used this approach to interrogate functional brain network organization at the individual level in adults. We acquired hours of resting-state fMRI, task fMRI, and structural MRI from 10 healthy young adults across 12 scan sessions per participant, and demonstrated methods for describing each individual's functional anatomy at the level of the cortex, subcortex, and cerebellum. Being able to use this approach in developmental populations would be beneficial for understanding individual variability in typical and atypical brain development. Given the time and effort required to acquire the data needed for precision functional mapping, we aimed to test its feasibility in children. Here, I will discuss our recent endeavor to use this precision functional mapping approach in both typically developing children and children with a neurodevelopmental disorder, namely Tourette syndrome. **METHODS:** We scanned 9 typically developing children (age 9-10 years old) and 3 children with Tourette syndrome (8-12 years old) over 3-12 sessions per child. We acquired 60-298 minutes of resting-state fMRI data and 1-14 T1-weighted structural MRI scans from each child. **RESULTS:** With these data, we have been able to delineate each child's individual functional brain network organization. We demonstrate similar broad network structure across children in addition to clear individual differences. **CONCLUSIONS:** These data demonstrate that precision functional mapping is indeed feasible for studying individual children, and is a promising approach for future work in developmental cognitive neuroscience.

Friday September 11, 2020

Flash talks 2

Unraveling the consequences of childhood maltreatment: Deviations from typical functional neurodevelopment mediate the relationship between maltreatment history and depressive symptoms

Divyangana Rakesh[1], Clare Kelly[2], Nandita Vijayakumar[3], Andrew Zalesky[1], Nicholas Allen[4], Sarah Whittle[1]
[1]University of Melbourne, [2]Trinity College Dublin, [3]Deakin University, [4]University of Oregon

Background: Childhood maltreatment is associated with lifelong psychiatric sequalae. However, our understanding of neurobiological mechanisms responsible for this association is limited. One way childhood maltreatment may confer risk for psychopathology is by altering neurodevelopmental trajectories during childhood and adolescence. However, longitudinal research, which is essential for examining this question, has been limited. **Methods:** In the current study, associations between childhood maltreatment and the longitudinal development of resting state functional connectivity (rsFC) were examined in 130 community residing adolescents. fMRI data was acquired at age 16 (T1; M age = 16.46 years, SD = 0.52, 66F) and age 19 (T2; mean follow up period: 2.35 years). Childhood maltreatment history was assessed prior to T1 and we used whole-brain functional connectivity analyses to examine maltreatment-associated alterations in the development of neural circuitry. **Results:** We found maltreatment to be associated with widespread longitudinal increases in rsFC, primarily between default mode, dorsal attention, and frontoparietal systems. We also found sex-dependent increased maltreatment-associated rsFC in males in salience and cortical limbic circuits. Cross-sectional analyses revealed a shift in maltreatment-related rsFC alterations, which were localized to subcortical and sensory circuits at T1 to frontal circuits at T2. Finally, longitudinal increases in rsFC connectivity mediated the relationship between childhood maltreatment and increased depressive symptoms. **Conclusions:** To our knowledge, this is the first study to longitudinally examine maltreatment-related alterations in rsFC in adolescents. Our findings shed light on the neurodevelopmental consequences of childhood maltreatment, and provide evidence for their role in risk for psychopathology.

Executive function behaviours and the developing functional connectome

Jonathan Jones[1], Duncan Astle[2]
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Executive function difficulties manifest as behaviours that are seen as hallmarks of many neurodevelopmental conditions. Although atypical functional connectivity has been observed in these conditions, little is known about how the functional organisation of the brain may underpin variability in these behaviours during childhood. The aim of the current study is to investigate whether and how executive function behaviours are associated with functional brain organisation. Utilising advancements in network science, we propose to use community detection to identify profiles of executive function behaviour in an intentionally heterogeneous sample of 957 children aged 5-15. Functional connectomes will be constructed from resting-state functional Magnetic Resonance Imaging (fMRI) data for 238 children. We then plan to use partial least squares regression, a multivariate dimension reduction technique, to identify components that maximally explain covariance between the behavioural profiles and functional connectomes. The analyses will be conducted at three topological levels of the

connectome, including: global graph metrics, connectivity within and between networks, and regional connectivity. Finally, we will examine how functional brain organisation develops with age.

Developmental trajectories of dynamic brain connectivity

Monica Lopez-Vicente[1], Oktay Agcaoglu[2], Laura Perez-Crespo[3], Rosa Mulder[1], Fernando Estevez-Lopez[1], John Flournoy[4], Tonya White[1], Anna van Duijvenvoorde[5], Berna Guroglu[5], Vince Calhoun[2], Henning Tiemeier[6], Ryan Muetzel[1]

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Dynamic brain connectivity is a novel functional MRI analysis technique that allows correlation patterns amongst networks to vary over time. Cross-sectional work has shown that these patterns are sensitive to age in children, however few studies used longitudinal designs. Our objective is to characterize the developmental trajectories of dynamic brain connectivity in a population-based pediatric sample. Resting-state MRI data were acquired repeatedly at the ages of 6-to-9 (n=964), 9-to-12 (n=3448), and 12-to-14 years old (n=2048). A spatially constrained group-independent component analysis (ICA) was applied to the second visit data using 51 reference components grouped in 7 networks (Agcaoglu et al., 2019 Hum Brain Mapp). Dynamic functional network connectivity (FNC) between all ICA time courses were computed using a sliding window approach. We used k-means to cluster 171 dynamic FNC windows of 44 seconds in 5 dynamic states. Preliminary cross-sectional results showed that sensorimotor, default-mode, and cognitive control network connections were the most variable. Dynamic states 1, 4 and 5 were modularized connectivity patterns, that is, the components showed intra- and internetwork connectivity. In state-2, the components were heterogeneously connected in a non-modularized pattern. State-3 was a globally disconnected pattern. The next steps are to include the data from the first and third visits into the ICA and dynamic FNC analyses and to conduct multilevel linear mixed-effects regression models to study how dynamic connectivity patterns change as children grow. We hypothesized that variability in connections among networks will increase and children will gradually spend more time in modularized states. Longitudinal analyses will provide individual growth trajectories of dynamic brain connectivity from childhood into adolescence, which is key to understand the influence of the environment on brain development.

The emergence of self: Neural analyses and heritability estimates of self-evaluations in middle childhood

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How the emergence of the concept of self is influenced by environmental versus genetic factors is a long-standing question. We investigated heritability estimates of behavioral and neural underpinnings of self-concept. To do so, a validated fMRI task was applied in a twin sample of 345 (150 complete twin pairs) participants aged between 7-9 years. Participants were asked to indicate to what extent academic and social traits applied to them by responding with 'yes' or 'no' (self-concept condition). In a control-condition, participants were asked to categorize the trait sentences into 'School' or 'Friends'. The fMRI analyses revealed stronger mPFC activation for self than for control conditions. This effect was more pronounced in the social condition. Stronger DLPFC activation was observed for academic self-

evaluations versus social self-evaluations. Genetic modeling revealed that variation in academic self-evaluations was explained for 16-27% by genetic factors, whereas social self-evaluations were explained for 0-20% by genetic factors and for 9-24% by shared environmental factors. Moreover, we report differential genetic and environmental influences on mPFC and lateral PFC for academic (genetic and unique environment) and social (genetic, shared environment, and unique environment) self-evaluations. This is the first study demonstrating in a young twin sample that self-concept development depends on both genetic and environmental factors, depending on the specific domain.

Microstructural maturation of language networks in early childhood

Sila Genc[1], Derek Jones[1], Catherine Lebel[2]
[1]Cardiff University, [2]University of Calgary

Early childhood is a dynamic period of white matter maturation, with continuous axonal growth and myelination. Developmental patterns of microstructure are generally studied with diffusion magnetic resonance imaging (dMRI) using voxel-based values averaged over entire fibre pathways. Recent tract-profiling approaches provide a means to study more subtle variations in microstructural properties at distinct points along a pathway. In this study, we quantify age-related profiles of tract development in fibre pathways that are involved in language skills both in childhood and adulthood. We included 322 dMRI scans from 103 participants aged 2-8 years (170M;152F) from the longitudinal Calgary Preschool MRI dataset. Data were pre-processed in MRtrix3, correcting for Gibbs ringing, eddy and motion artefact. Automated subject-specific tractography was performed using TractSeg to delineate three segments of the superior longitudinal fasciculus (SLF_I, SLF_II, SLF_III) and the arcuate fasciculus (AF). Along-tract profiling was performed and fractional anisotropy (FA) values were mapped at 20 equidistant points in each tract and compared across ages in 1-year bins. Evidence for a group difference was determined by non-overlapping 95% confidence intervals. We observed the expected age-related increases in FA for all tracts. However, the left SLF_II, SLF_III and AF showed distinct "jumps" in FA between 4-5 years, rather than smooth development across age groups. These discontinuous patterns may correspond with increased language acquisition during this period of development. Future work will include additional microstructural metrics, model the degree of lateralization, and evaluate longitudinal age- and sex-relationships across tract segments. Overall, our findings suggest that white matter microstructural properties along the length of language-network tracts may develop in a stepwise manner rather than smoothly across early childhood.

Longitudinal trajectories of cognition and white matter microstructure in adolescents

Ines Mürner-Lavanchy[1], Julian Koenig[1], Ayaka Ando[2], Romy Henze[3], Susanne Schell[2], Franz Resch[2], Romuald Brunner[4], Michael Kaess[1]
[1]University of Bern, [2]University of Heidelberg, [3]University of Berlin, [4]University of Regensburg

Background and objectives: Important cognitive changes during adolescence coincide with the maturation of white matter microstructure. This study aimed to characterize longitudinal developmental trajectories of inhibition, planning, emotion recognition and risk-taking and their association with white matter maturation in a healthy adolescent sample. **Methods:** In an accelerated longitudinal cohort design, n = 112 healthy adolescents between ages 9 and 16 underwent cognitive assessment with the Cambridge Neuropsychological Test Automated Battery (CANTAB) and diffusion MRI over three years. Fractional anisotropy (FA) and mean diffusivity (MD) were extracted for major white matter pathways

using TRActs Constrained by UnderLying Anatomy (TRACULA), an automatic probabilistic reconstruction technique. Mixed models were used to analyze age trajectories of cognitive performance and white matter microstructure. **Results:** Inhibition, planning and emotion recognition performance improved linearly across adolescence. Risk-taking developed in a quadratic fashion, with relatively stable performance between 9 and 12 and an increase between ages 12 and 16. Including cingulum and superior longitudinal fasciculus FA slightly improved model fit for emotion recognition across age. We found no evidence that FA or MD were related to inhibition, planning or risk-taking across age. **Conclusion:** In line with existing studies, we found improvements in inhibition, planning and emotion recognition across adolescence as well as increases in risk-taking in late adolescence. Weak evidence regarding effects of FA and MD challenge the additional value of white matter microstructure to explain neurocognitive development. More longitudinal research with large datasets is needed to identify the potential role of white matter microstructure in cognitive development.

Symposium: Dimensions of adversity and neurodevelopment: Translational approaches

Chairs:
Katie McLaughlin, *Harvard University*
Dylan Gee, *Yale University*

Links between adversity and neurodevelopment the case for a focus on dimensions of experience

Margaret Sheridan[1]
[1]*University of North Carolina, Chapel Hill*

Background: Childhood adversity is common and associated with a host of negative developmental outcomes. The most common approach to studying adversity in childhood is a cumulative risk score that counts the number of adversities experienced. In contrast, we and others have proposed that different dimensions of adversity influence health through distinct pathways and that these differential associations with developmental outcomes are replicable despite adversity co-occurrence and clustering by socioeconomic status (SES) and minority status. **Methods:** We demonstrate support for this hypothesis using first hypothesis-driven approaches examining these associations in early childhood and longitudinally and then we determine whether these differential associations emerge from a data-driven clustering analysis in the population-representative Fragile Families study (N=2566). **Results:** Consistent with our predictions, across both hypothesis driven and data-driven methods, threat and deprivation appear to be differentially linked with mediators on the pathway between adversity exposure and psychopathology. These differential associations are sometimes robust to controls for SES and cumulative risk. In our data-driven analysis we observe that inclusion of parental SES and minority status revealed the centrality of these societal variables for increasing adversity exposure, but also that inclusion of these variables did not fundamentally alter network structure. **Conclusions:** We provide several datapoints indicating the importance of conceptualizing adversity as including dimensions of exposure and of expanding methods of linking adversity to neurodevelopment beyond cumulative risk approaches.

Leveraging a data-driven approach to parsing heterogeneity in the effects of early adversity on brain development

Lucinda Sisk[1], Seok-Jun Hong[2], Camila Caballero[1], Anthony Mekhanik[3], Amy Roy[4], Michael Milham[3], Dylan Gee[1]

[1]Yale University, [2]Sungkyunkwan University, [3]Child Mind Institute, [4]Fordham University

BACKGROUND AND AIM: Early-life experiences play a profound role in conferring risk and resilience for brain and behavioral development. However, there is vast heterogeneity in the nature of early experiences and in child and adolescent outcomes following adversity. Increasingly, dimensional approaches have focused on delineating how specific features of the early environment may differentially shape the developing brain and mental health. **METHODS:** In the current work we applied a data-driven approach to examine how specific environmental factors and types of adversity were associated with brain structure. Using data collected from 1,000 youth in the Adolescent Brain Cognitive Development Study, we applied a cross-modal integration and clustering approach called Similarity Network Fusion. This approach combined two brain morphometrics (cortical thickness and myelin-surrogate markers) with environmental exposures related to trauma, neighborhood safety, and school and family environments to identify homogeneous subgroups. **RESULTS:** Depending on the subtyping resolution, results of similarity network fusion identified two or five subgroups, each characterized by distinct profiles of co-occurring brain structure and environmental features. Notably, more supportive caregiving and school environments were associated with increased myelination, whereas less supportive caregiving, higher family conflict and psychopathology, and higher perceived neighborhood safety were observed with increased cortical thickness. These subtypes were highly reproducible and predicted externalizing symptoms and overall mental health problems.
CONCLUSIONS: Our findings highlight substantial heterogeneity in the associations between early experiences and neurodevelopment and support the feasibility of using data-driven approaches to better understand how distinct environmental exposures differentially influence outcomes. Delineating more precise associations between risk factors, protective factors, and brain development may inform approaches to enhance early risk identification and optimize interventions targeting specific profiles of experience.

Unpredictability, a novel, actionable early-life adversity, impacts neurodevelopment: A cross-species perspective

Tallie Z Baram[1], Elysia Davis[2], Laura Glynn[3], Curt Sandman[1], Mike Yassa[1], Ali Mortazavi[1], Hal Stern[1]

[1]University of California Irvine, [2]Denvier University, [3]Chapman University

BACKGROUND AND AIM: Early-life adversities (ELAs or ACEs) have a profound, cumulative impact on cognitive and emotional health. However, the spectrum of ELAs, their direct causal relation to neuropsychiatric outcomes, and the mechanisms by which they may impact the maturation of brain molecules, cells and circuits are not fully understood. **METHODS and RESULTS:** Employing rodent models of ELA, we have established fragmented and unpredictable patterns of parental care as a key determinant of early-life stress in rat and mouse pups. These chaotic, 'high-entropy' patterns of sensory signals, received during sensitive periods, disrupted synapse pruning and brain circuit maturation, associated with enduring selective and sex-modulated deficits in memory and reward-related behaviors. To determine whether unpredictable sensory signals from the parents and the home environment were

important in human neurodevelopment, we quantified unpredictability of maternal care behaviors mathematically, and developed the Questionnaire for Unpredictability in Childhood (QUIC). Unpredictable signals from the mother presaged significant problems in memory, self-control and reward-seeking behaviors in infants, children and adolescents. Importantly, these correlations persisted when factors associated with human ELA including socioeconomic status and maternal depression were considered. Notably, the importance of early-life unpredictability has been established in international cohorts (e.g., in Finland). Ongoing studies to uncover the underlying mechanism for the profound effects of unpredictability on processes of children's brain maturation include longitudinal neuroimaging and intra-individual epigenomic approaches. **CONCLUSIONS:** We conclude that unpredictable patterns of parental and environmental signals constitute a significant ELA. Notably, unlike many other ELAs, unpredictability may be readily mitigated through education and related interventions, providing impetus for uncovering how this novel, actionable ELA impairs brain development and for identifying predictive markers for affected individuals. Supported by P50 MH 096889

Molecules to mechanisms to meaningful impact: T he promise of translational neuroscience

Philip Fisher[1]
[1]University of Oregon

Modern neuroscience provides a multitude of tools for understanding how we learn, sense, feel emotions, and remember experiences. This knowledge can serve a scientific end in itself, and it can also be applied to the development of effective strategies for promoting health and well-being; indeed, this is the domain of translational neuroscience. By identifying specific brain and biological systems that underlie psychological disorders--as well as those associated with resilience in the face of adversity--and by targeting these systems, the potential exists to develop more effective and scalable interventions. Moreover, randomized clinical trials (RCTs) to test interventions that emerge from basic neuroscience research have the potential to go beyond simply program evaluation studies to serve as "mechanism experiments" that can advance theory. In order to achieve this potential, however, it is necessary to specify (and measure) both the mediational pathways by which an intervention is hypothesized to impact outcomes via alterations in underlying neural systems, and to consider potential moderators that help to explain variations in impact. In this presentation, we will elucidate the translational neuroscience process and provide examples from our own and others' work of family-based intervention studies to promote child wellbeing that have employed this approach to achieve social impact.

Symposium: Using a developmental cognitive neuroscience approach to understand and predict psychopathology

Chair: Nathan Fox, *University of Maryland*

Testosterone and hippocampal trajectories mediate relationship of poverty to emotion dysregulation and depression: A longitudinal study

Deanna Barch[1], Elizabeth Shirtcliff[2], Nourhan Elsayed[1], Diana Whalen[1], Kirsten Gilbert[1], Alecia Vogel-Hammen[1], Rebecca Tillman[1], Joan Luby[1]
[1]Washington University, [2]Iowa State University

BACKGROUND AND AIM: There is robust evidence that early poverty is associated with poor developmental outcomes, including impaired emotion regulation and depression. However, the specific mechanisms that mediate this risk are less clear. Here we test the hypothesis that one pathway involves hormone mechanisms (testosterone and DHEA) that contribute to disruption of hippocampal brain development, which in turn contribute to perturbed emotion regulation, and subsequent risk for depression. **METHODS:** To do so, we used data from 167 children participating in the Preschool Depression Study, a longitudinal study that followed children from preschool (ages 3 to 5) to late adolescence, and which includes prospective assessments of poverty in preschool, measures of testosterone, DHEA and hippocampal volume across school age and adolescence, and measures of emotion regulation and depression in adolescence. **RESULTS:** Using multilevel modeling and linear regression, we found that early poverty predicted shallower increases of testosterone, but not DHEA, across development, which in turn predicted shallower trajectories of hippocampal development. Further, we found that early poverty predicted both impaired emotion regulation and depression, even when controlling for depression in preschool. The relationship between early poverty and self-reported depression in adolescence was explained by serial mediation through testosterone to hippocampus to emotion dysregulation, while a pathway from hippocampus to testosterone was not significant. There were no significant interactions with sex. **CONCLUSIONS:** These results provide novel evidence about a hormonal pathway by which early poverty may contribute to disrupted brain development and risk for mental health problems later in life. Identification of such pathways provide evidence for potential points of intervention that might help mitigate the impact of early adversity on brain development.

Development of brain mechanisms underlying threat bias: relations with childhood social reticence and adolescent anxiety

Anita Harrewijn[1]

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Social reticence during childhood predicts the development of anxiety symptoms, which typically emerge during early adolescence. We studied the relation between childhood social reticence and adolescent anxiety symptoms from a developmental cognitive neuroscience perspective. Specifically, we focused on one potential moderator of this relation: the development of brain mechanisms associated with attention bias to threat. Previous research showed that amygdala-prefrontal cortex connectivity during threat bias moderated relations between early-childhood temperament and anxiety symptoms at 10 and 13 years. The current study extends this research by assessing neural correlates of threat bias across adolescence (10-16 years) and testing relations with childhood social reticence and concurrent anxiety symptoms. This study is part of a longitudinal study on behaviorally inhibited temperament and childhood social reticence. Childhood social reticence was measured when children were 2, 3, 4, 5 and 7 years old using behavioral observations and questionnaires. Anxiety symptoms and threat bias were measured when children were 10, 13 and 16 years. Threat bias was measured using the dot-probe task, in which children were shown two faces on the screen (angry-neutral, happy-neutral, or neutral-neutral) and responded to the location of a probe replacing one of the two faces, either in a threat-congruent or threat-incongruent location. Useable fMRI data was collected during the dot-probe task for 69 children at 10 years of age (M=10.57 years, SD=0.45, 42 girls), 83 children at 13 years (M=13.24 years, SD=0.73, 45 girls) and 80 children at 16 years (M=16.26 years, SD=0.67, 39 girls). 57 children had data at 2 time

points, 15 children had data at 3 time points. I will focus on amygdala functional connectivity during the threat-congruent and threat-incongruent conditions, assessed with a psychophysiological interaction (PPI) analysis. Relations with childhood social reticence and concurrent anxiety symptoms will be tested with a linear mixed-effects model with the individual-level PPI data as dependent variable, social reticence, concurrent anxiety symptoms, task condition, time and their interactions as independent variables, and subject as random effect. This will test whether development in the neural circuitry related to threat bias is associated with the development of anxiety symptoms in socially reticent children.

Neural noise at 8-months predicts infant internalizing and externalizing behavior

Koraly Perez-Edgar[1], Brendan Ostlund[1], Berenice Anaya[1]
[1]The Pennsylvania State University

Adaptive information processing depends on efficient communication between neurons and may be disrupted when neuronal networks are synchronized too strongly (overcoupling) or too weakly (undercoupling). Neural noise is thought to serve as a safety mechanism that prevents pathological coupling. A moderate level of noise facilitates information processing, whereas excessively high or low levels may lead to cognitive and behavioral dysfunction by disrupting neuronal synchronization. Low noise may contribute to internalizing disorders; anxiety may, for example, reflect an overcoupling of the default mode network as a result of reinforcement (e.g., rumination). High noise, on the other hand, undercuts neuronal synchronization and is related to age-related cognitive decline, as well as cognitive dysfunction (e.g., ADHD). Neural noise can be measured by the EEG power spectral slope. Computational and animal models demonstrate that the spectral slope is attributable to the balance of synaptic excitation to inhibition in the brain. A flatter slope indicates more random neuronal activity. In this study, we examined how neural noise emerges in the first years of life and associates with childhood psychopathology. We predicted that a steeper spectral slope (less noise) would be related to more internalizing behavior while a flatter spectral slope (more noise) would be related to more externalizing behavior at 18-months of age. Given known developmental shifts in the distribution of spectral power, we also predicted that stable high neural noise (i.e., less decrease) over time would associate with behavior problems. Families were drawn from an ongoing multisite longitudinal study examining infant temperament and attention (N=350). We estimated spectral slopes from resting EEG via FOOOF. Preliminary data are currently available for infants at 8- (N=124), 12- (N=88), and 18-months (N=72). Mothers reported on infant behavior problems at 18-months via the ITSEA. Latent growth models showed that 8-month neural noise was negatively associated with neural noise trajectories (β=-0.55, p=.01), suggesting that infants with initially lower noise (steeper spectral slopes) were more likely to show stability over time. These infants also showed more internalizing (β=0.23, p=.01) and externalizing behavior (β=0.19, p=.01) at 18-months. These data suggest that less noise (overcoupling) is associated with early childhood psychopathology risk. Changes in neural noise from 8- to 18-months did not predict behavior problems at 18-months (ps>.57). Our preliminary results converge with prior evidence to show individual differences in the shift of spectral power from lower to higher frequencies across early life, as indexed by changes in the spectral slope over time. We also show that disrupted neural communication, as early as the first year, may portend later childhood psychopathology risk, and may be attributable to the balance of inhibition to excitation in the developing brain.

Intrinsic functional architecture predicts progression of future pathology in a community pediatric sample

Susan Whitfield-Gabrieli[1], Laurie Cutting[2], Silvia Bunge[3]

[1]Northeastern University, [2]Vanderbilt University, [3]University of California Berkeley

Background: I will describe ways in which the intrinsic functional architecture of the human brain, as elucidated by resting state networks (RSNs), can predict individual developmental trajectories towards behavioral problems as measured by the Childhood Behavioral Checklist's (CBCL) empirically based syndrome scales, which are highly predictive of future psychiatric diagnoses. **Methods:** First we examined, in a community pediatric sample, whether RSNs can predict individual children's progression of behavioral problems characteristic of major depression (MDD) such as such as internalization problems (which combine the Anxious/depressed, Withdrawn, and Somatic complaints subscales). Next, we sought to replicate/extend these findings in 1) a familial at-risk for MDD pediatric population and 2) adolescents with and without anxiety/depression. **Results:** Weaker connectivity at age 7 between the subgenual anterior cingulate cortex (sgACC) and dorsolateral prefrontal cortex (DLPFC) predicted the development of internalization problems by age 11. Logistic regression analyses of resting state metrics revealed that RSNs were a more accurate predictor than initial behavioral measures of whether a child would progress to a subclinical CBCL scores. In independent samples, we found that this biomarker predict worsening of CBCL behavioral problems in both children at-risk for MDD and adolescents with diagnosed anxiety/depression. **Conclusion:** Such neuroimaging biomarkers are promising for the early identification of vulnerabilities in neural systems and may support preventive treatment of at-risk children prior to the emergence of full-blown psychiatric disorders of MDD.

Flash talks 3

Neurobiological markers of resilience to depression following childhood maltreatment: The role of neural circuits supporting the cognitive control of emotion

Alexandra Rodman[1], Jessica Jenness[2], David Weissman[1], Daniel Pine[3], Katie McLaughlin[1]

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Childhood adversity is strongly linked to negative mental health outcomes, including depression and anxiety. Leveraging cognitive neuroscience to identify mechanisms that contribute to resilience in children with a history of maltreatment may provide viable intervention targets for the treatment or prevention of psychopathology. Here, we examined neurobiological mechanisms of resilience to depression and anxiety following childhood adversity. Specifically, we investigated whether neural circuits underlying the cognitive control of emotion may promote resilience, wherein a child's ability to recruit the frontoparietal control network to modulate amygdala reactivity to negative emotional cues--such as during cognitive reappraisal-- buffers risk for internalizing symptoms following exposure to adversity. A longitudinal sample of 151 participants aged 8-17 years with (n=79) and without (n=72) a history of childhood maltreatment completed a cognitive reappraisal task while undergoing fMRI. Among maltreated youth, those who were better able to recruit prefrontal control regions and modulate amygdala reactivity during reappraisal exhibited lower risk for depression over time. By contrast, no association was observed between neural functioning during reappraisal and depression among youth without a history of maltreatment. These preliminary findings support the hypothesis that

children who are better able to regulate emotion through recruitment of the frontoparietal network exhibit greater resilience to depression following childhood maltreatment. Interventions targeting cognitive reappraisal and other cognitive emotion regulation strategies may have potential for reducing vulnerability to depression among children exposed to adversity.

Neural correlates of emotion reactivity and regulation and youth suicidal ideation: Examining cross-sectional and longitudinal links

Adam Miller[1], Jessica Jenness[2], Kelly Sambrook[1], Margaret Sheridan[1], Katie McLaughlin[3]
[1]University of North Carolina at Chapel Hill, [2]University of Washington, [3]Harvard University

Prior research links neural responses underlying emotion reactivity and regulation with suicidal ideation (SI) among youth (e.g., Miller et al., 2017). It is unknown if neural correlates of emotion reactivity and regulation predict future SI. Here, we examined cross-sectional and longitudinal associations between neural correlates of emotion reactivity and regulation and SI. Hypotheses: Youth with SI will exhibit reduced activation in prefrontal regions supporting emotion regulation (e.g., dorsolateral prefrontal cortex; dlPFC) during reactivity trials, which will predict presence and severity of SI. Youth (N=151, 8-16, M=12.76) completed a baseline fMRI scan and clinical interview assessing presence and severity of SI. Two years later, 123 youth (81%) completed a follow-up interview. A well-known fMRI task assessed reactivity and regulation (via cognitive reappraisal) to negative stimuli. Whole brain and ROI analyses (dlPFC, anterior cingulate cortex (ACC)) examined associations between SI and neural activation during reactivity and regulation. Models controlled for age, sex, and maltreatment severity. Longitudinal models also controlled for time and past SI. Baseline whole brain analyses revealed a positive association between lifetime SI severity and activation in the posterior insula, postcentral gyrus, and superior and middle temporal gyrus during reactivity. Follow-up whole brain analyses revealed a negative association between presence of SI at follow up and activation in the motor cortex, precuneus, and occipital cortex during regulation trials. Consistent with hypotheses, less activation in the dlPFC ROI during reactivity predicted more severe SI at follow-up, $b = -.24$, $p < .05$. This is among the first studies to longitudinal link neural correlates with future SI. Results partially support hypotheses suggesting that neural correlates of emotion reactivity and regulation may predict future SI among youth.

A person-centered examination of regulation, sensitivity to threat and impulsivity among children and adolescents: An ERP study

Taylor Heffer[1], Teena Willoughby[1]
[1]Brock University

The imbalance model suggests that asynchrony in the maturation of interconnections between the prefrontal cortex (i.e., regulation) and the limbic striatal regions (i.e., socioemotional processing) contributes to adolescents being more sensitive to emotionally salient events than children. Adolescents may be more susceptible than children to bottom-up processing (i.e., impulsivity, IMP; or sensitivity to threat, ST) in emotionally-arousing situations, as their ability to regulate these emotions is not yet fully mature. At the same time, there may be individual differences among adolescents in both bottom-up (IMP & ST) and top-down regulation. Latent class analysis (LCA) was used to identify distinct groups of youth who differ in these processes. We also investigated group differences on the error-related negativity (ERN, an ERP) during an inhibitory control task that requires top-down control over bottom-up responding. The ERN is thought to be associated with motivational significance of errors; IMP has

been associated with a smaller ERN, while ST is associated with a larger ERN. Children and adolescents (N=1313, Mage=11, range=7-14 years) completed a survey assessing their dysregulation (DYS), ST, and IMP. A subsample (N=483) also completed a go/no-go task while EEG was recorded. The LCA identified four groups with differential levels of DYS, ST, and IMP. In line with imbalance models, adolescents had greater odds than children of being in the (1) high DYS/ST_lowIMP or (2) moderateDYS/ST_high IMP groups, compared to two other groups that had lower scores on these measures (OR:1.6-2.7). The highDYS/ST_lowIMP group had the largest ERN, while the moderateDYS/ST_highIMP group had the smallest ERN ($p<.05$). Adolescents are more likely to be in groups with greater DYS; at the same time there are differences in whether they have greater IMP or ST. The ERN may be a biomarker that distinguishes between the different types of bottom-up processing that adolescents might use.

Inhibitory control circuitry and externalizing psychopathology in a large sample of higher-risk youth

Rachel Tomlinson[1], S. Alexandra Burt[2], Luke Hyde[1]
[1]University of Michigan, [2]Michigan State University

Disinhibition has been proposed as a common factor underlying many forms of externalizing psychopathology. Though there is consistent evidence that behavioral response inhibition performance relates to externalizing psychopathology, neuroimaging studies have produced conflicting results. Prior work has frequently used clinical samples or small convenience samples of affluent participants, limiting generalizability of results. Thus, there is a need for additional clarity regarding the relationship between inhibitory circuitry and externalizing, particularly using a large sample of higher risk youth. The present study will examine the relationship between go-no/go-related inhibitory control activation and externalizing behavior, and test whether behavioral measures of inhibitory control mediate this association. We will use data from a sample of 708 twins in 354 families who completed a go/no-go fMRI task as part of the Michigan Twins Neurogenetics Study (MTwiNS), which uses an epidemiologic sampling frame (birth records) to focus directly on families residing in modestly-to-severely disadvantaged neighborhood contexts. We will create an inhibitory control latent factor using go/no-go efficiency, stop-signal reaction time, and the Inhibitory Control subscale of the Early Adolescent Temperament Questionnaire. To isolate inhibition-related inferior frontal gyrus (IFG) activation, we will extract values for the no-go>go contrast from a bilateral anatomical IFG mask. We will quantify externalizing using well-validated parent-, child-, and teacher-report measures of rule breaking, aggression, ADHD, and substance use. We will use structural equation modeling to test for an indirect effect of IFG activation on an externalizing latent factor via a behavioral inhibitory control latent factor while adjusting for the non-independence of the twins. Our findings will have implications regarding inhibitory control circuitry as a potential marker for externalizing psychopathology.

Prefrontal-striatal circuitry supports adaptive memory prioritization across development

Kate Nussenbaum[1], Daphne Valencia[1], Jamie Greer[1], Nora Keathley[1], Catherine Hartley[1]
[1]New York University

Previous work has revealed that the ability to strategically encode high-value information may improve gradually over development, as the systems supporting cognitive control processes mature. However, studies of value-directed memory have relied on explicit cues that signal the importance of information, which are rarely present in real-world contexts. Here, using a novel fMRI paradigm, we examined whether individuals across a wide age range (N = 90; ages 8 - 25 years) could learn the relative

frequency of items in their environment and prioritize memory for information associated with higher frequency items, which would ultimately enable them to earn more reward. We found that from childhood to early adulthood, individuals improved both at transforming their experiential learning into explicit representations of information value and at using these value estimates to strategically modulate encoding. Memory prioritization for high-value information was supported by increased engagement at both encoding and retrieval of the caudate, putamen, and lateral prefrontal cortex - regions that have been implicated in value processing and the implementation of cognitive control mechanisms. Our results suggest that developmental improvements in the ability to dynamically adjust memory based on the statistics of the environment are supported by a wide network of brain regions that support both the recognition and use of information value to implement strategic control over encoding.

The thriving brain: effects of individual child characteristics and environmental factors on self-regulation and associated neural circuitry

Bram Gooskens[1], Dienke Bos[1], Pascal Pas[1], Matthijs Vink[1], Bob Oranje[1], Sarah Durston[1]
[1]*University Medical Center Utrecht - UMC Utrecht*

Self-regulation is the ability to regulate one's emotions, behavior and social interactions in daily life, including when faced with difficult circumstances. Given the impact that self-regulation has on mental health and behavior, more insight into the factors that drive its development is necessary. In this study we aim to examine whether and how individual child characteristics and environmental factors affect self-regulation and associated neural circuitry. We included a sample of 673 children (age 8-11 years) from the Dutch developmental YOUth (Youth Of Utrecht) cohort study, part of the Consortium on Individual Development (CID). Exploratory Factor Analysis (EFA) performed on questionnaire data yielded six child characteristics factors (externalizing behavior, impulsivity, anxiety, outgoing/socializing behavior, self-esteem, withdrawal) and seven environmental factors covering parenting style (incompetence, interference, strictness and liberty), stress (conflicts father, conflicts mother) and socio-economic status (SES). All participants performed a Stop-Signal Anticipation Task during fMRI. Increased perception of incompetence in parenting was associated with increased externalizing behavior of the child (r=.41, q=.002), impulsivity (r=.26, q=.002) and anxiety (r=.23, q=.002), and reduced outgoing/socializing behavior (r=-.13, q=.026) in children. An interfering parenting style was associated with lower self-esteem (r=-.24, q=.006). Externalizing behavior was related positively to a strict- (r=.15, q=.036) and negatively to a liberal parenting style (r=-.14, q=.048). The presence of conflicts in the father's life was associated with child anxiety (r=.15, q=.048). None of the individual child- or environmental factors were associated with stop-signal reaction time. We will present findings on the effect of child characteristics and environmental factors on the neural correlates of self-regulation in a larger, imputed dataset of 1060 children at the meeting.

Saturday September 12, 2020

Symposium: Developmental psychopathology

Chairs:

Sarah Wittle, *University of Melbourne*

Christian K. Tamnes, *University of Oslo*

Furthering understanding of externalizing psychopathologies through richer modeling of developmental process, behavior, and neurobiology

Jamie Hanson[1]

[1]*University of Pittsburgh*

Forms of externalizing psychopathology impart a profound impact on individuals, and society more broadly. However, despite the significant impact, progress is somewhat stalled in understanding the developmental trajectories of aggressive behaviors, rule-breaking, substance misuse, and other forms of externalizing problems. Neuroimaging studies have provided some insights, but often past f/MRI investigations have not been firmly anchored in developmental psychopathology frameworks. This may be a significant limitation, as we will need to understand forms of externalizing psychopathology at "multiple levels of analysis", through longitudinal study of adaptation and maladaptation, and with an eye toward other theoretical concepts from developmental psychopathology. Here, we detail promising findings from multiple longitudinal cohorts leveraging Bayesian modeling of decision-processes, item-response theory, and advanced neuroimaging analytics (e.g., structural covariance). Using these approaches and ideas from developmental psychopathology, we find that liability for substance misuse is related to differences in corticostriatal brain structure and structural covariance of related networks. We also find that reward processing relates to risk for these forms of externalizing psychopathology. More broadly, and across this work, we demonstrate how the study of externalizing psychopathology may be advanced by integrating ideas from developmental psychopathology, with state-of-science quantitative techniques, to ultimately reduce the profound impact that externalizing behaviors can exert on individuals and communities.

Emerging emotional problems across adolescence coincides with trajectories of structural brain development

Marieke Bos[1]

[1]*Leiden University*

BACKGROUND AND AIM: Adolescence is a developmental period characterized by heightened emotional reactivity, which for some sets the stage for emotional problems. There is a dramatic increase in prevalence rate of emotional problems across adolescence - such as depression and (social) anxiety, but also externalizing problems like substance abuse and aggression. Adolescent onset of emotional problems is associated with worse expected course of illness and disease burden. Previous cross-sectional studies suggest a relation between aberrant structural brain development and emotional problems. However, to identify whether trajectories of brain development across adolescence relate to the emergence of emotional problems, longitudinal studies are pivotal. Here, I will present data from a longitudinal study examining the relation between structural brain development with depression and externalizing behavior. **METHODS:** The presented studies are part of a large-scale accelerated

longitudinal research project, BrainTime. 299 participants were recruited from a community sample that underwent magnetic resonance imaging during three bi-annual waves, spanning 5 years across 8-29 years. Emotional problems were assessed with Beck Depression Inventory and the Child Behavior Checklist. Multilevel models and maturational coupling analyses were used to assess the relation between structural brain development and emotional problems **RESULTS:** The emergence of depressive symptoms was associated with accelerated corticial thinning, specifically in frontal areas. Hippocampal volume was negatively associated with externalizing behavior. Exploratory maturational coupling analyses showed a relation between externalizing behavior and synchronous development between striatum, limbic system, and prefrontal regions. **CONCLUSIONS:** I will discuss the differential relation between development of cortical thickness and cortical surface area on depressive symptoms and externalizing behavior. Importantly, our data emphasizes that developmental trajectories seem key to gain more detailed understanding of the neurobiological mechanisms related to the emergence of emotional problems during adolescence

Brain-predicted age associates with psychopathology dimensions in youth

Vanessa Cropley[1], Ye Tian[1], Kavisha Fernando[1], Sina Mansour[1], Christos Pantelis[1], Luca Cocchi[2], Andrew Zalesky[1]

[1]The University of Melbourne, [2]QIMR Berghofer Medical Research Institute

BACKGROUND AND AIM: Psychiatric symptoms in childhood and adolescence have been associated with both delayed and accelerated patterns of grey matter development. This suggests that deviation in brain structure from a normative range of variation for a given age might be important in the emergence of psychopathology. This study investigated whether variation in psychopathology in youth is related to a novel index of neurodevelopment called the brain age gap, and to determine whether these psychopathology constructs share common neurodevelopmental profiles. **METHODS:** Psychiatric symptom ratings from 9312 youths (8-21 years) from the Philadelphia Neurodevelopmental Cohort were parsed into 7 independent dimensions of clinical psychopathology representing conduct, anxiety, obsessive-compulsive, attention, depression, bipolar, and psychosis symptoms. Using a subset of this cohort with structural MRI (n=1313), a normative model of brain morphology was established and the model was then applied to predict the age of youth with clinical symptoms. We investigated whether the deviation of brain-predicted age from true chronological age, called the brain age gap, explained individual variation in each psychopathology dimension. **RESULTS:** Individual variation in the brain age gap significantly associated with clinical dimensions representing psychosis ($t=3.16$, $p=0.0016$), obsessive-compulsive symptoms ($t=2.5$, $p=0.01$), and general psychopathology ($t=4.08$, $p<0.0001$). Greater symptom severity along these dimensions was associated with brain morphology that appeared older than expected for typically developing youth of the same age. Psychopathology dimensions clustered into two modules based on shared brain loci where putative accelerated neurodevelopment was most prominent. Patterns of morphological development were accelerated in frontal cortices for depression, psychosis and conduct symptoms (Module I), whereas acceleration was most evident in the subcortex and insula for the remaining dimensions (Module II). **CONCLUSIONS:** Our findings suggest that increased brain age, particularly in frontal cortex and subcortical nuclei, underpins (sub)clinical psychosis and obsessive-compulsive symptoms in youth. Our results suggest that deviations in normative brain age patterns in youth may contribute to the manifestation of specific psychiatric symptoms of subclinical

severity that cut across psychopathology dimensions. Psychopathology dimensions share common neural substrates, despite representing clinically independent symptom profiles.

Development of the neural correlates of emotion regulation in adolescents with and without conduct disorder

Nora Raschle[1], Lynn Fehlbaum[1], Réka Borbás[1], Christina Stadler[1], FemNAT-CD consortium[1]
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Background: Conduct disorder (CD) is a psychiatric disorder of childhood and adolescence characterized by severe aggressive and antisocial behavior. Behavioral evidence strongly suggests that emotion processing and regulation deficits are key features of CD. First fMRI evidence indicates alterations in brain regions which form the emotion regulation brain network in CD females compared to typically developing controls (TD). **Methods:** To date, we employed fMRI during emotion regulation in >200 adolescents (average age 14y; range=9-18y) with a diagnosis of CD (N=94; 70 females) as well as TD controls (N=109; 71 females) as part of the FemNAT-CD project. Additionally, a small subgroup of female CD adolescents further participated in a group-based behavioral skills training (START NOW) and was invited for an MRI session prior to and post treatment. **Hypothesis & Preliminary Findings**: Preliminary findings based on region of interest analyses for areas associated with emotional reactivity (e.g., limbic brain regions) and emotion regulation (e.g., prefrontal brain regions, angular and temporal gyrus) indicate reduced activation during emotion regulation in adolescents with CD compared to TD controls. Furthermore, we expect regionally specific linear and non-linear functional changes across age. These may differ across sex and diagnosis. Finally, we hypothesize that girls with CD who improved from the START NOW training (therapy responder) showed amelioration in the neuronal correlates of emotion regulation. This may be mirrored by increases in neuronal activation of emotion regulation areas of the brain previously found to be disrupted in CD (e.g., prefrontal cortex and angular gyrus). **Significance:** An increased understanding of the development and neuronal correlates of emotion regulation across adolescence will complement past neuroimaging work in healthy youths and add to our understanding of affective disorders in childhood and adolescents, such as CD, ultimately informing diagnosis and treatment.

The impact of parental presence on a neural marker of anxiety (the error-related negativity) in 5 to 7 year-old children

Alexandria Meyer[1]
[1]Florida State University

BACKGROUND AND AIM: Anxiety disorders often begin early in life and result in chronic impairment. Thus, there is substantial interest in identifying neural markers that characterize trajectories characterized by anxious outcomes. A neural marker, the error-related negativity (i.e., ERN), has been linked to anxiety and risk for anxiety in adults and children in over 50 studies to date. Thus, there is an increasing interest in identifying environmental factors that may shape the ERN early in development. Previous work suggests that harsh parenting styles may relate to an increased ERN in offspring. However, no study had yet examined the specific mechanism whereby parenting style may impact the ERN in children. We propose that it may be children's repeated exposure to making mistakes in the presence of their caregiver that may lead to an increased ERN. **METHODS:** We test this hypothesis by measuring the ERN in 79 children between the ages of 5 - 7 years old while their parent observed them

complete a go/no-go task and then while an experimenter observed them complete a go/no-go task. **RESULTS:** Results suggest that the presence of parents characterized by a controlling parenting style potentiated the ERN in their children. Furthermore, the extent to which parents potentiated the ERN in offspring compared to an experimenter, related dimensionally to controlling parenting styles. **CONCLUSIONS:** These findings are important and novel insofar as they highlight the impact of an environmental factor (i.e., parenting) in shaping a neural marker of risk for anxiety in children (i.e., the ERN). Future work should examine whether novel parent-based intervention strategies may reduce the ERN in children early in development, and thus reduce risk for anxiety.

Symposium: Elucidating relationships among neurodevelopment in utero and infancy and future childhood behavioral outcomes

Chair: Mary Phillips, *University of Pittsburgh*

Predictive relationships in infants among emotional regulation white matter and resting state functional connectivity and concurrent and future emotional behavior

Mary Phillips[1], Alison Hipwell[1], Layla Banihashemi[1], Vincent Schmithorst[1], Lindsay Hanford[2], Ashok Panigrahy[1]

[1]University of Pittsburgh, [2]Harvard University

Introduction: Dramatic gains in emotion regulation occur in the first years of life. Positive and negative emotionality(PE, NE) can be measured reliably in human infants in the first months, and predict future behavioral and emotional regulation-related impairments: depression, anxiety, suicidal behavior, behavior problems and substance abuse. Elucidating the neural bases of infant PE and NE can elucidate pathophysiologic processes of risk for future problems, and provide objective neural markers to help identify at-risk infants before symptoms emerge. **Methods.** Study 1: In 20, 3-month infants, we examined white matter in tracts connecting prefrontal and temporal regions supporting emotional regulation: uncinate fasciculus(UF), cingulum bundle(CB) and forceps minor(FM). Penalized and multiple regression (demographic, clinical covariates) examined predictive relationships among tract volume, normalized quantitative anisotropy(NQA), QA and fractional anisotropy(FA) at 3 months and infant PE and NE at 9 months, using independently-coded, filmed infant behaviors. Study 2: In 59, 3-month infants, multiple regression examined relationships among infant wholebrain resting state functional connectivity(rsfc) during sleep (voxelwise mean connectivity strength) and standardized reports (Infant Behavior Questionnaire) of infant PE and NE. Study 3: In 46, 3-month infants, we examined wholebrain rsfc during sleep, using graph theory to examine nodal metrics of neural network function, relationships among these metrics and infant PE and NE, and moderating effects of parental negative, positive and mental state talk(MST) caregiving on these relationships, using independently-coded filmed interactions of infant and caregiving behaviors. **Results.** Study 1: UF NQA(ß=-0.631 p=0.005), FM FA(ß=-0.619,p<0.001), maternal postnatal depression(ß=-0.592,p<0.001), UF volume(ß=0.383,p=0.002) and infant age(ß=0.259,p=0.018) significantly(FDR-corrected) predicted 9-month NE. Study 2: Medial prefrontal cortical mean connectivity strength positively associated with 3-month NE; lateral prefrontal-parietal cortical mean connectivity strength inversely associated with PE(p<0.05,FWE). Study 3: Higher parental MST strengthened relationships among infant PE and prefrontal and occipital cortical nodal

metrics(p<0.0001,FDR). **Conclusion.** The relationship between 3-month UF structure and 9-month NE highlights the key role of this tract in emotional regulation, and parallels reports of lower UF integrity in mood disorder at risk youth. Wholebrain 3-month rsfc findings suggest compensatory recruitment of emotional regulatory prefrontal cortical regions with NE but not PE, while parental MST strengthens links between emotional regulatory prefrontal cortical neural circuitry and PE. Our findings provide objective neural markers to help identify at-risk infants, and guide and monitor caregiving-based interventions to help reduce risk for future emotional problems in these infants.

The white matter connectome as an early imaging biomarker

John Gilmore[1], Maria Bagonis[1], Jared Williams[1], Rebecca Stephens[1], Emil Cornea[1], Martin Styner[1], Brent Munsell[1]

[1]University of North Carolina

BACKGROUND AND AIM: The identification of early imaging biomarkers is important for the identification of children at risk for sub-optimal cognitive and behavioral outcomes. The relationship of region of interest or white matter tract with later outcomes is typically modest. As it is becoming clearer that the brain substrates for cognitive functions and behaviors are widely distributed, whole brain network approaches offer the promise of improved predictive ability. We studied the development of the white matter (WM) connectome from birth to age 6 and its relationship with cognitive development and anxiety and attention problems. **METHODS:** Children from the UNC Early Brain Development Study underwent 3T MRI imaging at birth and at ages 1, 2, 4, 6 years and were assessed with the Stanford Binet and BASC parent report at ages 4 and 8 years. A deep learning model was applied to the WM connectome focusing on hub eigenvector centrality metrics at age 4 years to determine relationships with IQ, and attention and anxiety problems at ages 4 and 8 years for 59 singletons and 80 individual twins. **RESULTS:** Eigenvector centrality for WM hubs is fairly stable from age 1 to age 6 years, and regional eigenvector centrality at 1 year and 6 years is highly correlated (r^2 =0.79). Hub values in the WM connectome at age 4 significantly predicted IQ at both age 4 (mean r^2: singleton 0.82, twin 0.74) and 8 years (mean r^2: singleton 0.79, twin 0.72). 16 of the top 20 hubs important for prediction were the same for IQ at 4 and 8 years. Similar strong results were found for attention and anxiety problems, with mean r^2 ranging from 0.60-0.71. Hubs important for prediction of attention or anxiety problems at age 4 were similar at age 8 as well. **CONCLUSIONS:** Many aspects of the WM connectome are established very early in childhood. The WM connectome at age 4 can predict IQ, attention and anxiety problems at age 8 with fairly high accuracy. The WM connectome in early childhood is a candidate imaging biomarker that deserves further study.

Intrauterine amygdala neural connectivity predicts autism spectrum disorder (ASD) traits in toddlerhood

Moriah Thomason[1], Christopher Trentacosta[2], S. Alexandra Burt[3], Autumn Austin[1], Natalie Brito[1]

[1]New York University, [2]Wayne State University, [3]Michigan State University

Core systems of the brain are established prior to birth and are foundational to infants' emerging developmental competencies. Here, we will address whether prenatal amygdala network connectivity relates to degree of autism spectrum disorder (ASD) symptomology in a neurotypical sample of children. We will further examine sex differences and also prenatal stress as factors that may influence this association. In particular, we hypothesize that ASD dimensions in toddlers will relate to measures of

reduced amygdala functional connectivity when they were in the womb. Based on prior literature, we will also test the hypothesis that this relationship will be stronger in females and in children of mothers that report higher levels of perinatal stress. These predictions fit well with a recent report by Lee and colleagues (2020) of amygdala connectivity differences in children with ASD at ages 2-7 years. In fact, the amygdala is widely implicated in the neurobiology of ASD, with reports of increased volume, quantity of neurons, and functional differences in individuals with ASD. Our approach will be to measure resting-state functional connectivity data in more than 100 healthy human fetuses during the second and third trimesters and to subsequently evaluate Brief Infant Toddler Social Emotional Assessment (BITSEA) and the Child Behavior Checklist (CBCL) autism subscales at child age 3. If confirmed, these observations would extend prior longitudinal research back into prenatal brain development and raise exciting new ideas about the advent of risk and the ontogeny of early sex differences.

Salience network functional connectivity relates to electrophysiological markers of attention in infancy

Nathan Fox[1], Courtney Filippi[1], Santiago Morales Pamplona[1], George Buzzell[1], Maya Bracy[1], Sanjana Ravi[1], Stephanie Leach[1], Daniel Pine[2]
[1]University of Maryland, [2]NIMH

The salience network involves brain regions (e.g., insula, anterior cingulate cortex) linked to rapid detection and organized responding to salient stimuli. Salience network function has been involved in temperamental negative affect and increased risk for anxiety. The current study evaluates the link between salience network fMRI connectivity during resting state and electrophysiological responses to novelty in 4- to 5-month-old infants (Mage=4 months 26 days). In this study, we utilized fMRI to quantify functional connectivity (rs-fc) during natural sleep (n=27; Median data post scrubbing=9 minutes 22 seconds). fMRI data were processed using the CONN toolbox (Whitfield-Gabrieli & Nieto-Castanon, 2012) with adaptations suitable for infants. To isolate activity driven by the salience network, independent components analysis was conducted and the salience network identified. Within two weeks of the fMRI visit (Mtime elapsed=13 days), infants returned to the lab to complete an auditory oddball task while high-density EEG was recorded (n=27). EEG data were processed using a standardized pre- and post-processing pipeline for developmental data (MADE, Debnath et al, 2020). In line with prior work (Marshall et al., 2009), neural responses to deviant stimuli were extracted at a central electrode cluster (Cz) for subsequent analyses. Focal analyses extracted the time series for the salience network and examined connectivity associated with the ERP response (controlling for age). These whole brain voxel-wise analyses were thresholded voxel-wise at $p<.001$ and cluster corrected at $p<.05$ using non-parametric permutation method. Results indicated that heightened response to the deviant was associated with increased salience network-medial prefrontal cortex connectivity and decreased salience network-superior frontal cortex connectivity.

Symposium: Oh behave! Individual differences in the development of social behavioral control

Chair: Michelle Achterberg, *Erasmus University Rotterdam*
Moderator: Eveline Crone, *Erasmus University Rotterdam*

Functional brain networks underlying multiple facets of behavioral control in middle childhood: A within study replication approach

Michelle Achterberg[1], Eduard Klapwijk[1], Anna van Duijvenvoorde[2]

[1]Erasmus University Rotterdam, [2]Leiden University

AIM: Theoretical perspectives have suggested that the increase of executive functions and maturation of the prefrontal cortex during childhood are important mechanisms for developing self-regulation functions in childhood. Most of these studies have focused on 'cool' behavioral control, that is to say self-control in a non-emotional setting. Whether the same 'cool' regulatory control functions are also important for regulation of 'hot' emotional behavior in a social context is far less studied and it is currently unknown whether these rely on similar or distinct brain networks. **METHODS:** In this study we aim to investigate different forms of behavioral control and whether they rely on similar or distinct brain networks. These questions will be examined using data from the L-CID middle childhood cohort (n=512, 7-9 yo children). We focus on three behavioral control facets: "cool" response inhibition; "hot" aggression regulation following social rejection; and general effortful control. **RESULTS:** Behavioral results showed no significant correlation between the 'hot' social aggression regulation and 'cool' response inhibition measure. The general effort control measure showed a significant, but small correlation with response inhibition (r=-.14, p=.002), indicating that the different forms of behavioral control measure distinct behaviors. We are currently conducting independent component analyses using resting-state fMRI to investigate four components of interest: the right and left fronto-parietal networks (FPN), the default mode network (DMN) and the salience network (SN), and their relations to behavioral control. We expect that connectivity in the DMN and the SN is specifically related to 'hot' aggression regulation. Whereas FPNs are expected to relate to effortful control and response inhibition. We aim to replicate our findings in an independent sample of same-aged children (n=360) that used the same study protocols, in order to test the replicability and robustness of our findings.

Distinct functional connectivity patterns for internalizing and externalizing behaviors in youth with and without developmental disorders

Dienke Bos[1], Maaike Oosterling[1], Bob Oranje[1], Sarah Durston[1]

[1]UMC Utrecht Brain Center

BACKGROUND AND AIM: Autism Spectrum Disorder (ASD) and Attention Deficit/Hyperactivity Disorder (ADHD) are the two most common developmental disorders and are characterized by high rates of co-occurrence, both in terms of symptoms and self-regulation. Previous behavioral work showed context-specific individual differences in self-regulation towards social or non-social stimuli in children with ASD and/or ADHD. These problems in self-regulation may arise through differences in salience processing and behavioral control, and their interaction. Here we investigate these abilities in children with ASD and ADHD, in relation to the brain networks that support them. **METHODS:** 313 Children (ages 6-18 years) with ASD and/or ADHD or without any history of developmental disorders participated in a 10-minute resting-state fMRI session and parents completed symptom rating questionnaires (Child Behavior Checklist (CBCL) and Repetitive Behavior Scale - revised version (RBS-r). We used Sparse Canonical Correlation Analysis (sCCA) to investigate the relation between severity of psychiatric symptoms and whole-brain functional connectivity (264-node parcellation). Further behavioral and developmental effects were assessed in a mixed cross-sectional and longitudinal design. **RESULTS:**

Results showed two canonical variates that showed distinct associations between psychiatric symptoms and resting-state functional connectivity. First, internalizing, social and anxious/depressed problems were related to hypoconnectivity within DMN, and connectivity changes between DMN and dorsal attention network regions. Second, externalizing, inattentive and aggressive behavior was associated with increased connectivity within DMN, and between DMN and salience-, frontoparietal executive control- and ventral attention network regions. **CONCLUSIONS:** The findings showed distinct patterns of functional connectivity in DMN and the salience network, associated with social and non-social self-regulation problems that cut across diagnostic categories in children with and without developmental disorders. Due to COVID19-related delays, behavioral and developmental findings will only be presented at the meeting.

Neural representations of close others and links to social decision preferences in late adolescence

Joao Guassi Moreira[1], Lisa Johnson[2], Sarah Tashjian[3], Paul Hastings[2], Adriana Galván[1], Jennifer Silvers[1]
[1]University of California, Los Angeles, [2]University of California, Davis, [3]California Institute of Technology

Social goal pursuit over the course of adolescence often requires that individuals navigate trade-offs. One such particularly salient type of trade-off involves making decisions that have opposing consequences for different people. Recent work has indicated that adolescents are likely to prioritize parents over peers in social decision-making scenarios. While we know who adolescents prioritize during social decision-making, it is unclear why. One hypothesis is that neural representations of parents and friends are differentially encoded as neural signatures of value, suggesting that accessing said representations during social decision-making relies on spontaneous and intrinsic value-based calculations that in turn guide behavior. To test this possibility, we scanned a sample of 47 late adolescents (ages 18-19) with fMRI. Participants viewed custom stimuli related to a parent and friend in order to elicit neural representations of each close other. Next, they completed a reward task in the scanner to help build a sensitive and specific neural signature of value. Finally, participants completed an out-of-scanner social decision-making task that pit parent and friend outcomes against one another. Preliminary findings indicate that the parent/friend representation and reward tasks were successful in eliciting the desired neural activity. Behavioral results replicate prior findings showing a preference to favor parents over friends. Pattern expression analyses in conjunction with multilevel logistic regression will be used next to determine the extent to which value-based neural representations influence social decision preferences.

Neural correlates of the impact of reward history on untrained tasks

Kristin Meyer[1], Joseph Hopfinger[1], Charlotte Boettiger[1], Margaret Sheridan[2]
[1]University of North Carolina, [2]University of North Carolina at Chapel Hill

Background: The ability to guide behaviors and allocate cognitive resources in service of goals or rules, termed cognitive control, is an integral part of daily activities. Cognitive control in "cold" contexts has been well-researched and has wide-reaching implications for a range of risk-taking behaviors and psychopathology. However, the cognitive control exhibited across risk-taking and psychopathology is often in a motivationally salient context, which is much less well understood. This is in large part due to a dearth of studies that investigate the specific impact of motivational history on cognitive control abilities. The present study aims to address this gap by manipulating motivational history of otherwise neutral stimuli and then testing the impact of this manipulation on attentional control, a well-

researched form of cognitive control. **Methods:** Adults (N = 27, Ages 22 - 40) underwent fMRI scanning during both the reward-association phase and the unrewarded testing phase. This study is the first of its kind to examine how individual variation in reward response, as measured by striatal activity, predicts both the effects of reward history on cognitive control performance and on neural activity while engaging cognitive control. We find that striatal activity during reward association predicts the degree to which attentional control is later disrupted by reward history and the neural response to reward history in visual cortical and attentional control regions. Furthermore, we examine differences in this predictive power when bias due to reward history and cognitive control align or are at-odds. **Results:** This study provides preliminary support that reward history of a stimulus is associated with changes in activation of the vmPFC during the novel testing task where no reward is present. Taken together this study suggests that reward history does bias attentional control through learning-induced changes in visual and parietal activity. **Discussion:** Furthermore, overcoming this bias may require both instantaneous top-down suppression to filter a distractor associated with reward history along with value updating over time to re-establish the stimulus with a reward history as once again neutral and reduce automatic biasing. Elucidating the neural correlates of reward history's impact on neural and cognitive recruitment in an untrained task informs our understanding of previously rewarding cues, such as in the case of addiction.

Poster Abstracts

Poster Session 1

Thursday September 10, 2020

A – Executive functioning

1-A-1 Longitudinal analysis of Stop Signal Task performance in late adolescence and early adulthood

Hannah Weiss[1], Paul Collins[1], Brandon Almy[1], Monica Luciana[1]

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Background: Dual systems models propose that in adolescents, the socioemotional-incentive processing system functions more robustly than the cognitive control system, and that this difference increases vulnerability to risk-taking and impulsive behaviors. Various versions of these models suggest different shapes of developmental change, with quadratic, linear, and inverse age functions potentially characterizing the development of these systems into early adulthood. Inhibitory control, the ability to voluntarily suppress motor response tendencies, is an essential aspect of cognitive control. To date, few studies have examined the development of response inhibition longitudinally in adolescence and early adulthood. **Methods:** Inhibitory control (Stop Signal Reaction Time (SSRT)) and response speed (Go Reaction Time (GoRT)) were estimated with the Stop-Signal Task. Data from 147 typically developing participants (overall age range 11-32 years) were collected across four timepoints of a longitudinal study, with each timepoint about 2 years apart. Linear, quadratic, and inverse age functions of SSRT and GoRT were tested with linear mixed effects models. Additional models tested possible gender and intelligence effects on task performance and developmental trajectories. **Results:** Go Reaction Times were best fit by a quadratic curve with performance peaking in early adulthood. Stop Signal Reaction Times were best fit by an inverse age function, and there was an interaction effect of sex on age, with males showing delayed development compared to females. **Discussion:** This study expands on previous research by showing continued developmental changes in SSRT and GoRT from adolescence into early adulthood. Future research will explore the neural correlates of the development of response inhibition in adolescence and early adulthood.

B – Socioemotional processing

1-B-2 Anxiety and neural responses to ambiguous social stimuli during the transition to college

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The tendency to evaluate ambiguous events negatively has been associated with anxiety disorders (Carleton et al., 2012). Conversely, positive evaluations of ambiguity may promote flexible interactions with unfamiliar situations and confer resilience to anxiety. Ambiguity tolerance may be particularly

adaptive during late adolescence and the transition to adulthood, when humans encounter novel challenges and navigate new social spheres. The present study sought to examine whether behavioral and neural evaluations of social ambiguity predict anxiety levels during the first year of college. In the present study, participants were longitudinally assessed for anxiety at three timepoints, each one month apart, during their first year of college (N = 101). A subset of participants underwent a neuroimaging portion of the study (N = 40). During the scan session, participants viewed threatening (angry), nonthreatening (happy), and ambiguous (surprised) faces while in the scanner. Outside of the scanner, participants were presented with the same stimuli and categorized the faces as positive or negative. After controlling for the time of year at assessment and number of trials, preliminary analyses demonstrate no association between how participants categorize ambiguous faces and their baseline anxiety ($t(36) = -0.426$, $p = 0.673$) or between their categorizations and changes in anxiety between the first two time points ($t(35) = -0.053$, $p = 0.958$) after controlling for baseline anxiety. Data collection is ongoing, and our future analyses will incorporate single trial estimates using multivariate approaches to examine whether (1) similarity in patterns of amygdala responses to threatening and ambiguous faces can predict later trial-by-trial categorizations of the stimuli and (2) if the degree of neural response similarity to ambiguous and threatening faces relates to baseline anxiety and changes in anxiety during the first year of college.

1-B-3 Neural systems supporting cognitive emotional regulation by young children in fMRI using a novel EEG-based task paradigm

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OBJECTIVE: Emotional regulation (ER) is key to healthy development. Cognitive reappraisal is a highly effective ER strategy commonly taught in therapeutic interventions. Neural correlates of reappraisal are well established in adults1 and adolescents2, yet poorly understood in young children. This is due to the lack of developmentally appropriate methods. **METHODS:** A novel paradigm involving directed reappraisal with caregiver participation has been developed to study ER in young children using EEG3. Here we adapt this paradigm for application in fMRI. Children view images preceded by a descriptive auditory story and followed by an emotion rating screen. The four conditions are neutral, look negative (negative image paired with negative story), and reappraisal (negative image with reappraisal story from the caregiver or a stranger). Participants included 42 children (19 female), ages 4 to 8 years (M=5.57, SD=0.77) with one caregiver per child (95.2% mothers). **PRELIMINARY RESULTS:** Participants felt more negative ($p<.01$) towards negative images compared to neutral. Participants also felt less negative ($p<.01$) during reappraisal conditions compared to look negative. Children who self-reported feeling less distress when simply looking at negative images were rated as more emotionally labile4 by their caregivers (trend significance; $r=0.23$). Next we will compare participants' BOLD response across conditions. We expect, consistent with previous research in older children and adults, to see more prefrontal activation during reappraisal conditions compared to look negative and more amygdala activation to look negative compared to all other conditions. **CONCLUSIONS:** Preliminary results suggest that directed reappraisal is effective in reducing negative emotions even in young children but that the method by which reappraisal is achieved differs substantially from methods used in older children, adolescents, and adults.

1-B-4 An ERP investigation of pubertal development, age, and emotional reactivity among children and adolescents

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Objectives: Puberty is thought to be associated with increased emotional reactivity (ER). Studies examining this relation tend to focus on either self-report or neuroimaging techniques. The purpose of this ERP study was to examine the association of pubertal development and age with both self-report and neural measures of ER among children and adolescents. **Methods:** 215 participants, aged 8-15, completed the Pubertal Development Scale and the ER Scale. They also completed an EEG session, consisting of a computer task to assess slow wave ERP responses to angry and neutral faces. **Results:** Given sex differences in pubertal development and ER, analyses were done separately for males and females. First, a regression was conducted using the self-report data with ER as the criterion and pubertal status, age, and parental education as predictors. The analysis was not significant for males, $F(3, 100) = 2.94$, $p = .111$, but significant for females, $F(3, 107) = 3.47$, $p = .019$. For females, age was the only significant predictor, $t = 2.517$, $p = .013$, with higher age associated with greater ER. For the ERP analysis, participants were divided into two groups (low vs high ER) using a median split of their self-report scores. An ANOVA, conducted separately by sex, revealed a significant 2 type (anger vs neutral faces, within-subjects) x 2 condition (low vs high ER, between-subjects) interaction for the slow wave amplitude, $p < .05$. For both males and females, amplitudes were larger for angry faces in the high ER condition than in the low ER condition. There were no differences for neutral faces. Pubertal status and age did not predict amplitudes for either males or females. **Conclusions:** These results suggest that pubertal development is not significantly associated with ER for either males or females, as defined by both self-report and neural measures. This study also confirmed that those reporting high ER do show greater neural responses to emotional faces than those reporting lo

1-B-5 Age-related changes in negative affective experience in childhood and adolescence

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Studies show that among healthy adolescents, there is a sharp increase in the frequency of daily negative affect and this normative change is paralleled by increasing risk for the onset of mental illness. However, few studies have examined qualitatively different types of negative affective experience beyond the positive-negative valence dimension. In the current study, we explore the age-related changes in different types of negative affective experience across late childhood and adolescence. 716 participants aged 8-16 completed the NIH toolbox emotion module, the behavioral inhibition and behavioral activation scales, and the Kiddie Schedule for Affective Disorders and Schizophrenia semi-structured interview. Items that assessed a wide range of self-reported negative affective experience were extracted from these measures. A factor analysis was conducted and revealed a 4-factor solution, with factors reflecting worry, anger, evaluative anticipation, and sadness. To explore age-related changes in these negative affect factors, null, linear and generalized additive models (GAM) were conducted and compared using Akaike Information Criterion (AIC) values. For worry, evaluative anticipation, and sadness, the spline models were found to be the best fit and thus these factors demonstrated non-linear changes with age (worry: p=.004; evaluative anticipation: p<.001; sadness:

p<.001). Sadness and evaluative anticipation largely increased in late adolescence, whereas worry showed a slight "U" shape with lower levels of worry around ages 12 and 13. For anger, no significant age-related changes were found (p=.172). These results suggest that different types of negative affect have distinct age-related changes during the adolescent transition period. Therefore, examining negative emotional experience in this detailed way may help refine theories of emotional development and ultimately better understand windows of risk for psychopathology.

1-B-7 Examining neural and behavioral correlates of negative self and social evaluation in adolescent girls

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Prior research has examined fear of negative evaluation in the context of social anxiety, with the impact it has on self-referential processing and social evaluation being largely understudied. To examine this gap in literature, we utilized a self and social evaluative task that was administered to a sample of adolescent girls (N = 70). In this task, participants were asked to create a three-minute introduction video where they describe themselves. These videos were later cut into short 10-20 second clips. Additionally, participants were told that "another girl" (a confederate) their age had created a similar video and while they are in a MRI scanner, their screens would either be connected with the other girls', meaning they would both be watching the same clip at the same time, or their screens would be disconnected, meaning they would be watching their own clips. Participants were also asked to complete a questionnaire that measures fear of negative evaluation and a brief questionnaire asking what they thought of their own video. This study looks at the association between fear of negative evaluation and change in neural activity when the "other girl" and participant are both viewing the participants' video compared to when the participant is viewing their own video. We expect a difference in activation of cortical midline structures (CMS) between these two conditions, with the magnitude of this contrast being explained by individual differences in fear of negative evaluation. While we specifically expect to see differences in CMS, we will perform a whole-brain exploratory analysis to extract group-level ROIs that reflect differences in self vs. other evaluation. These ROIs will be interrogated to look at individual differences in the correlation between fear of negative evaluation and mean BOLD response. Understanding the difference in neural mechanisms between social and self-evaluation has implications for adolescent emotional and psychosocial development.

1-B-8 Motor functioning in childhood differentially predicts externalizing and internalizing outcomes in girls and boys

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Motor function is often impaired in children with externalizing (EXT) disorders, such as ADHD, and internalizing (INT) disorders, such as anxiety. Sex differences in motor function, as well as in INT and EXT disorders, have been reported. However, there is a lack of research on sex differences in the longitudinal relationship between motor impairment in childhood and INT and EXT outcomes in adolescence. Our study applied a dimensional approach to examine this among a sample of typically- and atypically-

developing children (n=112; 78 boys; 59 ADHD). All children had two time-points of data separated by at least 2 years: the first (T1) between ages 8-12, and the second (T2) between ages 12-17. Partial-correlation analyses tested whether impaired motor function at T1 (measured by Physical and Neurological Examination of Subtle Signs [PANESS]: higher score indicating impairment) predicted higher EXT and INT scores at T2 (measured by Behavior Assessment for Children, Second Edition, parent-report: higher T-scores indicating greater problems). Analyses were run separately for girls and boys, and controlled for: baseline EXT/INT scores at T1, age at T2, and difference in age between time-points. Results showed that, in boys, T1 PANESS did not predict T2 EXT scores after partial correlations (r=.153, p=.191), due to the significant baseline relationship between PANESS and T1 EXT scores (r=.486, p<.001). Additionally, in girls, T1 PANESS did not predict T2 EXT scores (r=-.068, p=.717), despite being associated with T1 EXT scores (r=.498, p=.003). In contrast, T1 PANESS significantly predicted T2 INT scores, in boys only (r=.258, p=.025), even after controlling for T1 INT scores. These findings reflect a predictive relationship between motor impairment and internalizing disorders in boys. Future research could examine whether specific motor skills differentially predict symptom trajectories among boys and girls.

1-B-9 Context matters: Developmental changes in threat representation in perceptual and affective neural circuitry

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Developmental changes in threat generalization may contribute to anxiety among youth (Glenn et al., 2020). However, little is known about whether individual differences elicited in social contexts are similarly elicited in non-social ones. Further, few studies have investigated whether perceptual similarly underlies threat generalization. We used representational similarity analysis in conjunction with fMRI to (1) explore perceptual and affective substrates underlying threat generalization, (2) assess the reliability of representations across social vs non-social contexts, and (3) examine differences across development. Twenty adults (M = 25.8 ± 5yrs) and 16 youth (M = 14.1 ± 2yrs) completed two differential conditioning paradigms: one paired a color bell with an alarm while the other paired a neutral face with a scream. Three weeks later, participants underwent an fMRI extinction recall task, during which they viewed the extinguished threat cue (CS+), safety cue (CS-), and generalization stimuli (GS) consisting of CS-/CS+ blends. Multivoxel BOLD signal patterns were measured in emotion-related (vmPFC, amygdala, dACC, anterior insula) and perceptual brain areas (inferior temporal cortex, V1 visual area). Preliminary analyses (n=27) revealed a task x ROI x age interaction ($F(5, 125) = 2.40$, $p = .04$). Across contexts, youth showed greater amygdalar GS-CS+ pattern differentiation than adults ($t(25) = 2.98$, $p = .006$) Youth also evidenced greater differentiation for social threat, specifically, in V1 ($t(25) = 2.68$, $p = .01$). These preliminary data point to the intriguing possibility that perceptual acuity for socially-relevant visual generalization stimuli declines with age, akin to what is observed for phonological discrimination across development at younger ages (Werker & Tees, 1984). If replicated, this may have important implications when considering timelines for anxiety treatment. Final analyses will test the full sample and compare across anxiety levels.

C - Learning

1-C-10 Developmental differences in model-based learning and abstract reasoning: an online replication study

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Moving research from the lab to an online environment makes it possible to more easily recruit a large and diverse sample of participants. To date, it is unclear whether remote, browser-based experiments examining value-based decision making in developmental samples can yield high quality data, since most online studies have tested adults. In this online study, we attempted to replicate findings from previous in-lab developmental value-based decision-making studies. We recruited 151 8- to 25-year-olds, who first completed Decker et al.'s (2016) version of the two-step sequential decision-making task, designed to dissociate model-free (reflexive trial-and-error) and model-based (flexible goal-directed) choices. We replicated previous findings showing that model-based decision-making increased with age. Developmental improvements in fluid reasoning have been found to mediate the relationship between age and model-based decision-making (Potter et al., 2017). We used a novel matrix reasoning item bank (MaRs-IB; Chierchia et al., 2019) to index fluid reasoning ability. Overall MaRs-IB accuracy was lower in our online sample than in previous in-lab findings, however we replicated previous findings of an age-related increase in fluid reasoning accuracy. Moreover, providing evidence that the MaRs-IB task reliably assessed abstract reasoning, in a subset of participants who previously completed an in-lab study, MaRs-IB accuracy correlated with their scores on a validated matrix reasoning scale (WASI-MR). Finally, we replicated the Potter et al. finding that fluid reasoning ability mediated age-related increases in model-based choice. Our results suggest that developmental experiments conducted online can replicate findings from in-lab studies. Insights into the process of conducting these replications will likely be of value to other researchers, specifically in developmental cognitive science.

1-C-11 Understanding the roles of novelty and uncertainty in exploration across development

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The way individuals learn from their environment changes with age and experience, with younger children tending to exhibit more random and exploratory behaviors. The goal of this study was to understand how exploration during learning changes across development. We used a decision-making task in individuals ages 8 to 27 to assess developmental differences in exploration versus exploitation. To better understand motivators underlying exploratory behaviors, we included conditions that could quantify the degree to which exploration was influenced by both uncertainty and novelty. Finally, we included a post-learning memory task to test how the reward structures participants learned may have influenced their memory. We used reinforcement learning modeling framework including parameters capturing the influence of uncertainty, novelty, and horizon on trial-by-trial learning. Parameters were recoverable in simulated data. In our preliminary data, we found that participants tended to avoid options with greater uncertainty, especially as the task progressed. In contrast, participants were more likely to choose novel options despite uncertainty being high. Developmental data collection is ongoing and results will be discussed. Taken together this work helps uncover drivers of exploratory behavior during learning.

D – Rewards/Motivation

1-D-13 Dynamic neural integration and risky decision-making across development

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Decision-making under risk is characterized by stochasticity and probabilistic contingencies. These features are particularly important for understanding the development of risk-taking, as children and adolescents use heuristics that rely heavily on contextual information to make decisions. It is therefore imperative to understand how the dynamics of the developing brain adapt from an intrinsic state to a task state in order to meet decision making demands. We addressed this question in a sample of 44 youth (MeanAge=15.6, SD=3.6) by estimating the brain's intrinsic state at rest with fMRI and measuring how much it changes during risky decision making. Participants completed resting state and a risk-taking task in-scanner, and an independent out-of-scanner risk-taking task. Resting state data were used to derive each participant's intrinsic neural state by extracting timeseries of 100 Regions of Interest (ROI) across 7 networks, performing Principle Components Analysis (PCA) on said ROIs, and using matrix algebra to estimate the low-dimensional manifold which defined a given participant's intrinsic neural state. ROI timeseries from the scanner risk-taking task were then projected onto the manifold, and the distance between projected and actual points were used to capture neural dynamics. Mixed-effect models estimated trial-level associations between task-related neural dynamics and out-of-scanner risky behavior. Our model showed that greater changes to task from the intrinsic state predicted more risk-taking and greater sensitivity to reward during out-of-scanner risk taking. These findings suggest that the brain's propensity to adapt to task demands relates to youths' risky decision making.

1-D-14 Rewards drive reconfiguration of whole brain networks in children

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Cognitive control relies on interactions across large-scale brain networks. External rewards improve performance on control-demanding tasks and, in adults, have been proposed to evoke integration across brain networks. However, little work has examined the impact of reward on brain network reconfiguration in children, which is critical to understanding impulsivity and self-regulation in childhood and has broad clinical applications across development. To test this, typically developing children (N=25(11F), 8-12yrs, mean=10.2yrs) completed standard and rewarded versions of a canonical cognitive control task, the go/no-go task, during an fMRI scanning session. The rewarded go/no-go task was identical to the standard task but with monetary rewards for accuracy and speed. To investigate brain network reconfiguration due to rewards, we compared functional connectivity using graph metrics characterizing segregation and integration of the whole-brain system between standard and rewarded go/no-go scans. We found that modularity, a measure of segregation of the brain into distinct subnetworks, significantly increased from standard to rewarded go/no-go. Conversely, we found that global efficiency, a measure of efficiency of information transfer across the brain, significantly decreased from standard to rewarded go/no-go. Thus with the introduction of monetary rewards, the whole-brain system became more segregated and less integrated. Further, this reconfiguration was driven by significant decreases in integration in the frontoparietal, cingulo-opercular, reward, and somatomotor networks. Together, these findings suggest that, in children, monetary rewards drive segregation in cognitive control and task-relevant brain networks, perhaps indicating specialization of information

processing. These results offer a preliminary characterization of the mechanisms by which rewards influence cognitive control in children and suggest a divergence from adult mechanisms.

1-D-15 The influence of reward-motivated memories on learning across development

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Cues associated with past rewarding experiences can harness attention and influence choices in new situations. Heightened sensitivity to rewards during adolescence might give rise to a particularly robust influence of reward-related memories on future behaviors during this stage of development, relative to childhood and adulthood. Reward associations have paradoxically been found to both disrupt and improve cognitive control in adolescence. Still, increased attention to previously rewarded stimuli may confer unique benefits for other behaviors, such as new learning. The current study aims to characterize age-related changes in how prior reward associations impact later learning. Ninety participants (ages 8 to 25, 45 females) first learned to associate one stimulus type with high reward and another with low reward. Twenty-four hours later, they completed a reinforcement learning task with 3 types of stimulus pairs: previously high and low reward-associated choice options and novel options. The results show that learning for all 3 stimulus types reaches an asymptote more rapidly with age. Stimulus type also modulates learning, such that optimal choice is highest for novel stimuli and lowest for previously high-reward stimuli, suggesting that reward associations initially impair learning. To characterize how reward history affects new learning, we implemented variants of computational reinforcement learning models that capture different possible learning mechanisms. We found that the best fitting model for the sample fits initial value estimates for each stimulus type, indicating that day 2 participant behavior is influenced by value transfer from day 1. Furthermore, initial value estimates of choice options decrease with age, suggesting that prior reward associations affect future behavior less in older individuals. These results hold the potential to enhance our understanding of how rewarding experiences influence subsequent learning across development.

1-D-16 Learning under uncertainty changes during adolescence

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As we transition from child to adult, we navigate the world differently. In this world, many of the relationships between events are unclear or uncertain because they are probabilistic in nature. We wanted to know how learning about probabilistic relationships changes with development and to interrogate the underlying processes. We investigated these questions in a probabilistic reinforcement learning task (The Butterfly Task) with 302 participants aged 8-30. We found performance in this task increased with age through early-twenties, then stabilized. Using hierarchical Bayesian methods to fit computational reinforcement learning models, we showed that this performance increase was driven by 1) an increase in learning rate (i.e. decrease in integration time horizon); 2) a decrease in exploratory choices. By contrast, forgetting rates did not change with age. We discuss our findings in the context of other studies and hypotheses about adolescent brain development.

1-D-17 Probabilistic reward learning in adolescents across anxiety continuum

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Objective Youth with anxiety display heightened striatal responsivity when anticipating reward, especially when rewards are contingent on performance, relative to non-anxious peers. During subsequent receipt of reward, youth with anxiety show either striatal hyperresponsivity or hyporesponsivity relative to controls. We will relate anxiety severity to neural correlates of reward anticipation by examining stimulus valuation and receipt of reward by investigating prediction errors during a probabilistic learning task in children and early adolescents. **Methods & Hypotheses** 131 youth (9-13 years old) completed a probabilistic learning task while undergoing fMRI. We will use a Rescorla-Wagner reinforcement learning model to examine trial-by-trial decision values and prediction errors, which will both be modeled using parametric regressors. These will test for the relationship between brain activation during anticipation of reward and receipt of reward with the magnitude of decision values and prediction errors, respectively. In whole-brain regression analyses, anxiety severity as measured by child-report on the Screen for Child Anxiety Related Emotional Disorders (SCARED) will be regressed onto neural activation during both anticipation and receipt of reward. Hypothesis 1: Youth with higher levels of anxiety will show greater striatal response during reward anticipation, specifically when contrasting predictive vs. non-predictive stimuli. Hypothesis 2: As existing literature is mixed, we hypothesize that anxiety severity will relate to reward processing in canonical reward regions (i.e., striatum, orbitofrontal cortex) but the directionality is unclear. **Implications** Youth with anxiety disorders avoid uncertainty and risk which can result in missed opportunities for real-world reward learning. Understanding the neural systems underlying reinforcement learning across anxiety can help clarify these behavioral tendencies.

1-D-18 Behavioral and psychiatric correlates of the brain's response to social feedback

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Prior studies seeking to understand the neural mechanisms of deficits in interpersonal relationships have often relied on reverse inference assumptions to match function to brain activity. We can test such assumptions by examining the correspondence between behavioral performance on reward and loss tasks and the brain's response to social acceptance and rejection. Further, we aim to examine the relationships between the brain's response and continuous measures of severity of depression and social anxiety. We will use a sample of 118 16-19-year-olds from the ongoing Preschool Depression Study, using the Island Getaway ERP task to measure participants' brain responses to stimuli that indicate acceptance or rejection by peers. Specifically, we will measure the mean amplitude of the reward positivity (RewP) to acceptance and feedback negativity (FN) to rejection. We will use the probabilistic incentive delay task to measure behavioral reward bias and loss avoidance. We will use multiple regression models to test hypotheses that individual differences in the RewP and FN to acceptance and rejection feedback are positively associated with behavioral measures of reward bias and loss avoidance, respectively. We will also test hypotheses that depression and social anxiety severity will be positively associated with the FN to rejection, while depression will be negatively associated with the RewP to acceptance. Finally, we will use structural equation modeling to test the overall fit of all proposed hypotheses to the data. This study will inform potential contributory mechanisms for a widely

distressing aspect of psychopathology--forming and maintaining interpersonal relationships. Such findings could inform individualized deficits for more targeted intervention and prevention.

1-D-19 Combining multiple learning tasks and computational models to isolate factors contributing to cognitive development between age 8-30

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Computational modeling has the promise to quantitatively isolate the processes that change in human cognitive development. However, early results using computational modeling have been contradictory. This may be driven by typical sample variation as well as the environmental statistics of experimental tasks and the distinct computational models applied. In an effort to understand this variability and reconcile previous findings in the reinforcement learning domain, we conducted a large-scale developmental study on 291 participants aged 8-30 years. Participants completed four learning tasks that varied on two experimental dimensions (stochastic / deterministic feedback, stable/volatile environment). We analyzed behavior and fitted computational models independently on each task, ensuring quantitative and qualitative fit, then compared the results across tasks. We found that performance (accuracy, response times) was highly consistent across tasks, and showed a stereotypical developmental trajectory: Performance increased steeply in the youngest age range 8-12, slowed down around age 12-17, and reached a stable plateau in mid-to-late adolescence/early adulthood ~18-25. This was mirrored by models' noise and forgetting parameters. However, other model parameters showed large variability across tasks: Most notably, the relationship of age and learning rate varied widely across tasks, where we observed stable, increasing, U-shaped, and inverse-U developmental trajectories. We used principal component analysis to identify which common factors underlie developmental differences between tasks, and support vector machines to determine what information different tasks contained about each other. Our research clarifies contradictions in the previous literature by assessing within-participant differences between tasks and models and identifying sources of difference. It also establishes stable across-task developmental factors.

1-D-20 Susceptibility to family context in predicting adolescent externalizing behaviors: Moderation by social motivational neural sensitivity

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The family environment represents a robust predictor of adolescents' externalizing behavior (EB), including rule-breaking and aggression; however, not all youth are susceptible to such influence. Individual differences in adolescents' neural sensitivity to social information may represent a marker of susceptibility to adverse family contexts, particularly given that adolescence is a period of increasing social motivation. While a small body of evidence has identified patterns of neurobiological susceptibility for internalizing phenomenon in adolescence, this study sought to identify the moderating role of adolescent neural sensitivity to social reward and punishment in predicting EB. 169 adolescents reported on family conflict (Parent-Adolescent Conflict Scale; Ruiz et al., 1998) and EB (CBCL-YSR; Achenbach et al., 2001), and completed an fMRI scan during a social incentive delay task. Ventral striatum (VS) sensitivity when anticipating social rewards and punishments moderated the association between family conflict and EB, such that for adolescents with heightened VS response, higher family

conflict was associated with higher EB (Reward: B=5.33, SE=1.33, p<.001, 95% CI [2.69, 7.97]; Punishment: B=5.76, SE=1.63, p<.001, 95% CI [2.54, 8.98]). Moreover, heightened amygdala sensitivity when anticipating social rewards (but not punishments) moderated the effect of family conflict, such that for adolescents with heightened amygdala response, greater family conflict was associated with higher EB (B=3.13, SE=1.43, p<.03, 95% CI [.30, 5.96]). Results suggest that sensitivity in neural regions involved in encoding the motivational salience of social stimuli, both social rewards and punishments, may represent a pattern of susceptibility to maladaptive family contexts. Findings extend evidence of neurobiological susceptibility to social context to externalizing phenomenon, highlighting individual differences in social motivational sensitivity.

1-D-21 When is my effort worthwhile? Learned efficacy influences how adolescents allocate cognitive control

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When deciding how hard to work on a task, a person needs to weigh the potential reward for performing well (e.g., college admission) and the extent to which they think this reward is determined by their performance versus factors outside of their control (the 'efficacy' of control). People therefore must track how efficacious their control is in a given environment, and adjust accordingly. During adolescence, increased independence creates more opportunities to decide when and how to allocate control. Previous research has examined how adolescents adjust control based on perceived rewards, but less is known about how they do so based on perceptions of efficacy. To test this, 17 adolescents (ages 13-17) performed a Stroop task for potential rewards. The reward was either determined by their performance (speed and accuracy; 'high efficacy') or it was determined at random ('low efficacy'). The likelihood of a trial being low or high efficacy varied over the course of the experiment. Crucially, participants were not told how likely it was that a given trial would be low or high efficacy, but instead had to learn this based on feedback. Measures of perceived efficacy showed that participants tracked the changing efficacy of the environment, and continually updated their estimates accordingly. By computationally modeling this learning process, we found that participants treated learned differentially from feedback that their control had been efficacious compared to feedback signaling a lack of efficacy. Further, perceptions of efficacy at a given time influenced control allocation, as reflected by improved performance (higher accuracy) when efficacy was perceived to be high. Collectively, these findings demonstrate that adolescents are sensitive to and adjust their mental efforts based on their learned efficacy, and lays the foundation for future work into how expected reward and efficacy are learned and integrated to determine control allocation across development.

1-D-22 Subjective valuation of agency is influenced by its utility across development

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People and non-human animals alike value having agency, or the ability to choose. The opportunity to make choices is objectively valuable and has greater utility when there is a reliable contingency between actions and rewarding outcomes. However, it is currently unclear whether people's subjective value of agency is sensitive to its utility. In the current study, we manipulated the utility of agency across three

choice contexts by varying the difference in reward probabilities among pairs of options. Agency had more utility when the difference in reward probability between choice options was greater because correctly choosing the high-reward option would more likely result in reward. Eighty participants (target: 90), ages 10-25, completed a probabilistic reinforcement learning task. On every trial, participants decided whether to accept a variable offer amount and allow a computer to randomly select an option for them, or to reject the offer and make the choice themselves. To quantify the subjective value of agency, we fit psychometric functions to participants' decisions to accept or reject different offer amounts in each context. Preliminary analyses reveal that while participants tended to overvalue their agency, the reward structure of the environment influenced their valuation. When the absolute difference in reward probability between option pairs was greater, both objectively and according to participants' subjective estimates, participants valued their agency more. These effects did not significantly vary across our age range. Future analyses will test whether participants' valuation of agency is related to self-reported indices of depression, anxiety, and attitudes towards control. We will also use reinforcement learning models to characterize how learning reward probabilities influences the value of choice.

1-D-23 Divergence of liking vs. wanting of rewards is associated with patience differently for hungry and non-hungry adolescents and adults

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Objective: Reward sensitivity is a major theme in developmental neuroscience, but fMRI-based tasks often confound important elements such as risk, reward phase, and developmental differences in memory. Research also suggests that liking and wanting of rewards are neurally and behaviorally distinct. Using an unconfounded task, we examine the effect of hunger on the relationship between reward sensitivity and temporal discounting in adolescents and adults, pulling apart wanting and liking. **Methods:** Subjects (69 adolescents; 62 adults) rated monetary rewards from $1 to $60 on a 21-point scale used in addiction research: liking right now, liking in general, wanting right now, and wanting in general. Hunger was experimentally induced for about half of the subjects (fasting at least four hours). Subjects completed an 8-item temporal discounting scale choosing between sooner smaller or larger later dollar amounts varying in magnitude. A difference score of liking minus wanting (ΔLW) was calculated. **Results:** For both age groups, non-hungry subjects chose the delayed option more as ΔLW for smaller reward magnitudes increased. In contrast, hungry subjects chose the delayed option more as ΔLW for larger reward magnitudes decreased. Non-hungry subjects made more patient decisions as relative desire for low reward magnitudes decreased, while hungry subjects made more patient decisions as relative desire for high reward magnitudes increased. **Conclusion:** Liking-wanting divergence prompts choosing larger delayed rewards when not hungry and settling for smaller sooner rewards when hungry. When not hungry, divergence in liking and wanting smaller "paltry" rewards motivates patience. In contrast, for hungry subjects, convergence of liking and wanting larger rewards motivates patience. These results shed light on the relationship between reward sensitivity and temporal discounting, emphasizing the importance of understanding the confluence of different motivations and drive states.

E - Education

1-E-24 Brain activity in cognitive control systems is related to academic skill in English Learners

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English Learners (ELs) are students from non-English speaking backgrounds and are a growing population in U.S. schools. This group is often characterized by wide gaps in academic achievement and economic background relative to their grade-level peers. Comorbid reading and math difficulties are especially high in ELs, and these students are placed in remedial programs designed for native English speakers. Uncovering the neural systems underlying the multiple learning processes and difficulties in this group is important for designing better educational and remedial programs. Here, we use low difficulty fMRI reading and math localizer tasks collected from a group of Hispanic middle school ELs with varied academic skill and language proficiency (N = 69 (31F), mean age = 12.32, 41 identified as struggling readers). Whole brain analyses tested for brain regions engaged in task-unique and task-common processes. Strong overlapping engagement across the two tasks was seen in regions belonging to established cognitive control networks. Through application of literature-based cognitive control regions of interest, we found several moderate relationships between brain activity and out of scanner measures of reading and math skills. Interestingly, activity in the same set of control regions during a control-demanding but non-academic task in the same group showed stronger and more widespread relations to standardized reading, language, and math measures. These findings suggest that engagement of control systems, in both academic and non-academic control tasks, is crucial for both reading and math processes in ELs. Notably, control engagement broadly, is related to real world learning outcomes for this group. This work suggests that engagement of cognitive control systems may be particularly important for learning in this understudied, growing U.S. population with unique learning challenges.

F - Memory

1-F-25 Influences of reward motivation on behavioral and neural memory processes across age

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Motivationally salient events are often prioritized in memory. In adults, memory for high-reward memoranda is related to increased activity and connectivity of the hippocampus, particularly anterior hippocampus, and mesolimbic dopamine systems during and after encoding. More generally, dopamine-dependent plasticity in the hippocampus is critical for memory formation. Converging evidence from studies in rodents and post-mortem humans suggests that dopamine signaling peaks during adolescence, which may lead to stronger memory representations of rewarding events relative to mundane events. To test whether reward associations have a larger influence on behavioral and neural memory processes during adolescence, 90 participants ages 8 to 25 years-old completed a reward-motivated encoding fMRI paradigm with baseline and post-encoding active rest periods and returned

24-hours later for a behavioral memory retrieval test. We find that while memory performance improves with age, individuals of all ages show better memory for high-reward memoranda. Parallel to the behavioral results, preliminary analyses of brain activity during active rest reveal that functional connectivity between the ventral tegmental area (VTA) and both anterior and posterior hippocampus increases following motivated encoding. Surprisingly, the relationship between post-encoding VTA-anterior hippocampus connectivity and the benefit of high rewards for associative memory varies with age, such that greater high-reward memory benefits are associated with increasing connectivity in older participants but are associated with decreasing connectivity in younger participants. Together, these preliminary results suggest that while reward motivation enhances memory across age, the neural mechanisms underlying reward-motivated memory benefits may change with age.

1-F-26 Relation between hippocampal neurite density and trace eyeblink conditioning in four- to six-year-old children

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Trace eyeblink conditioning (EBC) may be a proxy for the efficiency and efficacy of hippocampal development across learning/memory domains. EBC has well-defined neural circuitry, which includes the hippocampus and cerebellum. EBC is non-invasive and can be employed in pediatric populations, making it a potential tool for investigating network development. We examined relations between trace EBC and hippocampal and cerebellar neurite density. Thirty 4- to 6-year-olds (M=5.7, SD=.88) completed a: (1) T1-weighted structural scan; (2) T2-weighted structural scan; (3) Diffusion Weighted Imaging scan (DWI; 3T; 102 diffusion directions); and (4) trace-EBC task. Two-dimensional surface renderings of participant T1-scans were constructed in FreeSurfer. Neurite orientation and density diffusion imaging (NODDI) reconstruction was accomplished with T2- and diffusion-scans (with MDT diffusion toolkit). NODDI models provide an intraneurite volume fraction metric, an indicator of neurite density. Using FreeSurfer region-of-interest segmentation, average neurite density was calculated for bilateral hippocampus and cerebellum. EBC training consisted of 80 tone-puff (i.e., presentation of 750-ms, 80dB, 1000Hz pure tone, followed by 500ms interstimulus trace interval during which no stimulus is presented, followed by 100ms airpuff, ~10 lb/in2), 10 tone-alone, 10 puff-alone trials. Conditioned Response (CR) onset latency, or average latency to start of the blink, was computed across tone-puff and tone-alone trials. Greater neurite density of bilateral hippocampus predicted higher CR onset latency (p=.0007 for left, p=.007 for right). Neither left nor right cerebellum predicted CR onset latency (lowest p=.27). Results suggest pruning hippocampal synaptic connections, through maturation and experience captured by decreases in neurite density, may engender resource-efficient differentiation of signal from noise in learned associations.

G – Environment (Stress, SES)

1-G-27 Early childhood cognitive and academic performance: associations with developing singing abilities and socioeconomic status

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Objective: To examine interrelations among early childhood cognitive, academic, and developing singing abilities, measured longitudinally, and their associations with measures of family socioeconomic status (SES). **Methods:** We tested 65 four- to five-year-old children in transitional kindergarten classrooms and collected demographic information from participant families. We used six subtests from the Woodcock Johnson IV ECAD and a newly developed measure of vocal pitch production. Children were asked to sing notes and melodies after hearing recorded human examples, and pitch distances were computed. Tasks were measured at three timepoints across one academic year to look at potential developmental changes in task relationships. Correlations were computed among tasks, and the effects of maternal education and household income on relationships among the measures were also examined. **Results:** Overall, developing vocal pitch production accuracy at all time points showed weak (r = 0.27 to 0.40) to no significant linear associations with the standardized early cognitive and academic measures. However, there were statistically significant effects of SES on several cognitive and academic skill measures (expressive word, vocabulary task, sentence repetition, and number sense, p=0.001 to 0.04), which were not evident for the singing measure. In general, these results remained consistent across the three longitudinal time points. **Conclusions:** Despite high correlations among traditional cognitive and academic skills in early childhood, such abilities may show relative independence from developing musical competencies, such as singing, which also shows less association with SES at these young ages. Our results suggest the existence of early differences in cognitive abilities and saliencies that may play an important role in explaining diverging educational outcomes. If uncovered early, such alternative cognitive strengths may be useful in lifting academic trajectories.

1-G-28 Late childhood stress and neurocognitive development: Exploring the role of school-based threat

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Objective. A growing body of research shows that adverse childhood experiences (ACEs) influence neurocognitive development. Much of this work has focused on effects of poverty, neglect, maltreatment, and traumatic events. A less-explored source of stress for some developing children is the school environment. I add to the literature by exploring the effect of school-based threat (i.e., feeling unsafe at school) on neurocognitive outcomes. **Methods.** I use baseline data from the Adolescent Brain and Cognitive Development (ABCD) Study, affording a large (n~11,000) and approximately representative sample of 9- to 10-year-olds. Outcomes of interest include 1) measures of neurocognitive functioning, 2) measures of grey and white matter volume, and 3) fractional anisotropy of white matter tracts. For neuroanatomical measures, I take a region of interest approach, focusing on structures associated with higher order cognitive skills and shown to be associated with the experience of ACEs. Regression models are built in sequential fashion to account for the role of potentially confounding variables such as demographics, socioeconomic status, family and neighborhood sources of stress, and social skills. **Results.** With controls, participating children who reported feeling unsafe at school exhibited lower performance across multiple measures of higher order cognition. Results also indicate a significantly smaller volume of the corpus callosum and left superior longitudinal fasciculus among children who report feeling unsafe. Fractional anisotropy is significantly lower in the corpus callosum and bilaterally in the superior longitudinal fasciculi. **Conclusions.** Results suggest that the experience of

feeling unsafe at school may be underrepresented in the literature on adverse childhood experiences. Results are discussed with reference to the causal inference challenge, and I consider how approaches from the econometric toolbox might be used to build causal claims with ABCD data.

1-G-29 Hippocampal structure as mechanism linking violence exposure with impaired associative memory in young children: a preregistration

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Early exposure to violence is associated with decreased hippocampal volume and impaired associative memory during late childhood and adolescence (Lambert et al., 2017; Lambert et al., 2019). Moreover, violence-exposed children do not achieve developmentally-expected improvements in associative memory with age (Lambert et al., 2019), suggesting that these associative memory difficulties may become more pronounced over time. Preliminary evidence suggests an association between violence exposure and poor associative memory even in young children (5-6 year olds) (Rosen et al., 2019). However, little is known about the potential role of hippocampal volume in mediating the association between violence exposure and associative memory in early childhood when the hippocampus is still developing rapidly. We address this question in the present preregistration for which data have been collected but not analyzed. 72 participants aged 6-8 (36 female) with varying levels of violence exposure participated in structural MRI scans and two associative memory tests. We assessed violence exposure using three parent-reported measures. We assessed associative memory through paired associative memory tasks (1) for shapes (Sheridan & Hamoudi, 2015; Rosen et al., 2019), and (2) for images of children belonging to one of two groups. We hypothesize that violence exposure will be associated with impaired associative memory on both tasks. Furthermore, we predict that hippocampal volume will be reduced in violence-exposed children, and this reduction in hippocampal volume will mediate the association between violence exposure and poor associative memory. Our goal is to examine whether reductions in hippocampal volume are evident in young children exposed to violence and explain impairments in associative memory early in development.

1-G-30 Deprivation, but not threat, as a mechanism linking socioeconomic status to working memory: a preregistered fMRI study

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Working memory (WM), the ability to hold in mind and mentally manipulate information, is strongly predictive of academic achievement. Children from lower socioeconomic status (SES) backgrounds tend to perform poorer on WM tasks than high-SES children (Noble et al., 2005; Lawson et al., 2017); these differences in WM and differences in frontoparietal network structure and function are mechanisms explaining the well-established income-achievement gap (Finn et al., 2016; Rosen et al., 2018, 2019). Low-SES confers risk for exposure of a wide range of experiences, but it remains unknown what specific aspects of the environment drive these cognitive and neural differences. A recent model proposed that early experiences of threat and deprivation have distinct influences on cognitive and neural development (Sheridan & McLaughlin, 2014). A sample of children aged 11-12 (n = 183) participated in a WM fMRI study, which is preregistered (https://osf.io/em4xu/). We hypothesize that lower WM

performance seen among low-SES children is explained by experiences of deprivation, but not threat. Furthermore, we hypothesize that deprivation, but not threat, explains low-SES-related reductions in activation in the frontoparietal network, as well as the ventral visual stream--a set of brain regions that processes visual information and has been proposed to play a role in SES-related disparities in WM (Rosen, Amso, and McLaughlin, 2019). Finally, we hypothesize that lower WM performance and less neural activation in these regions will be associated with poor academic outcomes. This study has implications for understanding the environmental, neural, and cognitive factors that contribute to the income-achivement gap.

1-G-31 Characterizing heterogeneity in psychopathology among children exposed to early caregiving adversity

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There is substantial heterogeneity in psychological outcomes following early caregiving adversity (ECA), yet it remains unclear why some youth go on to develop psychopathology while others remain resilient. This study seeks to: 1) subtype children exposed to ECA based on current psychopathology symptoms; and 2) identify what ECA components predict membership in psychopathology subtypes utilizing data-driven, machine learning methods. Participants were 225 children (6-12 years, 122F/103M) exposed to heterogeneous ECA experiences, including but not limited to maltreatment, abuse, caregiver separation, institutional care, and physical neglect. ECA experiences were assessed with the Caregiver History Interview, Maternal Interview on Childhood Maltreatment, and Traumatic Events Screening Inventory. Child psychopathology was assessed with the Child Behavior Checklist, Connors Comprehensive Behavior Rating Scale, and Revised Child Anxiety and Depression Scale. Raw psychopathology items were submitted to unsupervised random forest clustering. Louvain community detection on the resultant proximity matrix revealed two subtypes characterized by high psychopathology across all items (HIGH, n = 114) and low overall psychopathology (LOW, n = 111). Results of a subsequent random forest model revealed that having an earlier age of ECA onset was most important for predicting membership in the HIGH (vs. LOW) psychopathology subtype followed, in order, by the experience of emotional neglect, a higher number of caregiving disruptions, greater cumulative ECA exposure, sexual abuse, and caregiver separation. The remaining 16 ECA variables were unimportant for subtype classification. Planned analyses include cross-validation to assess model robustness and probing interactions among ECA variables in classifying psychopathology subtypes. The study findings will help disentangle the complex relationship between the early caregiving environment and mental health in vulnerable children.

1-G-32 Generalization of learned fear in children exposed to early caregiving adversity

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Learning to distinguish safe from unsafe cues is critical for survival. When safe cues are confused as threatening, it can lead to the generalization of fear, which has been attributed to weakened pattern

discrimination at the behavioral and neural levels (Lange et al., 2017; Lecei & van Winkel, 2019). Fear generalization is heightened in children (Schiele et al., 2016) and may be exacerbated by environmental disruptions, a prediction supported by findings in emerging adults (Lange et. al., 2019) and work indicating that the development of fronto-hippocampal regions implicated in fear generalization is modified by early stress (Teicher et al., 2016). In the present study, we investigate fear generalization behavior in children who have experienced heterogeneous early caregiving experiences (i.e. institutionalization, foster care, kinship care, temporary parental separations) (N = 190, anticipated N ≈ 330, Age = 7-14 years). Fear generalization behavior was characterized using a modified faces task (Schiele et al., 2016), in which participants provided trial-by-trial ratings of neutral faces either paired with an aversive US (CS+), not paired (CS-) or morphs containing varying CS+/CS- ratios. Multilevel logistic regression analysis showed a recruitment group x face stimulus interaction ($\hat{\beta}$ = -1.20, 95% CI [-2.40, -.04]), such that children who were adopted domestically or internationally from foster care attributed greater fear to CS- morphs (i.e., blended with CS+) relative to non-adversity-exposed comparisons. Planned analyses include conducting representational similarity analyses (RSA) of functional magnetic resonance imaging (fMRI) to examine whether the similarity of fronto-hippocampal patterns of activity in response to fear versus neutral faces predicts generalization behavior, and probing specific caregiving experiences that may be driving the effect of recruitment group.

1-G-33 Effects of emotion regulation strategy usage on internalizing symptoms following early institutional care

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Early adversity, and particularly institutional orphanage care, has been associated with the development of anxiety and mood disorders (McLaughlin et al., 2010; Silvers et al., 2017). Previous research also shows that early adversity exposure can disrupt core emotion regulation processes, which in turn contributes to internalizing symptoms (Tottenham et al., 2010). To our knowledge, no studies have examined the links between expressive suppression (an emotion regulation strategy that involves suppressing external displays of emotion) and internalizing psychopathology in previously institutionalized (PI) youth. 36 PI (Mage=14.47, age-range=9-17) and 58 comparison youths (Mage=13.24, age-range=9-17) participated in this cross-sectional study. Participants completed the Emotion Regulation Questionnaire for Children and Adolescents (Gullone & Taffe, 2012), a self-report measure that assesses individual differences in the use of expressive suppression and reappraisal. Each youth's parent completed the Child Behavior Checklist for Ages 6-18 to assess internalizing behaviors (anxiety, depression, somatic complaints, and withdrawal) in their children (Achenbach & Rescorla, 2001). A path analysis revealed that PI status indirectly influenced the development of internalizing symptoms through its effect on suppression while controlling for gender. Bootstrap analyses revealed that the indirect effect was positive and significant (ab; indirect effect = 1.35), such that relative to comparison youth, PI youth on average had 1.35 more units of internalizing symptoms via their use of suppression (10,000 bootstrap samples; 95% CI: [.07 - 3.10]). This suggests that maladaptive emotion regulation is a contributing factor to internalizing problems after being previously institutionalized,

pointing to specific maladaptive emotion regulation processes that should be targeted during interventions.

1-G-34 Family functioning and adolescent behavioral problems: The moderating roles of the amygdalar and hippocampal responses during emotional processing

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Objectives: The quality of interpersonal relationships in family contexts (i.e., family functioning) is a robust predictor of youth's development of problem behaviors. However, youth often do not respond equally to similar rearing environments. Recent research suggests that the variability in youths' responses to family influences stems in part from individual differences in neurobiological interactions with rearing environments (Schriber & Guyer, 2016). This study aimed to examine the neural architecture underlying youths' differential responses to the influences of family functioning, with the amygdala and hippocampus as key neurobiological foci. Specifically, this study investigated how amygdalar and hippocampal activations during negative and positive emotional processing moderated the associations between family functioning and youths' internalizing and externalizing problems. **Methods:** Data were obtained from 123 rural adolescents (aged 12-14) and their primary caretakers recruited from Georgia. Youths' amygdalar and hippocampal responses to emotional stimuli were obtained during an fMRI Emotional N-back paradigm (Cohen et al., 2016). fMRI data were analyzed using AFNI (Cox, 1996). Then, data analyses were conducted with structural equation modeling in Mplus 7.4 (Muthén & Muthén, 2012). **Results:** Left amygdalar responses to positive and negative emotional stimuli, as well as left hippocampal responses to positive emotional processing, significantly exacerbated the effects of family functioning on youth adjustment. With heightened amygdalar and hippocampal activations, youth who reported unbalanced family functioning exhibited increased problem behaviors. However, youth with elevated neural responses also presented reduced problem behaviors when they experienced balanced family functioning. **Conclusions:** Heightened left amygdalar and hippocampal activations during emotional processing were associated with youths' elevated sensitivity to family influences.

1-G-35 Fear learning predicts posttraumatic stress disorder symptoms in children after Hurricane Florence

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Following a traumatic event, posttraumatic stress disorder (PTSD) symptoms are common. Considerable research has identified a relationship between physiological responses during fear learning and PTSD. Adults with PTSD display atypical physiological responses, such as increased skin conductance responses (SCR), to threat cues during fear learning (McTeague et al., 2010; Orr et al., 2000). Two prospective studies found that greater SCR to threatening stimuli predicted PTSD symptoms after subsequent trauma exposure (Guthrie & Bryant, 2005; Pole et al., 2009), suggesting that SCR to threat can predict PTSD symptoms. However, little research has examined these responses in early childhood when fear learning first emerges. We hypothesized that atypical differential SCR amplitude during fear learning would predict PTSD symptoms following Hurricane Florence in a sample of young children with hurricane exposure. 65 children in North Carolina completed a fear learning paradigm prior to Hurricane

Florence. After the hurricane, we assessed child hurricane exposure and PTSD symptoms. We used regression models to examine whether SCR amplitude to the CS+ (threat cue) during fear learning predicted overall PTSD symptoms or PTSD symptom clusters, controlling for SCR amplitude to the CS- (safety cue), age, gender, and baseline anxiety. We found that SCR to threat during fear learning predicted PTSD hyperarousal symptoms and that child hurricane exposure predicted PTSD symptoms following the disaster. We also found a marginally significant interaction between SCR to threat during fear learning and child hurricane exposure: fear learning predicted PTSD symptoms only in children with significant hurricane exposure. Our work suggests that prospective associations between SCR during fear learning and PTSD symptoms are replicated in early childhood. Limiting young children's exposure to widespread trauma may protect against the development of PTSD symptoms.

1-G-36 Neural and behavioral correlates of inhibitory control as mediators between childhood adversity and externalizing problems

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Threat and deprivation are two distinct dimensions of early adversity that significantly impact neural development and psychopathology. Yet, research on their differential underlying mechanisms is needed. The planned study focuses on testing whether inhibitory control is a key cognitive process that differentially mediates the links between threat versus deprivation to externalizing behaviors. Studying the specificity of the mechanisms underlying early adversity to psychopathology could further inform interventions. We hypothesize that 1) increased threat and deprivation is differentially associated with aberrant neural responses in a priori ROIs during behavioral inhibition; 2) neural response during behavioral inhibition differentially mediates the associations between threat and deprivation and externalizing behaviors; 3) inhibitory control, measured by task reaction time (SSRT), also mediates those associations. Data from the ABCD study will be used. Deprivation is operationalized by levels of parental acceptance, monitoring, and school quality whereas threat is measured through family conflict, neighborhood, and school safety. fMRI and SSRT data are from the Stop Signal Task. A priori ROIs include inferior frontal gyrus, anterior cingulate cortex, supplementary motor area (SMA), dorsolateral prefrontal cortex (dlPFC), insula, pre-SMA, thalamus, basal ganglia, medial PFC, precuneus, posterior cingulate, inferior parietal lobule, superior temporal cortex, inferior temporal gyri, and amygdala. Externalizing (i.e., aggressive, delinquent) behaviors, is measured by CBCL. Hypotheses will be tested using structural equation modeling. First, all a priori ROIs are regressed onto latent factors of threat and deprivation, controlling for demographic covariates and sibling level dependence. Then, externalizing behaviors are regressed onto ROIs. Lastly, mediation models are created. These steps will be repeated for SSRT and include corrections for multiple comparisons.

1-G-37 Early life stress is associated with accelerated dental development

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Introduction A growing body of evidence indicates that exposure to adversity in childhood undermines both physical and mental health, and ultimately is associated with increased risk for premature mortality. Recently, accelerated biological aging has gained increasing attention as a potential

mechanism linking early adversity to poor health outcomes. Here, we examine how a novel domain of somatic maturation - namely, dental development - is related to early life stress, mental health, and neural maturation in childhood. **Methods** Eruption status of the primary molars was evaluated for 117 children (63 female) between ages 4 and 7. Molar eruption was rated on a scale of 1 (unerupted) to 4 (fully erupted and in occlusion) from T2-weighted MRIs. Volumetric segmentation of T1-weighted structural images was performed using FreeSurfer. Parents completed the Child Behavior Checklist (CBCL) and Adverse Childhood Experiences (ACEs) questionnaire about their child, and reported their family income. Relationships between molar eruption and childhood environment CBCL subscales, and lateral ventricle volumes were examined using linear models, with age and sex as covariates. **Results** Lower family income and greater exposure to adversity were each significantly associated with earlier molar eruption. Family income remained significantly associated with molar eruption after controlling for race and ethnicity. Earlier molar eruption was associated with elevated levels of attention problems and aggressive behavior, as well as increased volume of the lateral ventricles. **Conclusion** These findings suggest that the impact of stress on the pace of biological development is evident in early childhood and detectable in the timing of dental development. Future research should determine whether psychosocial interventions can alter patterns of accelerated biological development and thereby reduce the burden of mental and physical health risk among children who experience early adversity.

1-G-38 Associations between childhood trauma exposure and the neural correlates of safety cue learning in development

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Exposure to trauma during childhood is prevalent and confers heightened risk for the development of psychopathology including anxiety disorders. Understanding threat and safety learning and related neural mechanisms is essential for the development of novel interventions and identification of mechanisms linking trauma exposure and psychopathology. The present fMRI study examined conditioned inhibition via safety cue learning (SCL) in a sample of healthy adults and youth (ages 12-30; n=67). The paradigm included stimuli representing threat, safety, and a safety compound (i.e., CS+ and CS- were paired). The Childhood Trauma Questionnaire (CTQ) assessed childhood trauma exposure. A general linear model examined neural activation in the anterior hippocampus, a key region of interest, and anterior hippocampal functional connectivity with the dorsal anterior cingulate cortex (dACC), a target neural pathway supporting SCL. There was a significant interaction between childhood trauma exposure and task condition ($F(3,62)=3.16$, $p=0.031$). Specifically, youth and young adults with higher levels of trauma exposure (i.e., total CTQ score equal to or greater than median score) showed lower hippocampal activation to the safety compound and higher hippocampal activation to the threat cue than those with lower levels of trauma exposure. In addition, anterior hippocampal-dACC functional connectivity during SCL was positively correlated with age ($r=0.293$, $p=0.025$), such that older individuals displayed greater functional connectivity between the anterior hippocampus and dACC during SCL. These findings suggest that the neural mechanisms supporting conditioned inhibition may be disrupted

following childhood trauma exposure. Furthermore, youth may be particularly vulnerable to this impact due to lower hippocampal-dACC functional connectivity during SCL.

1-G-39 Childhood maltreatment and explore-exploit decision making in early adolescence

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Study objective Early adversity, such as abuse or neglect, can lead to a wide range of behavioral problems. This study investigates explore-exploit decision making as a potential mechanism mediating this link. In uncertain environments, making decisions poses conflicts between staying with a known option (exploitation) versus trying an unknown alternative (exploration). Children and adolescents gather information and learn about their environments through sampling and exploration. We hypothesized that early adversity, exemplified in harshness and unpredictability in parenting, would associate with decreased exploration. **Methods** We recruited 101 10-13-year-old participants with various exposure to maltreatment based on documented physical abuse through the Child Protective Services division. They completed a horizon task, a patch-foraging task, and a sequential decision-making task to capture different aspects of explore-exploit decision making. We collected information about parents' disciplinary behaviors (reflecting harshness) and unpredictability through the Parent-Child Conflict Tactics Scale and Questionnaire of Unpredictability in Childhood. **Results** Unpredictable parenting was associated with reduced strategic exploration ($\beta = -0.025$, $t(2, 34) = -2.278$, $p = .029$) and fewer reward points ($\beta = -0.469$, $t(2, 34) = -2.795$, $p = .008$) in horizon task. No associations were found between parenting measures and exploratory decision-making in the patch-foraging task or the sequential decision-making task. **Conclusions** Exposure to unpredictable parenting associated with an increased preference towards immediate rewards (exploitation) at the expense of information that can guide subsequent behavioral choices, and therefore hinders effective information seeking and reward-related learning (exploration). Taken together, disruptions in explore-exploit decision making may be one cognitive mechanism linking childhood maltreatment to later behavioral problems.

1-G-40 MindHive: A citizen neuroscience platform for adolescent brain & behavior research and education

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MindHive is a digital citizen science platform focusing on adolescent brain and behavior research and education. MindHive supports virtual Student-Teacher-Scientist (STS) partnerships using an open-science approach: Students, teachers, and scientists across the globe are invited to contribute research projects, resources, and data to the platform, as such supporting both STEM learning and scientific discovery. By involving young citizen scientists in each other's projects through peer-review and data collection, they will learn that scientific progress is collaborative, iterative, and transparent. In Spring 2020, we worked with an 11/12th grade environmental science class at Grace Church School (NYC) to co-develop an online curriculum comprising modules on (a) research ethics, (b) human brain function and behavior, (c) the scientific process (inspired by UC Berkeley's 'Understanding Science' project), (d) collaborative and iterative study design, and (e) constructive peer review ('preregistered report'-style, i.e. prior to data collection). Since curriculum development coincided with the onset of coronavirus-

related societal changes, including the shift to remote teaching, content is linked to the COVID-19 pandemic and students' day-to-day experience where possible, e.g. highlighting the brain basis of risk-taking, stress, and group behavior, and discussing emerging tensions between 'fast science' and 'rigorous science'. Students developed research projects investigating neuropsychological effects of the pandemic on high school students, for which data collection is currently underway. Other ongoing MindHive projects focus on e.g. COVID-related stress and coping in low-SES neighborhoods in New York City, and the role of social influence to explain whether adolescents engage in environmentally conscious behavior. Over time, we envision MindHive to become a diverse research database that informs scientific discovery, educational practice, and government policy.

1-G-41 Characterizing relationships between the environment and aspects of youth cognition

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Individual differences in children's cognitive abilities have significant consequences for life and health outcomes. What factors influence these individual differences during development? Research suggests that enriched environments and resource availability, often measured using caregiver income and education, promote healthy cognitive development. Here we ask whether children's environments are related to their cognitive performance independent of effects of socioeconomic status and demographic characteristics. To this end, we analyzed data from 9,002 (52.2% male) 9-10-year-olds from the Adolescent Brain Cognitive Development Study, an ongoing longitudinal study with community samples across the US. Using youth- and caregiver-report questionnaires and geodatabase registries (e.g., neighborhood crime, walkability), we defined four principal components (PCs) summarizing youth's home, school, neighborhood, and cultural environments. We next input these PCs and a sociodemographic summary measure into three linear mixed-effects models to predict aspects of cognition defined in Thompson et al. (2019): general cognitive ability (GC), executive functioning (EF), and learning/memory (LM). Across independent ABCD data releases, children's sociodemographics and home, neighborhood, and cultural PCs explained unique variance in GC. In addition, there was a significant interaction between sociodemographics and neighborhood environments in explaining variance in GC, such that increased neighborhood enrichment decreased the relationship between sociodemographics and GC. The neighborhood PC was the only significant factor explaining unique variance in EF, whereas sociodemographics and cultural PCs explained unique variance in LM. Together these results demonstrate that aspects of physical and social environments predict aspects of cognitive performance during development, independent of sociodemographic factors, and identify future environmental targets for intervention.

1-G-42 Examining the mediating effect of brain resting-state functional connectivity in the relationship between adolescent peer victimization and subsequent psychopathology

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Peer victimization (PV) is associated with increased risk of psychopathology and altered neural responses in regions subserving emotion regulation and affective processes during adolescence. The present study examined the mediating effects of resting-state functional connectivity (rsFC) between

adolescent PV and subsequent internalizing (depression and anxiety), and externalizing (conduct and hyperactivity/inattention) symptoms. A total of 151 adolescents from a community sample (baseline mean age=13.5±0.6, 54% male) were assessed and imaged three times during a five-year period. We focused on rsFC analyses for a network of a priori determined Regions-of-Interest (ROIs) implicated in the emotional regulatory processes (i.e., insula, anterior cingulate cortex, amygdala, and medial prefrontal cortex (mPFC)). Regions from the resting-state fMRI sessions were defined based on the multi-resolution parcellation of functional brain networks (MIST) atlas. A multilevel mediation analysis leveraging the longitudinal data examined the relationship between PV and internalizing/externalizing symptoms through changes in the rsFC at the between-person, concurrent within-person, and lagged within-person levels, controlling for the effects of self-reported childhood maltreatment and sex differences. Results indicated that increased rsFC of the posterior insula-amygdala mediated the lagged within-person effect of PV on internalizing symptoms (β=.144; 95% CI [.018, .332]). No significant mediation effect for rsFC was found in the relationship between PV and externalizing symptoms. These findings suggest that PV may result in difficulties in bottom-up affective regulation which in turn increases the risk of a delayed emergence of internalizing symptoms in victimized adolescents.

1-G-43 Self-reported screen time and risk-taking in the transition into adolescence

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Engagement with digital technologies, and its impact on adolescent health and behavior, has been a source of concern in the past years. However, research in this field is still new, and it is unclear how commonly used measures of screen engagement relate to health-risk behaviors or risky decision-making processes in adolescents. In the present study, we examine the relationship between self-reported screen time use with measures of risk-taking and related processes in young adolescents by examining two datasets. We first examined how profiles of self-reported screen time use were related to risk behavior and tolerance to ambiguity when engaging in risky decision making in a sample of 311 middle school students. Participants in the middle school sample completed the ABCD Screen Time Survey, the Health and Social Risk Questionnaire, and Lottery Task. Using a data-driven approach, participants were categorized into five different profiles of screen time usage, which were then related to the likelihood of taking health risks, and tolerance to ambiguity. We found no relationship between the profiles of screen time use and either measure. We then examined a subset of 1,000 participants from the baseline data release of the ABCD study. We related profiles of self-reported screen time use, generated using the same procedure as our middle school sample, to measures of health risk behavior and impulsivity, including the UPPS-P Impulsive Behavior Scale and the BIS/BAS Scale, as well as functional connectivity in subcortical-cortical circuits previously identified as having a relationship to risk-taking. We found no relationship between profiles of screen time use and these measures. In addition to the findings, this study raises important questions about the numerous ways that screen time use can be related to cognitive and behavioral measures, as well the many ways in which different methods of collecting screen time use data may affect potential analytical approaches.

1-G-44 Socioeconomic status and neural mechanisms during statistical learning in preschool children: A fNIRS investigation

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Low socioeconomic status (SES) has been identified as an environmental risk that negatively impacts cognitive development. SES-related differences have been found in regions associated with learning and language development such as the left inferior frontal gyrus (Noble et al, 2015a). The deprivation of cognitive stimuli in low-SES families constrains implicit learning that scaffolds cognitive development (McLaughlin, Sheridan & Nelson, 2017). However, how SES risk influences neural mechanisms of implicit learning is relatively unknown. The current study examined the association between income-to-needs ratio and brain activation during auditory statistical learning. Forty families with preschool children were recruited. Children were first familiarized with a continuous stream of tone-words. The only information indicating the word boundaries was the transitional probability (TP) between tones. They then listened to separate tone-words with either high, low or zero TP while having their brain activity recorded by functional near-infrared spectroscopy. Regions of interest analyses reveal that in the left inferior frontal gyrus, there is generally less oxygenated hemoglobin (hbo) concentration under the high TP condition. There is an interaction between SES and hbo concentration under the zero TP condition: the higher the SES, the larger the increase in hbo concentration. In the dorsal lateral prefrontal cortex, we observe increased hbo concentration under the zero TP condition. Our results show that these children could identify word boundaries using statistical probabilities through increased recruitment of language and attention related brain areas during novel situations compared to familiar situations. SES moderates the learning progress such that children from higher SES backgrounds display a greater degree of employment of these areas. Future research should examine relationships between SES, neural mechanisms of statistical learning, and behavioral outcomes.

1-G-45 Associations between variations in caregiving and infant brain activity

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Lower socioeconomic circumstance has been linked with disparities in brain development as early as the first year of life. One proposed mechanism through which disparities may emerge is caregiving style, yet research directly examining the link between caregiving style and infant brain development is limited. The present study investigated the relationship between variations in caregiving style and infant brain function using electroencephalography (EEG) in a socioeconomically diverse sample of 21 mother infant-dyads (infant age range: 11.73-12.75 months; M = 12.15). We hypothesized that more developmentally supportive caregiving would be associated with greater high-frequency power (alpha) and less low-frequency power (theta). Caregiving style was assessed using a play-based observational measure of developmentally supportive caregiving across four domains: affection, responsiveness, encouragement, and teaching. Resting brain activity was recorded for five minutes using EEG. Results indicated that, after controlling for age, there was a marginally significant association between more developmentally supportive parenting and lower theta power (β = -.429; p =.078), but no significant association with alpha power (β = -.330; p =.184). Although only one of these associations reached marginal significance, which may be due to the small sample, the moderate effect sizes suggest there may be a meaningful relationship between developmentally supportive parenting and infant functional brain development (alpha and theta power). These findings provide preliminary evidence linking caregiving style and infant

brain development, but additional research is needed to better understand the nature of the relationship.

H – Brain structure

1-H-46 Poverty, cognition, and changes in white matter integrity in adolescence

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Background: Adolescence is characterized by changes in white matter in areas including the superior and inferior longitudinal fasciculus (ILF, SLF), thalamic radiations (TR), internal capsule (IC), corticospinal tract (CST), arcuate fasciculus (AF), and the corpus callosum (CC). These changes may be associated with enhanced cognitive performance and control. Furthermore, poverty may be related to reduced integrity of white matter tracts implicated in cognitive performance and control, with such alterations serving as mediators or moderators linking poverty and cognitive ability. **Objectives:** The proposed study aims to examine: (1) poverty's relationship to four indicators of white matter integrity (i.e., Fractional Anisotropy (FA), Mean, Radial, and Axial Diffusivity (MD, RD, AD)) at two-time points during adolescence, and (2) the association between changes in white matter integrity and changes in cognition in youth facing poverty. **Methods:** Data will come from two waves of the large sample of youth taking part in the Adolescent Brain and Cognitive Development study. Poverty will be assessed by household income and the Parent-Reported Financial Adversity Questionnaire. White matter integrity will be assessed in following tracts: fornix, cingulum, CST, anterior TR, Uncinate, ILF, SLF, inferior frontal occipital fasciculus, CC, superior corticostriatal, striatal inferior frontal cortex and the inferior frontal superior frontal cortex. Cognitive ability will be assessed using data from the NIH Toolbox. Analysis Plan: Latent and bivariate latent change score models will assess how white matter integrity and cognition change across the two waves. We will then regress poverty onto the values of the model to see if poverty predicts change in white matter integrity and to see if changes in white matter integrity are related to changes in cognition. **Implications:** Analyses will reveal the contributions of poverty to white matter microstructure and cognition.

1-H-47 Subjective neurodevelopmental risk is more robustly associated with cortical structure than objective measures of executive function in the ABCD Study sample

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Objectives: Neurodevelopmental disorders (NDDs) possess some shared symptoms (e.g., executive function deficits) and structural brain presentations, so it may be useful to study neural processes in NDDs transdiagnostically. We assessed subjective and objective measures of neurodevelopmental risk (ND risk) in relation to structural magnetic resonance imaging (sMRI) metrics in the baseline sample of the Adolescent Brain Cognitive Development Study (Release 2.0.1). We hypothesized that greater ND risk would cross-sectionally relate to decreased cortical volume, surface area, and thickness. **Methods:** Youth were excluded for poor MRI data quality (final N=10,605; 48% female; mean age=119 months, sd=7.5). The subjective measure of ND risk was a 15-item neurodevelopmental factor on the Child Behavior Checklist (CBCL; higher score=higher ND risk). The objective measure was a combined score from a set of NIH Toolbox executive function tasks (EF; lower score=higher ND risk). Linear mixed-effects

models were used to assess the relationship between ND risk and sMRI metrics. Fixed effects covariates were child ethnicity, gender, and age and parent education, income, and marital status. Random effects covariates were study site and family (i.e., having a sibling in the study). **Results:** CBCL scores negatively related to cortical volume and surface area (p's<.001; controlling for EF). Semi-partial correlations (sr2) ranged from .003-.005. EF scores positively related to cortical surface area (p<.008; sr2=.001; controlling for CBCL). No significant results were found for cortical thickness. **Conclusions:** Findings support the idea of studying NDDs transdiagnostically and our hypothesis that greater ND risk relates to decreased cortical structure, albeit effect sizes are very small. Interestingly, the subjective measure of ND risk was more robustly associated with cortical structure than was the objective EF measure, which may be due to CBCL reflecting a broader range of function.

1-H-48 Relationships between gray matter structure and reading ability in a large, diverse sample: Testing age- and sex-specific effects

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Studies of gray matter (GM) anatomy and reading ability have yet to converge upon reliable effects1. A recent study (N=404) encompassing a broad age range (6-22) failed to identify correlations between reading skill and GM volume across the full sample, but sex-specific effects were found in the 15-22 year old group2. We recently investigated associations between reading skill and GM structure using surface-based modelling to test 2 metrics of GM structure that are genetically and developmentally dissociable3: cortical thickness (CT) and surface area (SA). We found that CT in the left superior temporal cortex was positively correlated with reading skill in 5-9-year-old children4. Here, we will investigate associations between reading skill and CT and SA in a large, diverse sample ranging in age from 5-21 including typical and poor readers. Behavioral and MRI data for this study will be drawn from the Healthy Brain Network Biobank5 (N=1187). We will include participants who have completed tests of word reading and a T1w-MPRAGE MRI scan. Scan quality will be assessed using image quality metrics including contrast-to-noise ratio (CNR), entropy focus criterion (EFC), and Full-Width at Half-Maximum (FWHM) of the spatial distribution of the image intensity; scans with CNR < 4.5, EFC >0.7, and/or FWHM <5 will be excluded. MRI data will be processed and analyzed in Freesurfer. We will test the correlation between CT and SA and reading skill using an exploratory whole-brain approach, with age, sex, CNR and EFC as covariates. We will test for age specific effects within 5 age bins: 5-7, 8-10, 11-13, 14-16, and 17-21, and we will test for sex-specific effects in the full sample and in each age bin. Consistent with our prior result, we expect a positive correlation between superior temporal CT and reading skill in the youngest age bins. We predict that GM structure in the left occipitotemporal cortex will be associated with reading skill in the older age bins.

1-H-49 Childhood sleep problems, mental health, and brain structure: Phenotypic and genetic associations in the ABCD baseline cohort

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Objective: Sleep problems are common in children and may precede the onset of psychiatric disorders. However, little is known about how sleep is related to brain development. Here we examine: 1) how

individual variability in sleep disturbances (SDs: insomnia, arousal, breathing, somnolence, hyperhidrosis, sleep-wake transitions) are related to heterogeneity in psychiatric symptoms (PS) and brain structure in 9-10-year-old youth, and 2) the extent to which childhood SDs are heritable and demonstrate shared genetic etiology with PS and brain size. **Methods:** Data for >10,000 9-to-10-year old youth were obtained from the Adolescent Brain and Cognitive Development study. Linear mixed-effects models were used to examine the relationship between SDs, PS, and MRI measures of brain volume (VOL), surface area (SA), and cortical thickness (CT) in the split-sample for discovery and replication. Genome-wide Complex Trait Analysis was used to compute heritability and genetic correlations. **Results:** SDs broadly predicted higher levels of PS; however, only insomnia showed replicable associations with both PS and brain size. More frequent insomnia was associated with higher PS, and smaller VOL and SA. SNP-heritability was moderate for insomnia (h2=0.16) and sleep-hyperhidrosis (h2=0.16), low-to-moderate for PS (h2=0.03-0.25), and highest for VOL, SA, and CT (h2=0.25-0.37). Insomnia was genetically correlated with multiple PS (i.e., total problems, externalizing, ADHD), but not with brain structure. **Conclusions:** These findings indicate that, among commonly occurring childhood sleep problems, insomnia is uniquely associated with smaller brain size in middle-childhood. Results further suggest that a moderate proportion of variability in pediatric insomnia is due to genetic factors, and that the genetic influences underlying childhood insomnia and mental health are in-part shared. Longitudinal data is required to elucidate temporal causality between poor sleep and psychiatric symptoms.

1-H-50 Distinct associations of deprivation and threat with alterations in brain structure in early childhood

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The impact of early adversity on risk for psychopathology is often examined using a cumulative risk approach in which adverse early experiences are additive. A complementary model, the dimensional model of adversity and psychopathology (DMAP), hypothesized that deprivation and threat impact risk for psychopathology through distinct neurobiological pathways. We examine associations between threat, deprivation, cumulative risk, and brain structure in young children. Based on the DMAP, we hypothesized that threat would be associated with reduced subcortical volume in the amygdala and hippocampus and that deprivation would be associated with reduced cortical thickness in association cortex. The final sample recruited from the Duke Preschool Anxiety Study included 68 children 5-10 years old (55.9% female). We collected and analyzed T1-weighted structural MRI scans using FreeSurfer. Threat was measured by the presence of domestic violence, sexual abuse, physical abuse, or a violent environment. Deprivation was measured by the presence of neglect. Cumulative risk was the sum of early adversity excluded from deprivation and threat. Anxiety was measured by clinical interview. We examined whether deprivation or threat was associated with differences in brain structure controlling for age, gender, scanner, anxiety, cumulative risk, and the other dimension (e.g. deprivation or threat) using the whole-brain vertex-wise analyses in FreeSurfer. We extracted bilateral subcortical volume and examined associations using multiple regression. Threat was associated with smaller amygdala and hippocampal volume and widespread decreases in cortical surface area across the prefrontal cortex and other regions. Deprivation was associated with increased thickness in orbitofrontal, inferior and superior

temporal, and lateral occipital cortices. Results suggest a widespread effect of threat on surface area and distinct associations of deprivation and threat on brain structure in early childhood

1-H-51 Examining associations between stressful life events and hippocampal subfield volumes using the ABCD cohort

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The impacts of early adversity on the brain are well known. Research has fairly consistently shown that early life stress relates to hippocampal structure (i.e., volume) in adulthood. However, findings assessing hippocampal structure during childhood have been mixed. One potential explanation for these mixed findings is that studies often consider the hippocampus as a homogeneous structure (i.e., assess total hippocampal volume), which may mask important associations. Importantly, the hippocampus is a heterogeneous structure comprised of functional subunits, referred to as subfields, which are distributed along the longitudinal axis of the hippocampus. The present study seeks to assess relations between stressful life events and children's hippocampal subfield volumes using data from the Adolescent Brain Cognitive Development (ABCD) sample. Specifically, data will include 4,950 9- to 10-year-old children who provided both stressful life events and structural MRI data. Freesurfer 6.0 will be used to extract hippocampal subfield volumes (CA1, CA3, DG, and subiculum). We hypothesize that stressful life events will relate to volume of CA1, CA3, and DG subfields given research in rodents which suggests that these subfields, in particular, are impacted by early life stress. Measured variable path analysis will be used to assess how variations in stressful life events relate to variations in hippocampal subfield volume. Furthermore, moderating effects of socioeconomic status (SES) and sex will be assessed to determine whether associations vary with respect to SES or sex. Intracranial volume, age, scanner type, and scanner site will be included as covariates. Results will help to clarify conflicting findings of early life stress and hippocampal structure during childhood and will add to the growing body of work focused on how adversity impacts brain development.

1-H-52 Hippocampal structure and memory for spatio-temporal context in toddlers

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The capacity to remember where events occurred emerges in infancy and has been linked to changes in hippocampal structure and function in non-human animals and older children and adults. Here, we sought to examine the association between individual differences in hippocampal volume and memory for spatio-temporal features in young toddlers. We assessed 41 2-year-olds (M = 28.34 months; SD = 2.19 months) during two behavioral sessions held approximately one week apart, allowing for the assessment of memory performance after shorter and longer delays. During each behavioral session, participants completed four 3-piece puzzle tasks. Each puzzle depicted a common object, such as a flower or a boat (see Figure 1). The puzzle tasks were demonstrated by the experimenter and then toddlers were allowed to imitate (Immediate test). During the second session, toddlers were asked to reproduce the puzzle (One-Week test). Spatial accuracy was determined by the proportion of correctly placed pieces on the puzzle board (Immediate: M = 0.65, SD = 0.22; One-Week: M = 0.68, SD = 0.17) and temporal accuracy by the proportion of pieces placed in the correct temporal order (Immediate: M = 0.50, SD = 0.26; One-Week: M = 0.46, SD = 0.18). Hippocampal volumes were obtained through a

structural scan conducted during natural, nocturnal sleep and were analyzed with a semi-automated correction tool applied to volumes initially generated with Free Surfer 5.0. Preliminary results show significant correlations between bilateral hippocampal volume and spatial memory in the immediate test (left: $r(39) = 0.38$, $p < .05$; right: $r(39) = 0.33$, $p < .05$), but not in the long-term test (left: $r(39) = 0.02$, $p = .85$; right: $r(39) = 0.16$, $p = .33$). No significant association was observed for temporal memory either in the immediate or one-week test ($r(39) = 0.10$, $p = .54$). Discussion will focus on possible sources of discrepancies between spatial and temporal memory in the context of this behavioral task.

1-H-53 Differential patterns of delayed emotion circuit maturation related to childhood abuse and psychiatric risk

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Childhood abuse represents one of the most potent risk factors for developing psychopathology, especially in females. Recent evidence suggests that exposure to early-life adversity may be related to advanced maturation of emotion processing neural circuits. However, it remains unknown whether abuse is related to early circuit maturation and whether maturation patterns depend on the presence of psychopathology. The current study examines these questions in a multi-site sample of 246 females (ages 8-18 years) completing clinical assessment, maltreatment histories, and high-resolution T1 structural magnetic resonance imaging (MRI). Girls were stratified by abuse history and internalizing disorder diagnosis: Typically-Developing (TD; no abuse/no diagnosis), Resilient (abuse/no diagnosis), and Susceptible (abuse/current diagnosis). Machine learning models of normative brain development were aggregated in a stacked generalization framework, trained to predict chronological age using gray matter volume in whole-brain, emotion, and language circuit parcellations. Brain age gap estimates (BrainAGEs; predicted age minus true chronological age) were calculated as indices of relative circuit maturation. Childhood abuse was related to reduced BrainAGE only in emotion circuits. Younger emotion circuit BrainAGE was further related to increased hyperarousal symptoms. Feature influence analyses revealed differential neural contributors to BrainAGE in abused girls, especially in lateral prefrontal, parietal, insular cortices, and hippocampus. These results suggest that abuse exposure in girls is associated with delayed structural maturation in emotion circuitry, a potentially adaptive mechanism to enhance threat detection. However, the differential influence of fronto-parietal cortices and hippocampus on circuit maturity in Resilient girls may represent neurodevelopmental markers of reduced psychiatric risk following abuse.

1-H-54 Prenatal cannabis exposure and brain surface morphometry in neonates

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Objectives: Prenatal cannabis exposure (PCE) has been linked to neurodevelopmental consequences for the offspring in childhood; however, it is unclear if differences in neonatal brain structural morphometry (cortical thickness and surface area) are evident at birth. **Methods:** Data derived from the Moms Helping Moms study, a prospective pre-birth cohort of two groups of mother-infant pairs, 22 with prenatal

cannabis exposure and 26 with no cannabis exposure. Maternal cannabis use was based on self-report during the 3rd trimester and again at delivery. T1-weighted structural images were obtained on neonates at a mean postnatal age of 24.48 days (SD = 8.68 days, range = 13-58 days) using a Siemens Magnetom Prisma. The analysis focused on the prefrontal, occipitotemporal, and temporal regions. An infant-adapted version of the CIVET tool was used to estimate mean cortical thickness and surface area based on the Destrieux cortical parcellation. Group differences in global brain volume as measured by total intracranial and total brain volume were evaluated using an ANCOVA with infant age at the time of the scan, infant sex, total intracranial volume, and maternal tobacco use as covariates. **Results:** No significant differences in cortical thickness were detected in the regions of interest. However, surface area was significantly lower among the infants with PCE in the left superior frontal gyrus ($\beta = -1.14$, $p < 0.05$), left lingual gyrus ($\beta = -1.76$, $p < 0.001$), right lingual gyrus ($\beta = -1.28$, $p < 0.05$), and left fusiform gyrus ($\beta = -2.22$, $p < 0.01$), compared to infants with no PCE exposure (see Figure 1). Consistent results were detected for total intracranial volume ($\beta = -41290$, $p < 0.05$) and total brain volume ($\beta = -41426$, $p < 0.01$). **Conclusions:** These findings suggest structural differences associated with PCE can be detected shortly after birth and may reflect cannabis-related alterations in fetal brain development.

1-H-55 Stress in early and late childhood interact to predict structural brain development in adolescence: Evidence for the mismatch stress hypothesis

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Stressful experiences can alter brain development. We know little, however, about whether stress in early childhood moderates the impact of subsequent stressful experiences on the maturation of grey and white matter in adolescence. In a community sample of 119 adolescents (mean age=11.51 years at Time 1), we conducted longitudinal tensor-based morphometry (TBM) over an approximately two-year period to assess patterns of volumetric expansion and contraction across the brain that were associated with the interaction of severity of stress in early and in late childhood. Participants completed interviews assessing different types of stressful experiences and their age at onset. A panel of raters coded interview responses for severity of each stressful experience reported. We defined stress severity in early and late childhood as the rating given to the most severe stressful event that occurred before and after age 6 years, respectively. We found significant interaction effects on volumetric changes in 15 brain regions, including the cingulate, superior frontal gyrus, superior temporal gyrus, anterior corona radiata, and cerebellum. Fourteen of the 15 regions showed the same cross-over interaction effect - adolescents who experienced either consistently low or high severity of stress across childhood showed similar levels of regional contraction, whereas adolescents who experienced severe stress only during either early or late childhood showed similar levels of regional expansion. Post-hoc analyses showed that greater contraction in the cingulate clusters were associated with decreasing anxiety and depressive symptoms over the same time period. Thus, normative loss of cingulate grey matter during adolescence may be one positive adaptation that confers resilience following consistently low or high stress across childhood. We interpret our longitudinal TBM findings as providing support for the mismatch stress hypothesis (e.g., Nederhof & Schmidt, 2012).

1-H-56 Brain maturation and aging on early-onset consumption of cocaine: Neurophysiological patterns extracted by deep regression convolutional neural networks (CNNs) from

t1-weighted MRI images.

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Cocaine is a dopamine (DA) reuptake inhibitor that can be smoked (SC) or insufflated (IC), which present different pharmacokinetics and behavioral pattern of consumption. Our work has shown that the administration route can drive interoceptive differences in consumers, involving insular adaptations. And drive different neuropsychological features, particularly related to the attentive-executive function domain related to frontostriatal structural and functional patterns. These regions are in development during adolescence, when the DA system maturation triggers critical neuroplastic events. On the other hand, drug exposure during adolescence can potentially accelerate/alter developmental processes, resulting in developmental-aging process in stimulant users, that can depend upon the administration route. In the present work, we trained a deep regression convolutional neural network (CNN) to predict age over a large database of t1-weighted MRI images from normal controls. With our methodology, age prediction over test images achieved state of the art, with a mean absolute error 3.5 years. We also estimated attribution maps (occlusion and integrated gradients) of the relevant features from test and validation datasets. We found that previously reported relevant regions to predict age are captured (both subcortical and cortical). Regional importance changes as a function of age, with subcortical regions peaking after the 20s. We evaluated the network in a group of 25 SC dependent, 22 CC dependent, and 25 CTR matched by age, gender, education, and SES. We found that young (below the 20s) consumers (independent from the administration route) show a tendency to aging features. Future work will focus on: improving the training to reduce the error over CTR, elucidating regions, and texture patterns that predict age in CTR samples and finally describe the features that account for the tendency to rapid aging in consumers.

1-H-57 Is habitual nap status related to memory, sleep physiology, and hippocampal volumes during early childhood?

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Research shows that there are marked differences in memory performance between children who nap, and those who do not. Although both habitual nappers and non-nappers benefit from afternoon sleep, habitual nappers' memory is significantly more impaired when they are kept awake. Furthermore, this nap-benefit has been associated with sleep spindle density (Kurdziel et al., 2013). The purpose of this investigation is to explore possible mechanisms that drive memory differences between nappers and non-nappers (i.e. the hippocampus). Participants are preschool-aged children from an ongoing longitudinal study. Preliminary analyses included 21 participants (Mage= 4.55 years, SD=0.51, 9 female). Of these, 8 were habitual nappers (≥ 5 naps/week) and 13 were non-nappers (< 5 naps/week). Each participant completed two home visits (a nap visit and a wake visit; separated by a week and counterbalanced for order) and an MRI session. During home visits, participants completed a visual-spatial memory task before and after an interval of wake (wake condition) or sleep (nap condition). Adjusted change in recall was calculated for each session (e.g. [(delayed recall - immediate recall)/immediate recall]). During the nap visit, each child was also fitted with a polysomnography

montage. Hippocampal volumes were extracted from a T1 weighted MRI scan and refined using the Automated Segmentation Adapter Tool. There were no group differences in age, sex, or ICV between nappers and non-nappers, thus these measures were not controlled for (ps > .29). A one-way ANOVA revealed significant differences in hippocampal tail volumes between nappers and non-nappers. Specifically, nappers had larger left hemisphere volumes, $F(1,19) = 8.51$, $p < .01$. These findings suggest that differences in hippocampal structure may account for disparities in memory performance between nappers and non-nappers. Future analysis will examine differences in memory and sleep spindle density between nappers and non-nappers.

1-H-58 The development of corticostriatal connectivity and goal-directed learning across adolescence

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During adolescence, individuals must learn to make autonomous choices that are likely to yield rewarding outcomes. Accordingly, prior work has demonstrated age-related increases in goal-directed learning across adolescence, which involves a "model-based" consideration of the reward structure of the environment. In adults, model-based learning is thought to rely on the caudate nucleus in the striatum, which is a hub with overlapping projections from multiple cortical regions. Further, some have proposed that the degree to which these corticostriatal projections converge may facilitate goal-directed behavior. However, little is known about how patterns of corticostriatal connectivity change over development or how they relate to behavior. In the present study, we examine how age-related changes in the strength and localization of cortical projections to caudate relate to age differences in model-based learning. Participants ages 8-25 underwent a diffusion weighted imaging scan and completed a two-step reinforcement-learning task. Consistent with prior research, engagement in model-based strategies increased with age, reflecting increases in goal-directed choices across adolescence. Although connectivity between medial striatum and ventromedial and dorsolateral prefrontal cortex did not significantly change with age, increased corticostriatal connectivity predicted model-based learning independently from age. In forthcoming analyses, we will compute DICE coefficients to measure the convergence of cortical projections on caudate. We will subsequently test the hypothesis that cortical projections increasingly overlap on the caudate across adolescence, which may drive age related increases in model-based learning.

1-H-59 Sex differences in pediatric regional cerebellar volumes

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The cerebellum, important for acquisition/control of a range of motor and cognitive functions, is crucial to child development. How regional cerebellar structure contributes to motor and cognitive function in boys and girls remains unclear. Addressing this question, regional cerebellar anatomy was examined in 97 typically developing children (50 girls) aged 10-12 years. T1 images were aligned to the SUIT-template and lobular volumes parcellated using an internally developed, manually-validated pediatric cerebellar atlas. The effect of Sex on 18 lobular gray matter volumes was assessed using a MANCOVA, covarying for total cerebral volume. Analysis revealed greater volumes in boys: Right (R) lobules I-V (p=.002), R crus II/lobule VIIb (p=.001), R lobule VIII (p=.001); Left (L) lobule VI (p<.0001), L crus II/lobule VIIb (p<.0001), L

lobule VIII (p=.002); vermis I-V (p<.0001), VIII-X (p<.0001). Pearson correlations with behavioral measures also revealed Sex differences: In girls, WISC processing speed index (PSI) correlated positively with bilateral lobules I-V (rright=.80; rleft=.62), bilateral lobule VI (rright=.73; rleft=.72), L crus I (r=.60), vermis I-V (r=.69) and vermis VIII-X (r=.57); in contrast, in boys, PSI correlated negatively with vermis I-V (r=-.40). Similarly for praxis, girls showed positive correlation with R lobule IX (r=0.52) while boys showed negative correlation with R crus I (r=-.42), R lobule IX (r=-.44), and L crus I (r=-.54). Finally, for motor function, assessed using the mABC-2, boys showed negative correlation of total score with bilateral crus I (rright=-.42; rleft=-.44) and negative correlation of manual dexterity with R crus 1 (r=-.36) and aiming and catching with vermis I-V (r=-.43); in contrast, among girls, balance correlated positively with R lobule X (r=0.61). These results suggest sexually dimorphic patterns of cerebellar structure and its association with motor and cognitive function in school-age children.

1-H-60 Family social function impacts hippocampal CA subfield structure

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Our social world influences our thoughts and feelings on a daily basis. An argument with a parent might dampen one's day, while a kind gesture from a sibling might make it. Here, we examined whether interpersonal family dynamics influence hippocampal structure within a normative developmental sample. Prior work has shown that hippocampal structure is influenced by one's environment. For instance, adverse physical and social environments, such as neglect or deprivation, lead to smaller hippocampal volumes and reduced cognitive function. At the other end of the spectrum, enriched physical and social environments lead to increased neurogenesis in the hippocampus, as well as improved performance of hippocampal-dependent tasks. Here, we investigate social experience as a continuum, exploring whether hippocampal structure tracks interpersonal family dynamics in a normative sample. We segmented hippocampal subfield volumes (CA1, CA2/3, dentate gyrus, subiculum, and posterior hippocampus) in a group of 7-to 12-year-olds and young adults (N=158). Self-reported family function was obtained using Systemic Clinical Outcome and Routine Evaluation (SCORE-15), which assesses family strengths, difficulties, and communication. Family function, but not the interaction between family function and age (ps>0.12), predicted greater CA2/3 (β=0.22, p<0.008) and CA1 (β=0.184, p=0.036) volume. Fewer family weaknesses, more strengths, and enhanced family communication all positively related to volume within these subfields. These results indicate that CA2/3 and CA1 are sensitive to normative variation in social environments, with impacts that are evident even in adulthood. These results suggest that both social problems and social successes within typical families influence hippocampal structure. Interventions designed to improve interpersonal interactions within families may thus have benefits not only for sociocognitive function, but also for memory behaviors that rely on the hippocampus

1-H-61 Associations between executive function performance and prefrontal cortex volume in youths with a history of early deprivation

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Objectives: Children reared in orphanages face unique forms of social, cognitive, and physical

deprivation. Early institutionalization has been linked to smaller brain volume and persistent difficulties in executive function (EF) even after children are adopted into well-resourced and highly functioning families. In the current analysis, we examined whether prefrontal brain volume is associated with behavioral performance on an EF task and whether these associations differ between post-institutionalized and comparison youth. **Methods:** One hundred and forty-one 12-to 14-year-old youths (114 adopted; 27 comparison) participated in the study, completing a structural MRI scan and a set-shifting paradigm. The task required participants to flexibly shift between responding to the motion or the color of a visual stimuli that varied in levels of stimulus and response conflict. EF performance was indexed by accuracy and reaction time load, defined as the decrement in performance on hard trials (shift, high conflict) relative to easy trials (repeat, low conflict). Higher load scores denote poorer EF performance. Regional cortical volumes were obtained via Freesurfer parcellation. **Results:** No differences in EF performance were found between groups. Pars opercularis volume negatively predicted accuracy load across all subjects. However, in other prefrontal subregions (caudal anterior cingulate, caudal middle frontal, lateral orbitofrontal), the association between volume and accuracy load was found only for the comparison group. Similarly, medial orbitofrontal and superior frontal gyrus volumes negatively predicted reaction time load only for the comparison group. **Conclusions:** Our results are consistent with previous findings of associations between prefrontal brain structure and EF performance in healthy adults and youths. However, evidence from this analysis suggests that these associations may be disrupted by early adversity as in the case of post-institutionalized children.

1-H-62 No association was observed between SES and the relative volume of the amygdala and the hippocampus

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Motivation: Several studies have hypothesized that the amygdala and the hippocampus are disproportionately susceptible to the impact of socioeconomic status (SES) during brain development, due to their heightened sensitivity to stress and HPA axis activities. However, the reported SES effects on the amygdala and hippocampus so far has been inconsistent, and there is little evidence in support of the presence of a regionalized effect of SES on these brain structures. **Method:** In a large, diverse, and typically developing sample of 9-10 year-old children within the ABCD Study (N=10000), we conduct an empirical examination of the effects of SES on the amygdala and hippocampus and examine the regional specificity of these associations (i.e., controlling for whole brain volume).We examined effect sizes (ΔR2) to quantify the associations between measures of SES, income-to-needs ratio (INR) and parental education, on bilateral amygdala and hippocampus regional volumes. All models controlled for age, sex, and scanner identification. **Results:** In contrast to the above-mentioned hypothesis1,4, we observed no individual differences in the regional volume of the amygdala statistically attributable to INR and parental education. INR was associated with greater regional volume of the left hippocampus ($p = 0.0121$), although the effect size observed was very small ($\Delta R2 = 0.0006$). **Conclusions:** In a large, normative sample of children, we found weak evidence of a localized effect of SES on the volume of the amygdala and the hippocampus, supporting previously reported findings of a global effect of SES on structural brain development. However, we hypothesize a regional effect of SES may be observed in other imaging phenotypes. We will subsequently present results on the associations between SES and

profiles of diffusion and resting-state functional connectivity of the amygdala and hippocampus, and report on the robustness of regional specificity for these brain structures.

1-H-63 Examination of regional cerebellar volumes in boys and girls with autism spectrum Disorder (ASD)

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Alteration in cerebellar structure is a consistent finding in post-mortem studies of autism. In vivo examination of the cerebellar structure, however, has been limited, with MRI studies of autism principally relying on gross cerebellar boundary definitions and on atlases not validated against manual delineation. Addressing this gap, T1 images from 180 children (90 ASD, 90 typically developing (TD); both 70M) aged 8-12 years were aligned to the SUIT template. Lobular volumes were parcellated using an internally developed, manually-validated pediatric cerebellar atlas. Effects of diagnosis (Dx) on regional volumes were assessed using multivariate GLMs controlling for total cerebral volume. Associations with autism-symptom severity were assessed using the Social Responsiveness Scale (SRS) and Repetitive Behavior Scale (RBS). Analyses were Bonferroni corrected. Findings across both boys and girls revealed significant effects of Dx, with ASD children showing smaller volumes in bilateral lobules 1-5 (pR=.007, pL=.005), right lobule 6 (p=.023), and vermis 1-5 (p=.008). Analyses within sex revealed more widespread decreases in regional volumes in boys with ASD, additionally including right Crus 2 (pboys=.008, pgirls=.86), left lobule 6 (pboys=.020, pgirls=.94) and left Crus 2 (pboys=.020, pgirls=.45). Pearson correlations among the entire group of children with ASD revealed higher (more impaired) SRS total score correlated with smaller volumes of bilateral lobules 1-5 (pR=.006, pL=.018) and vermis 1-5 (p=.024), with marginal correlation for right Crus 2 (p=.090). Higher (more impaired) RBS total score correlated with smaller volume of right lobule 6 (p=.048). Findings suggest that, across boys and girls, regional reductions in cerebellar volumes, particularly anterior cerebellum, are associated with childhood autism diagnosis and symptom severity and that abnormalities are more extensive in boys with ASD, involving both anterior and posterior (Crus 2) regions.

1-H-64 Developmental changes in intracortical myelination are associated with ventral striatal dopamine

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Cortical thinning is well established to persist through adolescence, especially in the prefrontal cortex as cognition improves. Recent studies indicate that gray matter thinning may be primarily underlied by increased myelination. In addition,there is emerging evidence that dopamine (DA) may play an important role in myelination. However, how maturation of DAergic systems contribute to myelination and cortical thinning is not understood. Thus, we characterized how striatal neurophysiology and indices of DA mediate the age-related increases in intracortical myelination and cortical thinning. Ninety 12-31 year-olds (45 females) including 170 total sessions across two longitudinal visits 18mo apart were included. 3T MRI scanning included magnetization transfer (MT), to assess myelin content within gray matter, MPRAGE to assess cortical thinning, and R2', to quantify non-heme tissue iron, which has been associated with presynaptic dopamine availability. Whole brain intracortical myelination increased significantly with age ($p < .001$), which were widespread across the cortical surface. ROI analysis

identified particularly robust changes in dorsolateral prefrontal and parietal cortices. We also found that increases in intracortical myelination were associated with decreases in R2' measures in par with developmental changes in these measures after controlling for cortical thickness ($p < .05$), particularly in parietal regions. We will also report on mediation by R2' on the association between myelination and cortical thinning. These results suggest that maturational changes in striatal dopamine may play a role in myelination and cortical thinning through adolescence illustrating an important mechanisms of plasticity through adolescence that can inform normative but also impaired developmental trajectories such as in psychopathology, which predominantly emerges in adolescence.

1-H-65 Intergenerational impact of maternal history of depression on brain structure and child psychopathology

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Background: Maternal depression is related to disturbances in child development. Unknown is whether a history of maternal depression transmits intergenerational effects on brain structure from mothers to their school-age children, impacting child behavior and psychopathology. **Methods:** Structural MRI data was acquired from 26 mother-child dyads enrolled in an ongoing study. Children were mean 7.25 +/- 0.71 SD years at the time of scanning. Thirteen mothers had a history of depression and all completed the Child Behavior Checklist (CBCL) about their children. Structural data were analyzed with Freesurfer 6.0 and regressions were conducted to relate regional cortical thickness to maternal depression and CBCL scores, controlling for child age and sex. **Results:** Maternal history of depression associated inversely with the thickness of the left inferior frontal gyrus (IFG) in both mothers ($t=-3.75$, $p=.001$) and children ($t=-4.08$, $p=.0008$). Left IFG thickness in children associated inversely with their externalizing behaviors on the CBCL ($t=-2.14$, $p=.05$), partially mediating the association between maternal depression history and externalizing behaviors ($p=.012$). **Conclusions:** A history of maternal depression may impact the structure of inferior frontal cortices in both mothers and their children. This intergenerationally transmitted structural effect of maternal depression may contribute to behavioral control deficits in school-age children. Functional connectivity analyses are currently being run to investigate the impact of maternal history of depression and trauma on inferior frontal gyrus connectivity in both mothers and their children. Subsequent analyses will also control for possible confounding variables (e.g., poverty, early adversity, etc.) that are often associated with both maternal depression and offspring development.

1-H-66 Developmental changes in restricted diffusion across early adolescence in 9,137 children from the ABCD Study

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Understanding typical maturational changes in brain structure is essential for understanding behavioural and cognitive development during adolescence. Diffusion tensor imaging (DTI) has been used to probe white matter changes, such as myelination and axonal organisation, with age. However, DTI is an inadequate representation of the complex tissue microstructure in the brain, as extra- and intra-cellular

compartments are not differentiated. Restriction spectrum imaging (RSI) decomposes the diffusion signal into different compartments allowing for greater tissue specificity. We analysed voxelwise associations between age (9-13yrs) and DTI metrics (mean diffusivity, MD; fractional anisotropy, FA) and RSI metrics (isotropic (N0) and anisotropic (ND) intra-cellular ('restricted') signal fraction) using observations from both baseline (n=9,137) and the year 2 follow-up (n=3,902) of the Adolescent Brain and Cognitive Development (ABCD) Study. We used linear mixed effects models to account for familial relatedness among subjects and controlled for fixed effects of MRI scanner, sex, genetic ancestry, ethnicity and socioeconomic status. MD and N0 showed opposite global effects across the brain with the most significant voxel for each measure in the globus pallidus (MD: zMAX=-53.13, N0: zMAX=47.87). This suggests decreasing mean diffusivity with age is likely driven by increased restricted isotropic diffusion. FA and ND demonstrated more localised effects, with ND more sensitive to changes in the cerebral white matter (ND: zMAX=20.47; FA: zMAX=11.58), and these metrics showed a different spatial distribution of effects within subcortical structures. Overall, age was associated with increased restricted diffusion across the brain, which may be due to increased myelination, axonal caliber or glial cell proliferation. Using novel RSI metrics and the unprecedented ABCD sample, we have conducted a comprehensive examination of tissue microstructural changes in early adolescence.

1-H-67 Typical subcortical development is regionally heterogeneous from ages 2-8 years

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Structural magnetic resonance imaging (MRI) provides insight on the phenomena of neural proliferation and pruning with consensus that subcortical gray matter volume increases, then decreases over the lifespan. However, due to challenges associated with acquiring and analyzing pediatric MRI, very little is known about subcortical development in young children. Objective: We characterized trajectories of subcortical volume in typically developing children aged 2-8 years using structural MRI. We hypothesized that regional volume would initially increase followed by a plateau, and that boys would have larger initial volumes and exhibit faster increases than girls. Methods: We acquired 395 T1-weighted structural MRI scans in 123 typically developing children on a 3T GE MR750w MRI scanner at the Alberta Children's Hospital. We processed images with MaCRUISE which integrates multi-atlas segmentation with surface reconstruction to label brain regions including the accumbens area, amygdala, basal forebrain, caudate, hippocampus, pallidum, putamen, thalamus, and ventral diencephalon. We modeled volume trajectories with the nlme package for mixed effects in RStudio with age and sex as fixed effects and subject as a random effect. Results: Most regional volume changes were quadratic (accumbens, amygdala, right basal forebrain, caudate, hippocampus, putamen, thalamus; $p<0.002$, $q<0.002$) while other areas increased linearly (ventral diencephalon, pallidum; $p<0.001$, $q<0.001$). We found a main effect of sex in the left basal forebrain ($p=0.04$) and interactions of sex and age in the ventral diencephalon, and left caudate and basal forebrain ($p<0.03$); boys had larger and more rapidly changing volumes than girls. Sex effects did not survive correction for multiple comparisons ($q>0.05$). Conclusion: These findings will inform future research linking maturational changes in subcortical brain structure to the rapid developments in cognition and behavior in early childhood.

1-H-68 Sensitive periods for the effects of poverty on hippocampal and amygdala volumes at age eight years: environmental mediators and moderators

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Abstract It is well known that poverty affects brain development in regions critical to socioemotional wellbeing such as the hippocampus and the amygdala; yet little is known about whether poverty affects these structures differentially at different points in development. Furthermore, little is understood about which specific aspects of poverty are causally related to hippocampus and amygdala volumes, or which environmental factors buffer or exacerbate poverty's effects. Using a birth cohort, we sought to identify associations between poverty longitudinally measured by income-to-needs ratio (INR) at child age 6 months, 1, 2, 3, 5, and 7 years and hippocampal and amygdala volumes at age 7-9 years. Linear mixed-effects repeated measures models and Johnson-Neyman post-hoc analyses determined that lower INR prior to age 4 and age 2 years was associated with smaller hippocampal and amygdala volumes, respectively (pFDR's< .01). These associations were mediated by unmet basic needs (e.g., food, housing, clothing, healthcare; pFDR's< .01). The effects of INR on hippocampal volumes were moderated by maternal perceived stress, and the effects on amygdala volumes were moderated by maternal stress, neighborhood stability, and environmental enrichment at age 5 (p's<.05). These findings elucidate the temporal specificity of poverty-related effects on hippocampal and amygdala structures. These findings also point to several opportunities to prevent or alleviate the neural consequences of poverty, both during and after poverty's sensitive period.

1-H-69 Sulcal depth in lateral prefrontal cortex predicts working memory in childhood

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Sulci, indentations in the brain, develop over childhood (Zilles et al., 1988; Alemán-Gómez et al., 2013), and demonstrate individual differences linked to cognition (Cachia et al., 2018; Im et al., 2011). Previous studies on working memory (WM), a key facet of cognition, show that WM maintenance engages ventrolateral prefrontal cortex (VLPFC), whereas WM manipulation engages VLPFC and dorsolateral prefrontal cortex (DLPFC; Crone et. al, 2006; D'Esposito et al., 2000). We examined the relationship between sulcal depth in these regions and WM for two tasks: Digit Span Forwards, which taxes maintenance, and Digit Span Backwards, which taxes manipulation and maintenance. As sulcal morphology has been proposed to be functionally relevant to cognition that engages PFC (Sanides, 1964), we hypothesized that there would be a relationship between sulcal depth and behavioral performance, whereby greater sulcal depth predicts better WM. Cortical morphometric analyses were performed on high resolution T1-weighted MPRAGE anatomical scans in 60 participants ages 6-18, from a previously published dataset (Wendelken et al., 2017). Cortical surface reconstructions were generated using Freesurfer. Sulci in lateral PFC were manually defined based on recently proposed definitions (Petrides & Pandya, 2012; Petrides, 2019), resulting in 2,157 labels. Mean sulcal depth was extracted for each sulcus. Our analysis approach revealed that there is a relationship between sulcal depth and Digit Span Backwards scores: the depth of eight sulci predict WM manipulation. While greater sulcal depth predicted better performance for five sulci, shallower depth predicted better performance for three sulci. Finally, these sulci are located around the contours of functionally-defined DLPFC and

VLPFC as proposed by Amiez and Petrides (2007). Taken together, these findings begin to shed light on the complex relationship between sulcal morphology in lateral PFC and the development of WM skills in children.

1-H-70 A data driven approach to examining relationships among environmental experience, hippocampal volume, and externalizing problems

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Childhood adversity (CA; e.g., abuse, poverty) has been associated with increased risk for the development of externalizing behaviors (Piotrowska et al., 2019) and changes in brain structures implicated in behavioral regulation (i.e., hippocampus; Hanson et al., 2011, 2015). However, other dimensions of early experience (e.g., inconsistency; Belsky et al., 2012) may interact with CAs to shape development. Here, we examine interactive effects of CAs with inconsistent discipline (ID) on externalizing problems operating through hippocampal volume. We aimed to integrate SES, dimensional, and multiple risk models of CA, by using a variable subset selection algorithm to assess which CAs (i.e., parent stress, SES, threat, parental absence) interacted with ID to best explain conditional direct and indirect effects. Methods: Cross-sectional data were drawn for a subsample (N=552; 9-18 years; 51% male) of youth in the Healthy Brain Network (Alexander et al., 2017). Hippocampal volume was measured via Freesurfer and harmonized with ComBat (Fortin et al., 2017). Moderated mediation analyses (Hayes, 2015), controlling for gender, age, and whole brain volume, were conducted using best practices in data science (Heinze et al. 2018). Results: All conditional effects were nonsignificant. Best fits were observed for total parenting stress (AICMean=1705.99; AICMin for 97% of the 10,000 bootstrapped resamples), income (AICMean=1819.40; AICMin for 3%). Threat (AICMean range = 2052.01 - 2067.89) and parental absence (AICMean range = 2382.28 - 2597.23) exposures yielded the poorest fits. Conclusion: While no significant effects emerged, our work highlights the potential utility of more complex modeling approaches that may allow future researchers to evaluate the relative importance (i.e., relative variance explained) of frequently cooccurring CA exposures, which could potentially identify combinations of exposures predisposing the greatest risk for adverse neurodevelopmental outcomes.

1-H-71 Developmental trajectories of cortical thickness and surface area and the role of socioeconomic status

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Background: The human brain undergoes a cascade of developmental changes that begin very early in life and extend through adulthood. These patterns are highly influenced by environmental, genetic, and hormonal differences, which ultimately affect regional trajectories of cortical thickness (CTh) and surface area (SA). Despite this knowledge, there is no consensus on what constitutes "typical development". Furthermore, literature examining how environmental variables differentially affect CTh and SA over development remains limited, as most previous normative samples have been skewed towards higher socioeconomic status (SES) youth. The Lifespan Human Connectome Project in

Development (HCP-D) aims to characterize age-related changes in brain networks over typical development using multimodal data from a large sample diverse in race, ethnicity and SES. The goal of the current study is to examine the developmental trajectories of CTh and SA, as well as investigate how SES influences these patterns. **Hypotheses:** We hypothesize that the developmental trajectories of CTh and SA will differ both in their timing and between cortical regions . Second, we hypothesize that the developmental patterns of CTh and SA will differ by SES. **Methods:** Structural MRI (T1w) data for 816 healthy participants (5-21 years) from the HCP-D dataset will be used for this study. Images were acquired on a 3T Siemens Prisma across four sites. Scans will be processed using FreeSurfer software and the Destrieux atlas. Developmental trajectories for CTh and SA will be estimated using a Generalized Additive Model (GAM) approach, with SES entered as a covariate. GAM curves will be clustered by estimated degrees of freedom (EDF) and examined by network. **Implications:** Results will expand on existing research suggesting that CTh and SA are driven by separate processes. Additionally, results will add to the literature on normative neurodevelopment and examine SES's role in brain maturation.

1-H-72 Waves of intracortical myelination and cognitive development during adolescence

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The transition from childhood to adulthood has been considered a sensitive period for higher-order cognition, marked by the refinement and stabilization of neural circuits supporting the dynamic control of attention and behavior. Myelination may play a critical role in stabilizing connectivity during sensitive periods of neurodevelopment, enhancing neural signaling speed and the reliable instantiation of adaptive behavior. Seminal post mortem studies of human brain tissue have identified waves of intracortical myelination from birth through early adulthood. However, it remains unclear how individual differences in the maturational timing of myelination impact cognitive development during adolescence. Here, we leverage in vivo cortical myelin mapping methods and behavioral data from the Human Connectome Project in Development (N=762, ages 8-21) to characterize the maturation of cortical myelin and surges in higher-order cognitive functions. We applied generalized additive modeling to identify windows of significant age-related change in T1w/T2w markers of cortical myelination and cognitive functions measured with the NIH Toolbox Cognition Battery. Age-related increases in cortical myelin followed a sensory-association gradient, with lightly myelinated association areas in canonical fronto-parietal, default mode, and limbic networks exhibiting more protracted age-related changes. Maturation of brain microstructure occurred in parallel with robust increases in executive functions such as working memory, inhibitory control, and set shifting. Future work will leverage 3-wave longitudinal data to characterize lead-lag relationships between cortical myelination and developmental surges in cognitive functioning during adolescence. Together, this approach may provide critical insights into mechanistic pathways driving individual differences in the maturational timing of neurocognitive development.

1-H-73 Sulcal morphology of the lateral prefrontal cortex predicts individual variability in cognitive development

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The human cortex folds in predictable patterns of gyri and sulci (LaGuen et al., 2018). Deep primary sulci emerge early, while comparatively shallow tertiary sulci appear later and deepen through development. Due to their morphological variability and protracted development, a classic, but largely untested, hypothesis situates tertiary sulci as functional landmarks for cognition in association cortex (Sanides, 1964). Here we extend this hypothesis to cognitive development and predict that morphological features of tertiary, but not primary, lateral prefrontal (latPFC) sulci will be associated with the reasoning in children. Cortical morphometric analyses were performed on high-resolution T1-w scans in 65 participants ages 6-18, from an existing dataset (Wendelken, 2017). Subjects were randomly assigned to Discovery (N =37) and Replication (N = 28) samples. 1,829 labels (14 labels per hemisphere, per subject) were manually defined and assessed for sulcal depth and cortical thickness. Each participant also performed a matrix reasoning task. We then employed a data-driven approach with nested cross-validation to predict reasoning performance from sulcal depth. A LASSO-regression was implemented as a regularization technique and revealed that only two tertiary sulci were relevant for reasoning. These two tertiary sulci, along with age explained 50.4% (RMSE: 2.32) of the variance in reasoning score. This model outperformed models with either a) age alone or b) depth of additional surrounding primary sulci. Finally, our model predicted reasoning performance in the Replication sample with high accuracy (R^2= 0.55; RMSE = 2.99). These findings provide strong evidence for tertiary sulci as sources of individual variability in cognitive performance and demonstrate how precise anatomical parcellations can provide valuable insights into the relationship between cortical anatomy and cognitive development.

1-H-74 Microstructural and morphometric associations with body mass index in subcortical grey and white matter in 8201 9-10 year olds from the ABCD study

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Pediatric obesity presents a serious public health concern in the US and worldwide. Neuroimaging studies have suggested a link between reward-related brain regions and obesity. However, many focused on volumetric measures and lacked statistical power. In this study, we applied restriction spectrum imaging (RSI) to study microstructural alterations in the brain associated with body mass index (BMI) in children aged 9-10 years (n=8201). RSI is a diffusion MRI framework which models the diffusion signal as emanating from hindered and restricted water compartments, reflecting the underlying tissue. Voxelwise RSI measures of the restricted anisotropic signal fraction (Ran) and restricted isotropic signal fraction (Riso) were derived for each subject. Volumetric tissue measures were computed using tensor-based morphometry. Linear mixed effects models were employed to test voxelwise associations between BMI and Ran, Riso and tissue volumes, conditioning on fixed effects of age, sex, household income, parental education, pubertal development, genetic ancestry, ethnicity and scanner effects, and Random effects of familial relatedness. Intracranial volume was included as a fixed effect in volumetric analysis. Higher BMI was associated with higher Ran and higher Riso in the basal ganglia, (Ran zmax=13.6, Riso zmax=17.2), amygdala (Ran zmax=6.6, Riso zmax=7.8), hippocampus (Ran zmax=6.8, Riso zmax=7.7) and thalamus (Ran zmax=8.2, Riso zmax=13.1), and with lower Ran and higher Riso in white matter (Ran zmin=-14.4, Riso zmax=16.8). Higher BMI was associated with lower pallidal (zmin=-19.2) and thalamic (zmin=-11.0) volumes and higher accumbens (zmax=9.2), hippocampal (zmax=12.0)

and white matter volumes (zmax=17.1). Our results demonstrate a complex interplay between microstructure and morphometry associated with BMI. Future analyses in the context of reward-motivated behaviours and neuroinflammation may provide important insights into the neural mechanisms related to obesity.

I - Networks

1-I-75 Whole-brain patterns of resting-state functional connectivity following childhood maltreatment

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Childhood maltreatment is a predictor of behavioral and biological outcomes in adulthood (Afifi et al., 2016). Other forms of adversity, such as orphanage care, have been shown to alter the development of functional connectivity several years after caregiver deprivation (Gee et al., 2013). Similar effects have been reported in maltreated individuals but many studies rely upon retrospective report in samples with high levels of psychiatric comorbidity, which may represent etiologically distinct populations compared to prospectively assessed cohorts (Baldwin et al., 2019). Method: In this study, graph theory analysis of resting-state fMRI data from a prospectively assessed cohort of individuals from low socioeconomic backgrounds with and without a history of maltreatment (N = 68) was used to examine whole-brain functional connectivity and its relation to adult adaptive functioning. Results: Though no group differences in adult adaptive functioning were found, main effects of age and sex were observed such that adaptive functioning increased with age and was higher for females than males ($F(3,64) = 8.523$, $p < 0.001$). Further, more variance in community size, a measure of whole-brain network maturity, predicted higher levels of adult adaptive functioning controlling for age and sex ($F(4,63) = 8.513$, $p < 0.0001$). No significant differences were found between maltreated and non-maltreated individuals in the brain metrics investigated, including subcortical eigenvector centrality, variance in community size, or within- or between-system connectivity. Discussion: Both groups were characterized by low socioeconomic status, making it difficult to disentangle the possible effects of general adversity from maltreatment in the current study. However, our results do indicate that rsFC in adulthood is related to current adaptive functioning. As such, future research may find important effects of neuroplasticity as a mechanism of resilience following childhood maltreatment.

1-I-76 Reconfiguration of functional brain networks from resting-state to task during childhood is associated with motor learning and working memory

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Brain networks have the ability to reconfigure when adapting to changing cognitive demands. In healthy adults, brain networks reconfigure to more integrated organization during early learning and more complex cognitive tasks that require the integration of multiple cognitive processes (e.g., working memory). Brain networks also reconfigure to more segregated organization during cognitive tasks that likely rely on a single network and at later stages of learning (e.g. motor execution). It is not known how brain networks reconfigure due to changing cognitive demands during childhood, a time when maturation of functional brain networks during rest results in increases in network segregation and integration. The current study, therefore, characterized functional brain network organization during a

resting-state and two fMRI tasks: a serial reaction time (SRT) task probing motor learning and an n-back task probing working memory in 19 children between the ages of 8-10 years. We used graph theory metrics to quantify network segregation (modularity [Q] and within-module degree [WMD]) and network integration (participation coefficient [PC]). Statistics are reported from t-tests. Network integration increased (decreased Q, increased PC) from resting-state to both tasks ($p<0.05$). Further, network segregation increased (increased WMD) from the SRT task to the n-back task ($p<0.05$). Finally, brain network integration during rest was positively correlated with behavioral measures of motor learning (reaction time; $p<0.05$) and working memory (accuracy and d'; $p<0.05$). Similar to adults, children demonstrated increased integration during early motor learning. Unlike adults where network organization is integrated during working memory, children demonstrated simultaneous increases in integration and segregation. This suggests that children's working memory may rely on the function of specific networks to a greater extent than adults, while integrating information between networks.

1-I-77 Neural systems underlying RDoC social constructs: An activation likelihood estimation meta-analysis

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Understanding atypical social functioning in developmental disorders such as ADHD and ASD requires a robust understanding of social processes among typically developing individuals. The NIMH-supported Research Domain Criteria (RDoC) is a research framework which allows for dimensional exploration across six major domains of human functioning. Within the social domain, RDoC defines four constructs which mediate interpersonal responses, including (i) affiliation and attachment, (ii) social communication, (iii) perception and understanding of self, and (iv) perception and understanding of others. However, the associations among these constructs and the underlying neural systems that support them remain unclear. Here, we sought to further inform the RDoC framework within the social domain and examine constituent constructs from a meta-analytic, brain-based perspective. We assessed activation patterns underlying social tasks by performing a series of coordinate-based meta-analyses using the activation likelihood estimation (ALE) method. A literature search identified 480 fMRI experiments (140 publications; 3,764 participants) of healthy social processing; whole-brain coordinates were extracted and meta-analyzed using the NiMARE Python package (nimare.readthedocs.io, v.0.0.3). ALE meta-analysis of all social fMRI tasks revealed expected consensus in the "social brain", including medial prefrontal (mPFC) and posterior cingulate cortices (PCC) and temporoparietal junction (TPJ). Separate RDoC social construct meta-analyses revealed that self- and other-processing emphasized mPFC and PCC convergence, affiliation relied on bilateral insula, and communication engaged a more widespread network of regions extending beyond the "social brain". While preliminary, these results demonstrate differential patterns of neural support for social functioning, which can be used to inform future RDoC-framed research to examine atypical social functioning in developmental disorders.

J – Mechanisms (hormones, neurotransmitters, physiology)

1-J-78 Paternal parenting influences psychobiological indicators of safety learning in daughters

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Objective: While models of anxiety emphasize the role of family processes and parenting in fear circuitry function during childhood, fathers have been neglected in investigations of threat and safety learning in children. We address this gap through a psychophysiology and parenting study that examines the influence of daughter anxiety and paternal discipline on daughter autonomic reactivity during threat conditioning. ¶**Methods:** Thirty-nine father-daughter dyads, recruited from a sample of predominantly Latina females on a range of anxiety symptoms, participated in this study. Daughters (MAge=9.73, ± 1.74 years) completed a differential threat conditioning and extinction paradigm validated in pediatric populations. Skin conductance response (SCR) indexed psychophysiological responding to conditioned (CS+, CS-) and unconditioned threat stimuli. Fathers reported on their parenting behaviors (e.g. discipline, monitoring, involvement) and provided a Five-Minute Speech Sample, coded for criticism and emotional overinvolvement. Daughters' anxiety was assessed continuously. ¶**Results:** Hierarchical regressions identified father criticism and inconsistent discipline as unique predictors of daughter SCR to unpaired safe stimuli, above child anxiety and controlling for pubertal status ($R2=0.44$, $p<.05$). Importantly, these effects were not observed for the paired conditioned stimuli, suggesting paternal parenting may be contributing uniquely to daughters' heightened physiological responding to safety cues, in the context of threat. ¶**Conclusions:** Criticism and inconsistent discipline may represent distinct dimensions of paternal parenting that are related to girls' threat and safety learning during middle childhood. These dimensions may contribute to daughters' vigilance toward ambiguous input, and apprehension of unpredictable stressors. Findings inform theoretical considerations by highlighting the potential role of father parenting behaviors in daughter fear circuitry function.

1-J-79 Association between changes in GABA and Glutamate through adolescence and age-related change in brain activity underlying working memory

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Improvements in working memory through adolescence have been associated with age-related changes in brain activation as measured by blood-oxygen-level dependent (BOLD) activation in prefrontal and association regions. However, little is known about the neurophysiological mechanisms underlying these developmental changes. Postmortem and 3T MRI studies have shown changes in gamma-aminobutyric acid (GABA)-ergic and glutamatergic (Glu) function consistent with critical period plasticity mechanisms. These changes in GABA and Glu suggest a shift in the balance of excitatory and inhibitory (E/I) neurotransmission toward greater inhibition, contributing to the stabilization of neural circuitry. In this study, we examined changes in GABA and Glu through adolescence relating to age-related changes in fMRI BOLD activity underlying working memory. 135 10-30 year olds (70 females) underwent a 7T fMRI working memory Memory-Guided Saccade (MGS) scan and a Magnetic Resonance Spectroscopic Imaging (MRSI) acquisition to assess GABA and Glu concentrations. An oblique MRSI slice was obtained of 24x24 voxels (1.0x0.9x0.9mm) using a J-refocused spectroscopic imaging sequence (TE/TR=35/1500ms). MRSI results show widespread decreases in Glu with age including in DLPFC ($p < 0.05$) and ACC ($p < 0.001$). Age-related decreases in GABA were observed in ACC ($p < 0.001$) and Anterior Insula ($p<0.001$). We found age-related changes in activation specific to the cue and maintenance periods of the MGS task, such as in Brodmann Area 6 ($p < 0.01$), which we discuss in the context of

developmental shifts in Glu and GABA. These results suggest that changes in excitatory/inhibitory mechanisms may impact brain function underlying cognitive development through adolescence to adulthood.

1-J-80 Androgen receptor genotype is associated with amygdala composition in adolescent females, but not males

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The amygdala - a region involved in emotional learning - is comprised of a heterogenous group of subnuclei. Moreover, these subnuclei contain varying degrees of androgen receptor (AR) density and the amygdala continues to develop late into adolescence, coinciding with an increase in sex steroids during puberty. Therefore, studying the effects of hormones and genetic differences in AR sensitivity on amygdala development could shed light on why internalizing and externalizing behavioral issues emerge in a sex-specific fashion during this time. The goal of the current cross-sectional study was to examine how testosterone and AR genotype relate to amygdala subnuclei volumes in 220 adolescents (46% female; ages 10-17). Total circulating testosterone and AR CAG repeat length - which inversely relates to AR sensitivity - was assessed from morning blood draws and participants completed a T1-weighted MRI scan. Using the in vivo probabilistic CIT168 atlas, 9 distinct amygdala subnuclei volumes were normalized to total amygdala volume to create a relative volume fraction (RVF) for each subject. Linear mixed effects models were performed in each sex to assess the relationship of AR sensitivity or testosterone to the RVF of each subregion, with follow-up analysis to see whether there was an additive or interactive effect of the two. The results indicate that, after FDR correction, only AR genotype was associated with an increased RVF of the lateral nucleus (R2=0.53) but a decrease of the basomedial (R2=0.38), centromedial (R2=0.40), and central (R2=0.33) nuclei in females. No significant associations were detected in males. Testosterone showed no independent, additive, or interactive effect in either sex. These findings suggest that genetic differences in AR sensitivity may be an especially important factor in amygdala development for females. Further research is needed to investigate whether these findings correlate with behavioral outcomes.

1-J-81 EEG-derived spectral processing and the development of working memory through adolescence

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Adolescence is characterized by neurodevelopmental specialization that impacts cognition and decision-making. Simultaneously, changes in the inhibitory (Gamma-Aminobutyric Acid, GABA) and excitatory (glutamate) signaling mechanisms in prefrontal cortex suggest changes in excitatory/inhibitory (E/I) balance which may contribute to developmental changes in cortical signal processing and, consequently, cognitive behaviors. The interplay of GABA and glutamate signaling plays a role in the generation of high frequency oscillations measured through electroencephalogram (EEG). Using EEG, we investigated age-related changes in the gamma (30-70 Hz), beta (15-30 Hz), theta (4-7 Hz) and alpha (8-12 Hz) frequency bands during the delay period of a memory-guided saccade (MGS) task in 148 10-30-year olds. A linear

mixed-effects model and a support vector regression (SVR) were utilized to determine associations between EEG activity (power, event duration, number of events, and trial-by-trial variability), behavior, and age. We found significant age-related decreases for spectral events in the gamma and beta bands and increases in the alpha band. The SVR-machine learning approach found that the delay period measures were more highly predictive of age than the fixation measures. Trial-to-trial variability in EEG activity decreased with age, consistent with decreases in performance variability. Gamma and beta band activity showed significant associations with MGS performance, with increases in these measures corresponding to increases in performance. Together, these data suggest that spectral events in high frequency bands, such as gamma and beta, may be indicative of developmental maturation of cognitive control underlined by maturational changes in GABA/glutamate function. Next steps will investigate associations between EEG findings and MRS evidence of age related changes in GABA and glutamate.

1-J-82 Maternal free fatty acid concentration during pregnancy is associated with mean diffusivity in the newborn hypothalamus

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Maternal overnutrition during pregnancy is a well-established risk factor for offspring obesity, yet the causal pathway remains unclear. Preclinical evidence supports altered hypothalamic (HTH) development in offspring exposed to high levels of circulating free fatty acids (FFA) during gestation as a potential pathway. Further evidence supports Mean Diffusivity (MD) as a replicable phenotype of HTH microstructure in the context of human obesity. Here, we test the hypothesis that maternal FFA concentration during pregnancy is associated with newborn offspring HTH MD, and that HTH MD is of functional/clinical relevance by testing its association with early-childhood body-fat percentage (BF%). Maternal blood samples were collected in early/mid/late pregnancy, and metabolites quantified via LC-MS. Mean FFA across pregnancy was based on our previous work demonstrating a strong positive association with maternal prepregnancy BMI. Newborn MRI-based MD (N=94 mother-child dyads, gest. age at birth (GA)=39.3±1.5 weeks, scan age (SA)=25.3±12.5 days) was derived via the FSL TBSS pipeline. HTH was defined using a high-resolution probabilistic atlas (PV>0.6) and a white matter (WM) ROI defined using the whole-sample mean FA map (>0.2). DXA was used to characterize early-childhood BF% (N=37 longitudinal; 4.8±0.8 years). Multiple linear regression (MLR) was used to test the association between HTH MD and maternal FFA adjusting for GA, SA, sex, and mean WM MD. MLR was used to test the association between HTH MD and early-childhood BF%, also adjusting for breastfeeding status. Maternal FFA concentration during pregnancy was positively associated with mean newborn HTH MD (R^2=5.6%;p=0.02). Mean newborn HTH MD was positively associated with early-childhood BF% (R^2=14.7%;p=0.01). These findings suggest that maternal nutritional status during pregnancy can program offspring HTH, a principal regulator of energy homoeostasis, with implications for obesity risk.

1-J-83 Testing multiple risk factors associated with maternal prenatal inflammation and infant birth and neurodevelopmental outcomes.

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Elevated maternal prenatal inflammation is found to increase risk for various pregnancy, birth, and child neurodevelopmental outcomes. While prenatal inflammation has often been examined as a mediator between singular risk factors (e.g. BMI, depression) and later outcomes, we aim to test the unique and joint contributions of multiple risk factors. In mid-pregnancy, participants (N=141) completed a blood draw and questionnaires; plasma will be assayed for a panel of inflammatory cytokines in July 2020. Neonates (N=120) were scanned at 2 weeks using 3T MRI. Along with relevant covariates, we will test whether prenatal metabolic indicators (pre-pregnancy BMI, diabetes), other chronic conditions (hypertension, asthma), health behaviors (smoking, alcohol use, sleep, diet), psychopathology (anxiety, depression), and perceived (general stress, social support) and objective stress (racist experiences, economic stress) are uniquely and/or jointly associated with concurrent inflammation. Using stepwise regressions, we will examine the unique variation in IL-1B, IL-6, CRP, and cumulative inflammation explained by each risk factor and the change in the total variation explained with the addition of each risk factor, removing unwarranted factors from the model. Using path analysis, we will test whether our inflammatory markers mediate the relationships between our culled set of risk factors and infant birth weight and brain structure and function. We hypothesize that metabolic indicators will be the strongest risk factors associated with inflammation and will be indirectly associated with lower birth weight, larger amygdala volume, and altered patterns of connectivity (Graham et al., 2017) via maternal inflammation. The results of this study will help to evaluate which inflammatory-inducing risk factors uniquely predict, jointly predict, or do not help to further explain inflammation when considered with others and their relation to infant birth and neurodevelopment outcomes.

1-J-84 Depression moderates the association between pollution burden and cortical levels of ascorbate in adolescents

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Both depression and pollution are sources of oxidative stress. Ascorbate (Asc) is a powerful antioxidant that is prevalent in the human brain and may serve a neuroprotective role. We examined Asc levels in the dorsal anterior cingulate cortex (dACC), a brain region linked to depression, in a community sample of depressed and non-depressed adolescents with varying exposure to pollution. 33 depressed adolescents and 13 healthy controls ages 13-18 (13 male; 16.43±1.37 years) underwent magnetic resonance spectroscopy (MRS) at 3T, from which we assessed in vivo concentrations of Asc in the dACC. Depression status was determined using DSM-IV criteria. We used census tract data on pollutant concentrations and environmental conditions (e.g., air quality, cleanup sites) to compute a neighborhood-level index of pollution burden. We conducted linear regressions to test the association between pollution burden percentile and Asc levels, and examined whether depression diagnosis moderated this association. Even after covarying for age, sex, percentage of gray matter in the MRS voxel, and medication use, higher pollution burden percentiles were associated with higher dACC Asc concentrations across participants ($\beta=0.70$, $t(38)=2.28$, $p<0.05$). Further, there was a significant interaction of pollution burden percentile and depression status ($\beta=-0.87$, $t(38)=-2.82$, $p<0.01$), wherein this association was attenuated in depressed adolescents compared to controls. Post-hoc analyses revealed that, at low pollution burden levels, depressed adolescents may have already elevated levels of Asc compared to controls ($p=0.06$). In young adolescents, high Asc levels may reflect a compensatory

response that is necessary to help counteract adverse physiological effects related to experiencing high pollution exposure and depression. Longitudinal research is needed to examine long-term associations among environmental pollutants, antioxidants in the brain, and depression.

1-J-85 Environmental influences on adrenarchal hormones

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Increasing evidence suggests that early adversity is associated with accelerated biological aging. Evolutionary models posit that accelerated development may be advantageous in stressful environments but at a cost to later physical and mental health. Early adrenarche is a known risk factor for later physical health problems, and higher levels of hormones during adrenarche are associated with increased psychopathology and alterations in brain function and structure. However, few studies have examined how environmental factors influence the timing of adrenarche. We pre-registered a study predicting that greater stress (greater early life adversity [ACEs] and lower parent income) will be related to higher levels of, and earlier developmental rises in, salivary adrenarchal hormones (DHEA, DHEA-S, testosterone). We recruited 64 children (35F) ages 4-9 (M=7.4 yrs) from the Philadelphia community, who provided saliva samples via passive drool. Our sample is racially (45% Black, 27% White, 5% Asian, 23% Multi-Racial), ethnically (8% Hispanic-Latinx), and socioeconomically diverse (Parent income range: $2.5K-200K, Med=$53K; Parent education range: 10-20 yrs, Med=13 yrs). Inclusion criteria included no neurological or psychiatric conditions or learning disabilities. We will test for main effects of ACEs and parent income and their possible interactional effects with age on salivary levels of adrenarchal hormones. We will run each model separately for males and females, with and without controlling for race and ethnicity. Exploratory analyses will examine effects of sex X stress interactions on hormones, and the relationship between hormone levels and mental health. All analyses will adjust for collection time of day. Understanding the influences of environmental stress on neuroendocrine events occurring during adrenarche may establish salivary hormones as an early and easily assessed phenotype to identify children at risk of accelerated development and related health pro

1-J-86 Developmental changes in dopamine function support the enhancing effects of incentives on adolescent inhibitory control

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While inhibitory control is consistently found to be limited in adolescents compared to adults, in the presence of reward incentives, adolescent's performance improves to adult levels, supported by increased engagement of cognitive and reward processing regions. How striatal dopaminergic processes support these developmental changes is not understood. Here, we characterize the effects of maturational changes in dopamine-related striatal neurophysiology to age-related improvements in cognitive control during reward incentives using an antisaccade task (AS). Longitudinal fMRI and PET data were collected simultaneously on a 3T Siemens Biograph mMR PET/MRI scanner. We acquired fMRI and AS data with both reward and neutral conditions (50 trials total) in 93 12-32 year olds (1-3 visits; 130 scans total; 61 female), and PET [11C]Raclopride (RAC) reflecting D2/3 receptor concentration, and dihydrotetrabenazine (DTBZ) in 53 adult 18-32 year olds (1-3 visits; 75 scans total; 33 female). MR-based

assessments of tissue-iron (R2') provided a non-invasive, indirect measure of DA-related striatal neurophysiology across the whole sample. As expected, AS performance improved with age for neutral trials, and incentives enhanced AS performance in adolescents. fMRI analyses revealed age-related increases in activation across conditions in the oculomotor control network (frontal eye field (FEF), parietal cortex, dorsolateral prefrontal cortex (DLPFC), and striatum). Importantly, we found increased reward-related modulation of striatal BOLD activation (vs neutral) in adolescence that decreased into adulthood. Finally, in line with the 'Inverted-U' relationship between DA and cognition, individuals with low indices of DA function (RAC & R2'; compared to high) showed increased reward-related modulation. Our results provide compelling novel evidence that developmental changes in DAergic processing underlies reward enhancements behavior in adolescence.

K - Methods

1-K-88 Parents' negative verbalizations are related to adolescents' emotion reactivity and regulation

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Objective: To determine effects of parenting on the neurobiology underlying adolescents' emotion processing **Methods:** Youth (n=32, 14-16 years) underwent fMRI while viewing negative and neutral pictures. Before each negative picture, they were cued with the word "look," indicating they were to passively view each picture, or "decrease," indicating they were to use cognitive reappraisal to downregulate negative emotions. All neutral pictures were cued with "look." During the same experimental session, youth and one of their parents also engaged in a conflict discussion task. The audio from the task was transcribed and coded for positively and negatively valenced statements, and the ratio of negative to total number of coded statements was used as a measure of parent negativity. To determine the relationship between parent negativity and youth emotion reactivity ('look' negative pictures, neutral pictures as baseline) and regulation ('decrease' negative pictures, 'look' negative pictures as baseline), a region-based Bayesian multilevel approach was employed (Chen et al., 2019, Neuroinformatics). Regions-of-interest (ROIs) were selected a priori for their involvement in emotion processing - anterior insula, amygdala, and dorsolateral prefrontal cortex (dlPFC). Effects were tested separately for each left and right ROI using the AFNI program RBA. **Results:** Analyses revealed evidence that parent negativity is associated with greater youth activity in bilateral dlPFC (effects within 95% quantile interval), bilateral anterior insula, and left amygdala (effects within 90% quantile interval) for the emotion reactivity condition. For the emotion regulation condition, we found higher parent negativity was associated with lower ROI activation, but effects were smaller, with estimated probabilities ranging from 0.87-0.90. **Conclusion:** Poor parenting practices may relate to heightened negative emotional reactivity in adolescents but have weaker effects on their regulatory abilities.

1-K-89 Measurement Matters: A factor analytic method for capturing socioculturally- and developmentally-valid measures of children's early environments

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Traditional measures of poverty--such as indices of cumulative risk and broad metrics of socioeconomic status--obscure heterogeneity in the mechanisms through which poverty influences individual differences in child outcomes. The present study draws from contemporary theory and methods to better capture the experiential nuances of poverty. Specifically, we used data from the Family Life Project (N=1,292), and leveraged moderated nonlinear factor analysis (MNLFA; Bauer, 2017) to establish group- and longitudinally-invariant measures of poverty-related adversity from infancy to early adolescence. Results indicated three latent factors--material deprivation, emotional threat, and sociocognitive stimulation--were distinct from each other and from family income. We extended and replicated this measurement model using the baseline wave of ABCD dataset (N=11,875) and examined how each factor varies as a function of key socioeconomic indicators. In the ABCD sample, we found a significant amount of bias at the item-level. MNLFA scores demonstrated a large increase in individual variability than raw scores due to the way it incorporates unique information on individual differences (i.e. scores adjust for which items were endorsed at each time point and by whom). Future analyses in the ABCD will explore the relation between the MNLFA scores and resting-state functional connectivity data to elucidate the ways in which both positive and negative aspects of the environment influence developing brain systems. Implications for ensuring socioculturally-valid measurements of children's early environments are discussed in conjunction with the value of applying the MNLFA method to high dimensional datasets.

1-K-90 Hippocampal subfields in a developmental population: Assessing the reliability of fully-automated segmentation

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Approaches to segmenting the hippocampus vary in the field of developmental cognitive neuroscience. The current "gold-standard" method relies on manual tracing of hippocampal subfields. However, this standard may be a barrier for researchers who do not focus on the hippocampus or are using large datasets as it requires expertise in neuroanatomy, is time-consuming, and often relies on higher image quality than is typically collected. The proposed study seeks to establish the reliability of fully-automated hippocampal subfield segmentation in 4- to 8-year-old children. We plan to compare volumes extracted using two different scans (a standard .9mm3 T1-weighted image and an ultra-high resolution .4 x .4 x 2mm T2-weighted image) and three different methods 1) gold-standard manual tracing, 2) a semi-automated method using Automated Segmentation of Hippocampal Subfields (ASHS) and 3) fully-automated via Freesurfer 7.1. Subfields will include CA1, CA2-4/dentate gyrus, and subiculum. Intra-class correlations (ICC(2,1)) will be used to assess the agreement of segmented volumes. We hypothesize that using both T1- and T2-weighted images in Freesurfer will result in volumes that more closely relate to ASHS volumes compared to using only T1-weighted images. Further, we hypothesize that both automated approaches will result in volumes that are comparable to ASHS. Finally, we hypothesize that ASHS segmentations will most closely align with manual segmentations. Demonstrating reliable segmentation using automated methods in a developmental population will promote replication and open new avenues of research by removing the barrier of manual tracing to examine hippocampal subfields.

1-K-91 Cortical Neurite Density and Orientation Predict Executive Function in Children with and without ADHD

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Neurite Orientation Dispersion and Density Imaging (NODDI) offers enormous promise for illuminating microstructural processes involved in brain development. Through the use of NODDI, our study examined myelination and synapse formation across typical (TD) and atypical brain development, and whether these microstructural properties predict executive function outcomes on NIH Toolbox tasks. Our sample consisted of 196 4- to 7-year-old children (m= 5.64); 100 diagnosed with attention deficit hyperactivity disorder (ADHD), a disorder commonly characterized by executive dysfunction. We found that certain brain regions, particularly the right pars opercularis (Op) and the bilateral caudate and putamen, show age-related neurite density increase that is significantly different from that of the whole brain ($p<0.001$). Further, our findings indicated that the ADHD sample had lower whole brain neurite density (ß=-0.18, $p<0.05$) and higher orientation dispersion ($\beta=0.15$, $p<0.05$) compared to TD, which might suggest that children with ADHD have delayed myelination and synapse formation, along with less coherent neural organization. When we examined brain-behavior associations, we found that ADHD diagnosis moderated the positive association between the left supplementary motor area (SMA) and attentional control ($\beta=0.13$, $p<0.05$). A significant group interaction was also observed between laterality of the Op and set-shifting ability ($\beta=0.15$, $p<0.05$). Greater right laterality differentially predicted the Op-set shifting association across groups. Overall, our findings imply that neurite density and coherence can provide insight into executive dysfunction as it is manifest in young children with ADHD.

1-K-92 Network-based statistics for longitudinal (unbalanced) samples: NBR, an R package

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The connectome models the brain as a set of interacting elements, allowing to characterize the brain from a systems perspective using network science. In particular, Zalesky et al. (2010) proposed Network-based Statistics (NBS) a mathematical approach that allows statistical inferences at the (sub-)network level, with a trade-off between false positive control and higher statistical power than mass univariate approaches (e.g. FDR). Nevertheless, NBS is based on general linear hypothesis testing (GLHT) which potentially limits its application to longitudinal samples, particularly, with an unbalanced sample, i.e., with a variable number of sessions per subject. We implemented a publicly available software R package, NBR (Network-Based R-statistics), that performs linear mixed-effects models (LME) in the NBS framework, allowing the exploration of unbalanced longitudinal samples. We tested GLHT- and LME-NBS in the public dataset INDI-SLIM, which includes 333 participants (145 males; 17-28 y.o.) with two (n=212) or three (n=121) sessions each. All sessions include a resting-state fMRI scan and psychometric data. State anxiety scores and connectivity matrices between brain lobes were extracted. GLHT and LME tested the edgewise brain-behavior relationship for balanced (424 matrices) and unbalanced (787 matrices) samples, respectively. The LME approach found a significant subnetwork, which includes the cingulum, frontal, parietal, occipital, and cerebellum (pFWE = 0.001), while GLHT found no significant results (pFWE = 0.355). In summary, we developed an R package that implements LME for NBS. We

showed that LME-NBS overpowers GLHT-NBS when dealing with unbalanced longitudinal samples. This is important given that missing data is very common in longitudinal samples, and balanced testing could dramatically undermine statistical power. Hence, considering the growth of longitudinal samples in neuroscience, we anticipate this method being potentially useful in the field.

1-K-93 Precision functional brain mapping of individual children

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Precision functional mapping is an approach in which a large quantity of fMRI data is collected from individual human participants. In contrast to standard resting state functional connectivity (RSFC) group-average studies that acquire 5-15 minutes of data from a large sample, this individual-centered approach uses 1+ hours of high quality data per person to capture stable individual variations in functional connectivity. Previously, we collected 5 hours of RSFC data from each of 10 adults (Midnight Scan Club: MSC dataset) to characterize the functional network organization of each individual's brain. Here, we applied this method to a pediatric population in order to 1) test feasibility of this precision functional mapping approach in children, and 2) examine similar and individually variable functional network organization in children. We collected 1-5 hours of RSFC data over 3-12 scan sessions in a span of 1-5 months from each of nine 9-10-year-old children. After data preprocessing, including strict motion censoring, we obtained 56-293 minutes of high-quality, low-motion RSFC data from each child, demonstrating feasibility of high sampling through repeat scanning in children. Similar to our previous findings in adults, we found comparable broad functional network structure across children as well as areas of individual variability. The ability to characterize individual-specific functional brain network organization in a pediatric population has the potential to inform our understanding of typical and atypical development and could be adapted as a clinical tool for informing individualized treatments of developmental psychopathology.

N - Language

1-N-94 Parent input and the neural mechanisms of language development in infants at risk of Autism

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Autism Spectrum Disorder (ASD) is characterized by general impairments in social communication skills, although there is considerable variability in other receptive and expressive language skills. Currently little is known about experiential factors that influence language development in ASD, nor the neural mechanisms underlying this input-output relationship. We investigated these questions in a subsample of infant-mother dyads from a longitudinal, prospective study of ASD biomarkers in 218 infants at either low (LR) or high (HR) familial risk of ASD. The present subsample (n=48) included 25 LR and 23 HR infants, of whom 12 received ASD diagnoses (HR+, oversampled) and 11 did not (HR-). At 18 months of age, 10-minute videos of dyad free-play were transcribed and coded for parent language input, including quantitative measures (tokens) and qualitative measures of lexical diversity (word tokens) and grammatical complexity (mean length of utterance, MLU). At 24 months, resting

electroencephalography (EEG) and standardized assessments of receptive and expressive language skills were collected. Infants exposed to greater quantity and quality of input at 18 months exhibited greater expressive language scores 6 months later. A group*input interaction indicated that HR infants showed stronger input-skill relationships than LR infants, and HR+ showed stronger relationships than HR-. Furthermore, in HR infants, greater/higher quality input was correlated with lower baseline gamma power (30-50 Hz) in frontal electrodes, which significantly mediated relationships between input and later expressive language scores. Results indicate frontal gamma power as a mechanism linking language input to language development in infants at elevated risk of ASD, and suggest that high-risk infants may be even more sensitive to the quantity and quality of their language environments. This has important implications for early intervention to support language development in high-risk children.

O – Brain function

1-O-95 Investigating whether dissociable types of hubs integrate brain function in infants

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Functional networks are organized such that select regions play an integrative role as connector hubs. Evidence suggests that the location of connector hubs is similar in adults, children, and even in infants (Hwang et al. 2013, Wen et al. 2019). Recently, connector hubs have been shown to have dissociable connectivity profiles in adults (i.e., default, control-to-control, control-to-sensorimotor) and that these hub types may have significance for brain function (Gordon et al. 2018; Lynch et al. 2019). Whether dissociable hub types are a property of brain network organization that is inherent at birth or that develops over time to support mature brain function has yet to be determined. In this project, we will test whether the functional connectivity of infants reveals similar types of connector hubs. Fifty infants (age 12-18 mos) from the NIMH funded "When to Worry" study completed natural sleep fMRI scans. 120 adults from WashU (age 18-35 yrs) will be used for comparison. First, modular networks will be identified among regions covering the cortex and subcortex (Seitzman et al. 2020) separately in infants and adults. Participation coefficient, a metric quantifying the ratio of within-network and cross-network connectivity, will be used to identify connector hubs. Connectivity profiles of connector hubs (i.e., average functional connectivity between each hub and 14 different functional networks) for infants and adults will then be categorized into types using similarity-based clustering. We hypothesize that connector hubs will be identified in similar locations in infants and adults, but the connectivity profiles of hubs will not be well differentiated into types in infancy. This would suggest that hubs are an intrinsic property of brain network organization, but the specific functional role of a hub (e.g., control-to-control) is shaped by experience and/or maturation.

1-O-96 Complex emotional processing in young children

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Early childhood is marked by rapid and nonlinear emotional development, however the neurodevelopment that gives rise to this maturation is not understood. Most work in mapping emotional neurodevelopment has relied upon un-naturalistic paradigms, presenting emotional stimuli in the absence of social context. The present study seeks to characterize how young children process complex emotional stimuli--contextualized in social content--and examines how this circuitry may shift

across age. Forty-five 4-7-year-old children watched a 21-minute episode of a children's TV show during multi-echo fMRI scanning. An independent cohort of adults rated this episode on a continuous basis for positive and negative content. This regressor was used to examine neural activation in children. Children demonstrated widespread activation in response to each increasing negative and positive content. Of note, in response to increasing negative content, children demonstrated increased activation of the dorsolateral prefrontal cortex (DLPFC) and decreased activation of the inferior parietal lobule (IPL) and orbitofrontal cortex (OFC). In response to increasing positive content, children demonstrated increased subgenual anterior cingulate and medial OFC as well as decreased DLPFC activation. Temporal and precuneus cortex activation during negative content decreased with age. These results suggest frontoparietal, limbic, and default mode network activation in processing complex emotional stimuli, providing insight to how young children process emotional information and how this activation may shift across development. Further analysis of the network dynamics underlying this processing will be conducted.

P – Brain connectivity

1-P-97 Evaluation of common brain atlases used in the a priori identification of primary functional networks.

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Over the past decade there has been a proliferation of work examining the segregation of the human brain into large-scale functional networks. These parcellation schemes are now commonly used as brain atlases for the a priori identification of functional networks, particularly in developmental research. However, there has yet to be an explicit evaluation as to whether these atlases can be used interchangeably. In the present study, we aim to examine whether common atlases produce comparable measures of average functional connectivity and assess the extent to which the data extracted from each atlas actually adheres to the original parcellation (i.e. network recapitulation). Furthermore, we examined whether network recapitulation varies with age. The resting-state functional scans from 113 subjects ages 8-18 were used to evaluate six parcellation schemes: Yeo 2011, Power 2011, Schaefer 2018 (100, 200, 400), as well as an atlas derived using Neurosynth. After preprocessing, the timeseries from the networks common to all atlases (control, default, dorsal attention and salience) were extracted using the six parcellations. We then calculated the average functional connectivity for each network. To assess whether the timeseries extracted from each atlas are equally able to recapitulate the original networks, a multi-dimensional scaling technique was used. Average connectivity within each network is significantly different across atlases, where the Neurosynth atlas produces the lowest average connectivity and the Yeo 2011 atlas produces the highest. The atlases also do not appear to be equally able to capture the original networks. The data extracted using the Power 2011 atlas was found to best recapitulate the networks of interest, while Neurosynth was the least able to do so. And finally, atlas recapitulation does not appear to vary with age. Taken together these findings suggest that the six atlases assessed should not necessarily be considered interchangeable.

1-P-98 Time-varying lateralization of major white matter tracts in the developing infant brain

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Objective: In the first months of life, infants experience not only the period of greatest postnatal brain growth, but also remarkable refinement of adaptive socio-cognitive skills. While lateralization of white matter tracts may represent the neurobiological specialization that accompanies the emergence of these discrete cognitive functions, little is known about how these structural asymmetries unfold over time. Here, we leverage a longitudinal design to compare trajectories of white matter maturation between the left and right hemispheres. **Methods:** Diffusion MRI data were collected at up to 3 time points between birth and 7 months in N=57 typically developing infants (24f, 33m). Template-based tractography delineated left and right masks for 9 white matter tracts and fractional anisotropy was used to quantify tract maturity. Trajectories were fit using Functional Principal Components Analysis. Left-right bias was quantified using a lateralization index (Dubois et al. 2016) and developmental windows of significant difference were determined by bootstrapped 95% point-wise confidence bands. **Results:** 4 of 9 tracts lateralize before 7 months. The cingulum (Ci), primary motor tract (M1), and uncinate fasciculus (UF) exhibit significant rightward bias and the primary somatosensory tract (S1) exhibits significant leftward bias ($p<.05$). Lateralization begins earliest in S1 (day 10), followed by Ci (day 43), M1 (day 46) and UF (day 180). The AF, ATR, Fx, IFOF, and ILF register no asymmetry. **Conclusions:** As the first study to longitudinally quantify lateralization of these 9 tracts in early infancy, we expand on findings from cross-sectional studies in infants and toddlers to show that white matter lateralizes in a time-varying pattern consistent with the maturational ordering of white matter tracts. Also, the majority of lateralization occurs after 6 weeks of life, suggesting experience-dependent mechanisms may contribute to this indicator of neurological specialization.

1-P-99 Neural predictors of psychosocial outcomes associated with the COVID-19 pandemic in children with autism spectrum disorder

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The 2019 novel coronavirus disease (COVID-19) has resulted in significant restrictions of everyday functions and abrupt changes in behavioral patterns. Children with autism spectrum disorder (ASD) have difficulties with flexibility in daily life and are at increased risk for anxiety and depressive symptoms. Children with ASD experiencing disruptions in daily routine and services as a result of shelter-in-place orders are expected to be especially impacted. Here, we aim to explore the neural predictors of quarantine mental health outcomes by examining brain-behavior relationships across a sample of typically developing (TD) children and children with autism. Data collected during quarantine will include behavioral measures of anxiety and depressive symptoms assessed by the Screen for Child Anxiety and Related Emotional Disorders (SCARED) and Mood and Feeling Questionnaire (MFQ) collected from approximately 70 children with ASD and 70 TD children who previously participated in neuroimaging studies in our laboratory. Functional MRI data will consist of 295 volume (TR=2) resting-state scans collected pre-quarantine and preprocessed using the DPABI toolbox. Independent component analysis (ICA) and dual regression in FSL will be used to identify large-scale executive control networks. Within-network functional connectivity (FC) strength will be associated with anxiety and depression outcomes in both ASD and TD children groups. We hypothesize that children with ASD will show negative associations between FC strength and depression/anxiety symptoms within executive control networks

compared to TD children as disruptions to routine typically have a greater impact on children with ASD and in those with lower executive control network integrity. Knowledge and understanding of quarantine outcomes in children with autism is crucial to promote community recovery and maximize clinical preparedness to offer additional support for those at increased risk for adverse consequences.

Q - Other

1-Q-101 Gut feelings: What the gut-brain axis may reveal about depressive symptomatology during adolescence

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Adolescence is a key period of neurobiological and social-affective development. It is also a time of increased vulnerability to psychopathology, such as depression (Crone & Dahl, 2012). Growing evidence suggests that the gut microbiome can modify neurobiological and social-affective processes as well as potentiated novel therapies for mental and physical health problems (Flannery et al., 2019). Despite the promise of these finding, it remains to be tested if these relationships exist during adolescence; a period of increased malleability within several of these system. Therefore, in a community age-cohort of adolescent (ages 11.5-14.5 years old), we assessed the cross-sectional associations among intrinsic functional brain connectivity, gut microbial composition and function, and depressive symptoms during adolescence; a fundamental period of change across these systems. Depressive symptomatology was measured via parent and self- report questionnaires as well as a semi-structured diagnostic interview. Functional brain connectivity will be assessed via resting state functional connectivity (rsfMRI; amygdala and hippocampal seed to whole brain parcellation). Gut microbial composition and function was sequence for 16sr RNA and functional metagenomics. We provide the first evidence that the functional composition of the microbiome associates with the amygdala resting state functional connectivity during adolescence. Specifically, these findings suggest the functional capacity of the microbiome associates with functional brain connectivity implicated in cognitive control and flexibility, emotional reactivity, and reward-seeking behaviors. Furthermore, both amygdala resting state functional connectivity and the function composition of the gut microbiome are associated with depressive symptomatology during adolescence. This provides the first evidence that the gut microbiome may be involved central neurobiological and affective behaviors during adolescence.

1-Q-102 Parent-adolescent cross-brain connectivity during an fMRI hyperscanning task is associated with adolescent emotion regulation

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Objective: The current study examined associations between parent-adolescent cross-brain connectivity (CBC) and adolescent emotion regulation (ER) strategies. CBC refers to concurrent and/or time-lagged connectivity between parent and adolescent brain regions. **Method:** Thirty-five parent-adolescent dyads were recruited. Before scanning, adolescents completed the Emotion Regulation Questionnaire (ERQ) assessing cognitive reappraisal and emotion suppression strategies. Dyads then completed a conflict discussion task while undergoing fMRI hyperscanning (i.e., simultaneous fMRI). A de-noising procedure

was used to remove speech-related head motion artifacts (Xu et al., 2014). CBC was measured using lagged cross-correlation analyses between the time course of one member of the dyad's emotion-related seed brain region and the other member of the dyad's BOLD time course in the whole brain during the conflict discussion. Seed regions were chosen a priori based on their role in emotion processing and regulation and included the dorsolateral prefrontal cortex (dlPFC), ventrolateral prefrontal cortex (vlPFC), anterior insula, and amygdala. Linear mixed-effect models were used for group analyses with a voxelwise threshold of $p<.001$ and cluster-size correction for multiple comparisons ($p<.05$). Fisher's r-to-z transformed cross-correlation coefficients for statistically significant CBC region pairs were then correlated with adolescent ERQ scores. **Results:** CBC between the parent thalamus and the adolescent right anterior insula seed was associated with decreased cognitive reappraisal ($r = -.36$, $p<0.05$). CBC between the adolescent right superior frontal gyrus and the parent right dlPFC seed was associated with increased cognitive reappraisal ($r = .45$, $p<0.01$) and decreased emotion suppression ($r = -.32$, $p<.05$). **Conclusion:** CBC may be a neural mechanism linking parent-adolescent interactions and adolescent emotional development.

1-Q-103 The influence of cognition and affect aggression following social rejection in adolescent girls

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Background: Although peer victimization increases risk for aggression, not all victimized youth respond aggressively to rejection. Moreover, little is known about the mechanisms that underlie the relation between victimization and aggression. An important first step is to identify cognitive and affective patterns that predispose an individual to aggress after victimization. This is especially important for adolescent girls, who experience more peer victimization than boys and are exhibiting increasing aggressive behavior. Thus, we examined how cognition (e.g., anger rumination) and affect (e.g., guilty feelings) were associated with aggressive behavior in victimized and non-victimized girls. **Methods:** Late adolescent females (n=84, 19.1±1.27 years) underwent Virtual School and aggression paradigms where they interacted with mean, nice, and unpredictable purported peers. They then had the opportunity to aggress by choosing the volume of a noise blast to deliver to each peer. Next, they reported how guilty they felt about their aggressive behavior. Real-world experience of victimization and anger rumination were also assessed. **Results:** Victimized youth were more aggressive ($F(2,81)=3.45$, $p=.05$) and felt less guilty about their aggressive behavior ($F(1,80)=5.65$, $p=.02$) than non-victimized youth. Among victimized youth, higher levels of anger rumination were associated with more aggressive behavior to mean ($r=.31$, $p=.04$) and unpredictable ($r=.35$, $p=.02$), but not nice, peers. **Conclusion:** Victimized youth were more aggressive, and felt less guilty about their aggression, than non-victimized youth. Anger rumination potentiated aggressive behavior. This suggests that feelings of guilt and anger rumination may partially explain why some victimized girls aggress, while others do not. Therefore, interventions aimed at preventing peer-based aggression should include both cognitive strategies to reduce anger rumination and affective strategies to mitigate reduced guilt.

1-Q-104 Effects of violence exposure on fear conditioning and extinction differ by sex during childhood

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Background: Fear conditioning paradigms have shown that fear-potentiated startle (FPS) is a common biomarker of anxiety disorders. The objective of this study was to characterize sex differences in the association between fear learning and type of trauma exposure during development. **Methods:** The study included N=61 (28 girls) 9-year-old children recruited from Detroit. FPS was assessed via electromyographic (EMG) recordings of the eye blink muscle during differential fear conditioning and extinction. Trauma interviews were conducted using the Violence Exposure Scale for Children-Revised (VEX-R). **Results:** Repeated measures ANOVA showed a significant interaction of block*CS type*sex*VEXR during fear conditioning, F=5.67, p=0.02. Follow-up analyses showed that in girls, but not boys, higher violence was associate with greater FPS to the CS+ (M=50.73 µV) relative to girls with lower violence (M=0.66 µV), F=4.54, p<0.05. Conversely, girls with higher VEXR showed lower levels of FPS to the CS+ during extinction compared to girls with lower VEXR scores, F=6.73, p=0.02. VEXR was not associated with extinction in boys. These effects were primarily associated with exposure to violence outside the home, CS+ during acquisition r=0.48, p=0.02. **Conclusion:** Our results suggest that differences in trauma levels and type may be associated with differential fear learning. Girls with greater violence exposure had higher FPS to the danger cue during fear learning, but had lower FPS to the previously aversive stimulus during extinction learning. Because boys did not show the same patterns in FPS, these results suggest a sex difference in the association between type of trauma exposure and learned fear.

1-Q-105 Higher executive control network coherence buffers against puberty-related increases in internalizing symptoms during the COVID-19 pandemic

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Early pubertal maturation has been posited to be a biopsychosocial risk factor for the onset of internalizing psychopathology in adolescence; further, early-maturing youth exhibit heightened reactivity to stressful events even in post-puberty. School closures and enforced social distancing, as well as health and financial uncertainties, during the COVID-19 pandemic are expected to adversely affect mental health in youth, particularly adolescents who are already at risk for experiencing emotional difficulties. The executive control network (ECN) supports cognitive processes required to successfully navigate novel challenges and regulate emotions in stressful contexts; it may buffer against stress-related internalizing symptom increases. We examined whether functional coherence of the ECN, measured via resting-state fMRI 5 years before the pandemic (at T1; Mage=11.29), is a neurobiological marker of resilience to increases in the severity of internalizing symptoms during COVID-19 (relative to 3 months prior; Mage=16.54) in adolescents who were in more advanced stages of puberty at T1 relative to their same-age peers (N=85; 49 F). Covariates included age at both time-points, early life stress, SES, and internalizing symptoms at T1. On average, participants reported an increase in symptoms from the 3 months prior to pandemic to the 2 recent weeks during the pandemic (t(84)=6.00, p<.0001). We found that early-maturing youth exhibited greater increases in internalizing symptoms during the pandemic if their ECN coherence was low (B=0.49, T=3.21, p<.001); in contrast, relative pubertal stage was not

associated with changes in internalizing symptoms in adolescents with higher ECN coherence at T1 (B=-0.06, T=-0.49, p=.630). These findings highlight the role of the functional architecture of the brain that supports executive functioning in protecting against risk factors that may exacerbate symptoms of internalizing psychopathology during periods of stress and uncertainty.

Poster session 2

Friday September 11, 2020

A – Executive functioning

2-A-106 Cardiorespiratory fitness and scholastic performance in 8-12 year olds: an investigation of the mediating role of executive functions

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Objective: This study investigates the extent to which different domains of executive functions (EF) mediate the relationship between cardiorespiratory fitness (CRF) and scholastic performance. More precisely, we examined whether the mediation process was driven by specific or global EF domains, and whether this relationship is specific to certain school topics. **Methods:** Children 8-12 years old (n = 182) completed nine cognitive tests and the multi-stage fitness test. Structural equation modeling techniques were used to analyse whether different domains of EF (inhibition, working memory, cognitive flexibility and a common factor to all EF) mediated the relationship between CRF and school grades, in three domains: (i) mathematics, (ii) grammar, spelling and vocabulary and (iii) text comprehension and expression. Covariate analyses included age and socio-economic status. **Results:** This study shows that the various domains of EF mediate in part the relationship between CRF and (i) mathematics (β= .12, SE=.03, p<.001), and between CRF and (ii) grammar, spelling and vocabulary (β=.12, SE=.03, p<.001). On the other hand, no relationship was observed between CRF and grades in (iii) text comprehension and expression. Interestingly, although EF correlated with school grades, the mediating effect was driven by cognitive flexibility when all EF domains were simultaneously considered. **Conclusions:** These results indicate that EF mediate the relationship between CRF and scholastic performance. Importantly, not all EF domains contributed equally to the mediation process, cognitive flexibility played a leading role across this wide age range of children. Furthermore, the relationship between CRF and academic performance was stronger for mathematics and for lower level language topics, but nonsignificant for higher level language topics which provided a more modulated view of the relationship of CRF on language.

B- Socioemotional processing

2-B-107 Social media use and the not-so-imaginary audience: Behavioral and neural mechanisms of the influence on self-concept

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We investigated the behavioral and neural mechanisms of the relation between social media use (SMU) and self-concept and longitudinal developmental outcomes. Adolescents and young adults (N=150, 11-

21 years old) performed a self-judgement task in an MRI scanner. They rated themselves on 60 traits in the academic, physical and prosocial domain, and also indicated how they thought peers would judge them on these traits (reflected-peer-judgements). Longitudinal questionnaires (1- and 2-year follow-up) were collected to assess positive and negative outcomes. Results indicated that heavier self-reported SMU related to enhanced overlap in self-judgements and reflected-peer judgements. SMU was also paired with less positive overall self-concept, particularly in the academic domain (boys and girls) and physical domain (girls). Neurally, increased SMU was linked to heightened mPFC-activity during self-judgements compared to reflected-peer-judgements, and increased activity during physical compared to academic and prosocial self-judgements. Longitudinal follow-up analyses indicated no evidence for long-term effects on clinical symptoms, prosocial behavior or self-concept clarity. These results point to concurrent negative relationships between self-reported SMU and self-concept, with integration of peer opinions into the self-concept as a potential mechanism. Neural results suggest different self-processing in mPFC. This study highlights the complex nature of influences of social media use on wellbeing.

2-B-108 Developmental and trait anxiety differences in interference from emotional distractors

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Background: The ability to sustain attention and resist distractors facilitates the achievement of goals. Adolescence is associated with heightened emotional reactivity and the maturation of cognitive control, as well as with the emergence of socio-emotional mental health disorders. Anxiety and negative affect associate with poorer executive functioning and differential processing of emotional stimuli. Aims: In this study, we investigated differences between adolescents and adults and as a function of trait anxiety in the effect of emotional distractors on behaviour and brain activity at different cognitive load. **Methods:** Adolescent (N=28, 12-14 years old) and adult (N=23, 23-34 years old) female participants performed a numerical n-back task in the presence or absence of flanking emotional face distractors while functional magnetic resonance imaging data were collected. Participants were split into high and low anxiety groups based on a composite measure of trait anxiety, perceived stress and negative affect. **Results:** Age group and anxiety group differences were observed both in terms of performance of the emotional n-back task, as well as in terms of brain activation. The adolescent and high anxiety groups showed increased activation of occipital regions in the presence of emotional distractors, and this was observed to a greater extent in the high anxiety adolescent group. The high anxiety group also showed greater inference on reaction times from the emotional distractors, and overall poorer working memory performance. **Conclusions:** These results suggest greater processing of emotional distractors in female adolescents than adults, irrespective of the cognitive demands of a task, and that the influence of trait anxiety may vary during development.

2-B-109 Internalising in early adolescence predicts later executive function, not the other way around

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Background: Poor executive functioning (EF) has been proposed to be a risk factor for emotional and behavioural problems. EF refers to a subset of cognitive processes, such as working memory (WM) and

inhibitory control (IC), necessary for complex behaviour. Poorer EF is associated with emotional and behavioural problems in both early and late childhood, as well as adult mental health problems. A dominant view is that poorer EF prevents the optimal development of top-down regulation of emotional responses. **Objective:** Little is known about the direction of these associations and how they influence vulnerability to mental health issues during adolescence, a time of great change in EF and emotional reactivity. **Methods:** In 1,445 participants from the British Avon Longitudinal Study of Parents And Children (ALSPAC) cohort, WM, IC, internalising and externalising (measured by the Strengths and Difficulties Questionnaire) were assessed in early and mid-to-late adolescence. Uni- and bi-directional longitudinal associations between individual and latent measures of both sets of constructs were assessed using structural equation modelling. **Results:** Cross-sectional analyses replicated previously observed associations. In longitudinal analyses, after controlling for associations between measures in early adolescence, early EFs did not predict later internalising or externalising behaviour. Instead, both early internalising and externalising predicted later working memory and internalising predicted later latent EF. **Conclusions:** These results call into question the widely held assumption that individual differences in EF impact on adolescent mental health. They suggest, to the contrary, that emotional well-being may in fact affect maturation or performance of EF during adolescence.

D - Rewards/Motivation

2-D-110 Delay discounting for self and friend in adolescence: An fMRI study

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Adolescents are typically characterized as impulsive with a preference for immediate rewards. Delay discounting (DD) is a key component of impulsivity which reflects their preference for a smaller immediate reward over a larger, delayed reward. Yet, many decisions that adolescents face do not only involve a choice between now and later, but also benefit for self and others. This study took the novel perspective of testing impulsivity in the context of DD where choices could affect outcomes of self and others. The current fMRI study focused on the neural mechanisms of DD for self and best friend. Participants were 96 adolescents (aged 10 - 19) who performed a DD task with the following conditions: 1) immediate reward vs. delayed reward for self (i.e., self now - self delay), 2), immediate reward vs. delayed reward for friend (i.e., friend now - friend delay), 3) immediate reward for friend vs. delayed reward for self (i.e., friend now - self delay), and 4) immediate reward for self vs. delayed reward for friend (i.e., self now - friend delay). Consistent with prior studies, behavioral results showed that adolescents discounted delayed rewards. Compared to other conditions, adolescents more often discounted rewards in the 'friend now - self delay' condition, but did so less often in the 'friend now - friend delay' condition, suggesting that they took into account benefit for the other. Across conditions, younger adolescents were more sensitive to reward magnitude than older adolescents. On a neural level, DD choices relative to a control condition bilaterally activated the lateral prefrontal cortex, caudate, and insula. Furthermore, decisions involving both the self and friend compared to decisions solely involving the self elicited activation in the right temporo-parietal junction and precuneus. Overall, this study highlights the importance of considering social contextual information to understand adolescents' impulsive behaviors and underlying neural mechanisms.

2-D-111 Information about others' choices selectively alters risk tolerance and medial prefrontal cortex activation across adolescence and young adulthood

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Recent studies have found increased risk taking under peer influence in adolescence. However, it is unclear what aspects in the social context influence adolescent decision-making. In this study we take a decision science approach to investigate 1) how information about others' choices influences decision making, 2) how peers differentially influence risky and ambiguous choices and 3) which neural mechanisms underly changes in risky decision making Participants (N=65, age range 14-22) completed an economic choice task while undergoing fMRI scanning. Choice options were systematically varied on levels of risk and ambiguity. On each trial a safer choice (low variability in outcome) and a riskier choice (high variability in outcome) were presented. Participants made choices in two different conditions: a social information condition in which they saw choices of peers and a solo condition in which they did not see any social information. A computational modeling framework was utilized to test whether altered decision making within the social context was related to changes in risk tolerance, ambiguity tolerance or both. Whole brain regressions were performed to test which neural regions respond to changes in risk and/or ambiguity tolerance. Results showed that participants' choices conform to the choices made by the peers. We did not find evidence for age related differences in risk and ambiguity tolerance in the solo condition. Information about others' choices selectively altered risk tolerance and not ambiguity tolerance. Changes in risk tolerance were positively correlated to changes in medial prefrontal cortex activation. These results show that peer influence on decision-making can both increase risky choices as well as increase safe choices and social influence processes alter the risk perception of the choices.

2-D-112 Emotional and intellectual capacities in adolescent risky decision-making and problem behavior.

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Adolescence is a period of intensive cognitive and emotional development. Affective situations imply the estimation of outcomes probability and emotion regulation. The relationship between risk behavior and adolescence and the possible role of cognitive and emotional control is still under discussion. The question was whether it is possible to distinguish between the effects of IQ and emotional intelligence on risky decision-making and problem behavior. Here, the group of adolescents (N=36; Mage=13.7;f=9) was taken from the large sample (N=183; 12-17 yrs; f=79) and divided into two groups differing by general emotional intelligence (MSCEIT v2) and by non-verbal intelligence (Raven matrix). The «EI» subgroup showed the above the large group average score in emotional intelligence and the results below the group average (but still in normal range) in IQ tests. The «IQ» subgroup showed the opposite ratio: high IQ score, low MSCEIT score. Adjusted average in BART (Pleskac, Wallsten, Wang, & Lejuez, 2008) had no significant differences. «IQ» subgroup showed longer reaction time especially after wins (p=0.02) and more careful strategy after loss (p=0.05) than «EI» subgroup. In executive functions comparison, the «EI» subgroup showed lower scores: more impulsive errors in Stroop test and lower accuracy in Bourdon test (p=0,05). The frequency of cases with problem behavior (according to experts

and YSR-Achenbach) was higher in the «EI» subgroup (χ2=6,2, p=0,01). Thus, despite the differences in emotional and non-verbal intelligence adolescents in the situation of laboratory monetary risk-taking shows almost similar results, but the IQ group might use cognitive control to a greater extent, as suggested by a prolonged reaction time (Schonberg et al., 2012).

F - Memory

2-F-113 Prenatal learning and stimulus recognition in newborns using hdEEG, ECG and videography

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Abstract We examined the effect of auditory stimulation and prenatal learning in 34 (initially 45) healthy newborns. For the latter, we presented the fetuses, from week 34 of gestation onwards, with a spoken nursery rhyme in the mother's voice and re-exposed newborns to this familiar, as well as to an unfamiliar rhyme two and five weeks after birth. Infants' sleep-wake state as well as heart rate activity and hdEEG during stimulation were analyzed. Our results demonstrate a calming effect of auditory stimulation in infants who were prenatally "familiarized" to that stimulation, as evidenced by lower heart rates and less waking states. Interestingly, infants also slept more and demonstrated stronger speech-to-brain coupling when hearing the maternal voice or being presented with a new rhyme. In contrast, newborns without experience in prenatal stimulation appeared more aroused (as evidenced by higher mean heart rates and distinct sleep-wake transitions) during the recordings. The results suggest "fetal programming" at multiple levels and point to the specific significance of the maternal voice as well as to the special relevance of unfamiliar speech material at birth.

2-F-114 Effects of spatial boundary on episodic memory in children

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Recent studies found that both spatial and event boundaries can influence episodic memory formation in both children and adults. Furthermore, young children have been shown to be particularly sensitive to the physical property of boundaries, such as continuity and 3D-ness, in their spatial memory. Given that children's ability to map space using boundaries changes over development, we tested whether the effect of boundaries on children's event memory also changes accordingly. Participants were 120 children from 36- to 85-month-old. Each child underwent 6 trials of a where-when episodic memory task in rectangular space with a boundary (2.5 m long and 33 cm high) in the middle. The boundary was one of three types: wall, fence, and line. There were two containers on one side and one on the other side of the boundary. During the task period, the experimenter and participant put three identical blocks into containers in a predetermined sequence. Following the sequential hiding event, the child was asked to put the same kinds of blocks in the same order of location. Overall, we observed a significant increase in general task performance over development (r=0.64, p<.001) and better performance in the wall-type boundary condition than the other two (Z=2.19, p=.029). This finding is consistent with previous studies that continuous, 3D boundaries serve as a clear boundary in children's spatial navigation. A logistic regression was conducted for correctness on each trial with age and boundary type as factors. Besides the main effects of age and boundary type, there was a significant interaction between age and boundary. The results imply that there exists an interaction between spatial and episodic memory,

which is particularly prevalent in young children whose spatial representations are still under development. We interpret these results to indicate the importance of hippocampal spatial representations in the organization of event memory.

2-F-115 EEG oscillations distinguish age-invariant subsequent memory effects of shallow encoding of perceptual features and distinct signatures of deep semantic encoding in young and older elementary-school children and young adults

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Episodic memory traces can result from various cognitive operations, but the relative contribution of semantic and perceptual elaboration across the life-span remains unknown. Here, we investigated subsequent memory effects (SMEs) in young (aged 7-8 years) and older children (aged 10-11 years) and young adults using both neural oscillations and event-related potentials (ERPs). While explicitly encoding colored line-drawings of every-day objects, participants decided (a) which colors were more frequent in the pictures (shallow perceptual task) or (b) whether those objects would fit into a shoe box (deep semantic task). During perceptual encoding, an increased theta activation over mid-frontal electrode sites predicted later successful retrieval of item features across age groups. By contrast, during the deeper semantic encoding task, only young children showed a comparable SME, suggesting that this age group does not flexibly adapt their encoding mechanisms to specific task demands. Older children showed a left (anterior-)frontal SME during item presentation, complemented by a second midfrontal theta modulation leading up to responses in the orienting task. In young adults, we observed only the latter effect, in line with monitoring of response conflict. ERPs revealed age-specific subsequent SMEs in item memory: a midfrontal negativity during item onset predicted successful item memory, in line with attentional fluctuations. For children, the critical time period was the offset of item presentations at 1000 ms: a bilateral prefrontal SME was observed for older children in line with ongoing semantic elaboration, whereas a centro-parietal positivity was observed in young children. Together, these results point to qualitative rather than quantitative changes in the cognitive processes critical for later item and feature memory. Replicating and extending earlier findings, we demonstrate that semantic, but not perceptual encoding shows a prolonged developmental trajectory

G – Environment (Stress, SES)

2-G-116 Do different early environmental risk factors predict different kinds of outcomes in adolescence? Evaluating cumulative and specific risk factors.

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Do different kinds of environmental risk factors (ERFs) predict different kinds of outcomes, or does cumulative exposure to any type of risk predict any type of developmental outcome? First, we claim the existence of a "specificity bias" in the psychological literature; that the methods commonly used show that ERFs have specific effects on certain kinds of outcomes, are unable to rule out where a cumulative risk factor model may be more appropriate. Using data from the UK Millennium Cohort Study, we take an exploratory, data-driven approach to identify associations between a broad set of 31 ERFs measured at 3-years-old or earlier, and 28 developmental outcomes in adolescence, encompassing cognition, behaviour and mental health. We employ Partial Least Squares Canonical modelling, which aims to find

orthogonal principal components in the ERFs and developmental outcomes that maximally explain covariance between two sets of variables. Contrary to the cumulative risk factor model, a single latent risk component did not best explain variance across all the outcomes. For some outcomes, additional domains of environmental risk could explain substantial, additional variance. Household and neighbourhood socio-economic status were the strongest predictors of most outcomes. In addition, initial evidence was found for a specific association between parent's and child's alcohol and tobacco consumption, as well as between parent's and child's mental health problems. Addressing the specificity bias requires additional methodological advancements, to prevent the literature being inundated by unjustified claims of specificity.

2-G-117 Assessing the development of visual working memory in a global context: The INDIA Project

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Visual working memory (VWM) is a highly limited cognitive ability utilised thousands of times per day. The development of the VWM network is affected by early adversity, including poverty, malnutrition, poor sleep hygiene, and many other developmental factors. While this early adversity renders it possible that a child can be trapped in an intergenerational cycle of adversity, the plasticity of these networks makes the VWM network a prime network for assessment, with the potential for future intervention. Participants of the present study were local residents of Uttar Pradesh, the most populous region of India, and a region with some of the worst human development indicators worldwide. Participants' VWM was assessed at either 6 or 9 months of age, and re-tested 12 months later. The lab-based task used to assess the VWM of infants used eye-tracking accompanied by optical neuroimaging with fNIRS. The task involved showing a display of coloured squares on either side of the screen, one side of which changed every 500ms. The optical neuroimaging results indicate functional VWM regions commensurate with previous US and UK based studies. Crucially, many of the significant regions overlap with regions found to be associated with VWM from a meta-analysis of the adult fMRI literature. Additionally, there is a relationship between performance in the task, and SES in several key VWM regions. The eye-tracking results also demonstrate a stable and consistent relationship between looking behaviour in the VWM task across both years, although this relationship is affected by socioeconomic status and gender of the infant. In addition, the stability of some of the looking behaviours across years is strongly affected by the physical growth of the participant, highlighting the importance of nutrition in cognitive performance.

H – Brain structure

2-H-118 Longitudinal trajectories of cognition and white matter microstructure in adolescents

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Background and objectives: Important cognitive changes during adolescence coincide with the maturation of white matter microstructure. This study aimed to characterize longitudinal developmental

trajectories of inhibition, planning, emotion recognition and risk-taking and their association with white matter maturation in a healthy adolescent sample. **Methods:** In an accelerated longitudinal cohort design, n = 112 healthy adolescents between ages 9 and 16 underwent cognitive assessment with the Cambridge Neuropsychological Test Automated Battery (CANTAB) and diffusion MRI over three years. Fractional anisotropy (FA) and mean diffusivity (MD) were extracted for major white matter pathways using TRActs Constrained by UnderLying Anatomy (TRACULA), an automatic probabilistic reconstruction technique. Mixed models were used to analyze age trajectories of cognitive performance and white matter microstructure. **Results:** Inhibition, planning and emotion recognition performance improved linearly across adolescence. Risk-taking developed in a quadratic fashion, with relatively stable performance between 9 and 12 and an increase between ages 12 and 16. Including cingulum and superior longitudinal fasciculus FA slightly improved model fit for emotion recognition across age. We found no evidence that FA or MD were related to inhibition, planning or risk-taking across age. **Conclusion:** In line with existing studies, we found improvements in inhibition, planning and emotion recognition across adolescence as well as increases in risk-taking in late adolescence. Weak evidence regarding effects of FA and MD challenge the additional value of white matter microstructure to explain neurocognitive development. More longitudinal research with large datasets is needed to identify the potential role of white matter microstructure in cognitive development.

2-H-119 Growth of corticolimbic regions and anxiety disorders in children born very preterm

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Objective: Children born very preterm (VP) display altered brain growth in corticolimbic regions during early childhood compared with full-term (FT) peers. However, the association between this altered developmental trajectory and the rates of anxiety disorders in this population has not been well characterized. This study aimed to compare developmental trajectories of corticolimbic regions in VP children with and without anxiety diagnosis at 13 years relative to FT children. **Methods:** Participants were recruited from the Royal Women's Hospital in Melbourne shortly after birth and were assessed at term-equivalent age (TEA), and again at 7 and 13 years of age. Structural T2- (TEA) and T1-weighted (7 and 13 years) MRI data from 124 VP children were used to calculate whole brain and corticolimbic region volumes (amygdala, hippocampus, parahipppocampal gyrus, entorhinal cortex, rostral and caudal anterior cingulate gyri, frontal pole, medial orbitofrontal cortex, and lateral orbitofrontal cortex) at each time point, and growth across time points. Volumetric z-scores were calculated based on sex-specific regional volumes in 45 FT controls. Presence of an anxiety disorder was assessed at 13 years using a structured clinical interview. **Results:** Anxiety disorder diagnosis at 13 years was associated with reduced bilateral hippocampal and left medial orbitofrontal cortex volumes from TEA to 7 years, before, but not after adjusting for total brain volume and social risk. After adjustment, anxiety was associated with increased left caudal anterior cingulate gyrus and right lateral orbitofrontal cortex volume z-score at 7 years. **Conclusions:** Children born VP with an anxiety diagnosis at age 13 years display region- and time-specific alterations in the corticolimbic system compared with those without anxiety. This work extends

on altered corticolimbic regions findings in VP vs FT children to provide an indication of regions involved specifically in anxiety in this population.

2-H-120 Adverse events in pregnancy and childhood and their relationships with pre-adolescent brain morphology: A population-based study

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Brain development begins in pregnancy and continues at a rapid pace into childhood. Thus, early life may be particularly susceptible to environmental factors, including adverse events. While key to public health, the effects of early-life adversities on child neurodevelopment in the general population are not well understood. Current research is based on small samples and often focused on one adversity. We examined the relation between prenatal and childhood adversities with brain morphology in 2,993 children from the general population. Ten adverse events (e.g. divorce, unemployment) occurring in the last 12 months were reported by mothers at 20-25 weeks of pregnancy. The child's lifetime exposure to four adversities (e.g. physical abuse, parental loss) was reported by mothers at child age 10 years. We separately modeled the cumulative number of prenatal and childhood adversities. The amygdala, hippocampus, cerebellum and total brain, grey and white matter volumes were assessed with magnetic resonance images at 10 years of age. In total, 36% and 35% of children were exposed to at least one adversity in pregnancy and in childhood, respectively. Prenatal adversities were not related to any brain outcome. In contrast, childhood adversities were associated with smaller global brain volumes, even after adjustment for confounders. No limbic differences were observed. Although children exposed to prenatal adversities were more likely to experience postnatal adversities, the prenatal events did not modify the link between postnatal events and brain morphology. Similarly, this association was not explained by maternal psychopathology. Our findings suggest that the cumulative number of adverse events in childhood, but not in pregnancy, is associated with smaller global brain volumes. We offer a unique contribution to the literature, with the first large population-based study to prospectively assess the association between prenatal adversities and the preadolescent brain.

2-H-121 The relations between reading and executive functions challenges in children with developmental dyslexia: A diffusion tensor imaging study

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Developmental Dyslexia (DD) is a reading disorder that affects individuals with average to above-average intelligence and is prevalent in about 15% of children. This condition is also related to challenges in Executive Functions (EF). The aim of the current study was to determine the alteration in white matter (WM) tracts related to reading and EFs difficulties in children with DD Diffusion tensor imaging data, reading and EF were acquired from children with DD and with typical reading (TR), ages 8-12 years. White matter tracts were identified using an in-house pipeline utilizing automatic fiber quantification (AFQ). Fractional Anisotropy (FA) values were calculated in white matter tracts related to reading and EF, analyzed and compared between the groups and correlated with the subject's respective reading and EF scores. Overall, children with DD showed significantly decreased reading and EF abilities

compared to typical readers. White matter clusters with higher FA in TRs compared to DDs were found in the left temporal and right frontal and ventral temporal regions. Clusters with higher FA in DDs compared to TRs were generally found in the left occipito-temporal region and right parietal and dorsal temporal regions. Consistent with our behavioural results, there were also significant associations between FA values, reading and executive functions (i.e., working memory, cognitive flexibility, general EFs and switching/shifting; r≥0.380) for DDs. In particular, significant association with reading was observed in left temporo-parietal tracts, while significant associations with EFs where found in right frontal and parietal white matter tracts and left temporo-parietal tracts in DDs. Our findings suggest that fractional anisotropy may capture clinically pertinent information regarding executive functions abilities in children with DD and suggests the significance of subtle white matter changes in relation to executive functions abilities.

2-H-122 Myelin development and neurodevelopmental outcomes in very preterm and typically developing children

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Background: The T1-T2 ratio can provide important insight into myelin maturity. Children born very preterm (VP) have developmental vulnerability of myelin. This study aimed to (1) determine whether myelin development from term-equivalent to 13 years of age differed in VP and full-term (FT) children; (2) determine how perinatal variables relate to myelination in VP children; and (3) examine associations between myelin measures and neurodevelopmental outcomes at 13 years **Methods:** 198 VP children born <30 weeks' gestation and 56 FT controls underwent T1 and T2-weighted brain imaging at term-equivalent, 7 and/or 13 years of age. Myelin maps were parcellated into 47 white matter regions. IQ, motor outcomes, memory and learning, and behaviour were assessed at 13 years **Results:** At 7 years the T1-T2 ratio was lower in the cingulum bundles, and at 13 in the cingulum bundles and left tapetum, in VP compared with FT children. T1-T2 ratio increased between term-equivalent and 13 years of age, in both birth groups. VP children with neonatal brain abnormality had lower T1-T2 ratios in the corpus callosum and left tapetum at 7 years, and at 13 years in the fornix, bilateral tapeta, and right cingulum. T1-T2 ratios at 7 years were lower in VP children born small for gestational age. Infection was associated with lower T1-T2 ratios in the pontine crossing tract and bilateral corticospinal tracts at 13 years in VP children. Increasing T1-T2 ratio trajectories between 7 and 13 years in the uncinate fasciculus were related to higher IQ scores, and higher T1-T2 ratios in almost all white matter regions at 13 years were associated with improved motor functioning, in both birth groups **Conclusion:** Myelin, assessed using the T1-T2 ratio, matured throughout childhood in all children but was reduced in the limbic system of VP compared with FT children, particularly those born small for gestational age or with brain abnormality. Better myelin development was associated with improved outcomes

2-H-123 Integrating multiple data types to identify novel brain-behaviour subgroups in very preterm born children

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Preterm birth has been associated with altered brain development and poorer cognitive and behavioural outcomes. However, heterogeneity in outcomes among children who were born very preterm makes it challenging to identify the most vulnerable subgroups. In this study we will use a data-integration approach to stratify individuals based on brain-behaviour profiles. We will study 251 very preterm children born at <33 weeks of gestation who participated in the Evaluation of Preterm Imaging Study (Eudra: CT 2009-011602-42), received multi-modal Magnetic Resonance Imaging (MRI) at term equivalent age and were followed-up for neuropsychological assessments at age 4.3 to 7.3 years (median: 4.8). Using Similarity Network Fusion (Nat Methods.2014 Mar;11(3):333-7), a network based data integration approach, we will integrate the following five data types: 1) neonatal Tract-Specific-Analysis of diffusion-MRI (fractional anisotropy and mean, axial and radial diffusivity of superior and inferior longitudinal, uncinate, inferior fronto-occipital fasciculi, corticospinal tracts and the corpus callosum); 2) neonatal voxel-wise Tensor-Based-Morphometry brain volumes; 3) environmental and clinical factors (Index of Multiple Deprivation, gestational age and clinical risk), 4) childhood executive function scores (Behavioural Rating Inventory of Executive Function subscale scores: Inhibit, Shift, Emotional Control, Working Memory and Plan/Organise) and 5) childhood socio-emotional outcomes (scores from the Empathy Questionnaire and Social Responsiveness Scale). Evaluation of the identified data-driven clusters will be made on out-of-model features including IQ and psychiatric outcomes. Identifying at-risk subgroups can guide personalised behavioural interventions aimed at improving psychiatric and cognitive outcomes in vulnerable children.

2-H-124 The use of Fixel-Based Analyses to investigate white matter micro- and macro-structure in school-aged preterm children

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Very preterm (VPT) birth (<33 weeks gestation) is associated with lifelong neurocognitive difficulties. Such difficulties may, at least in part, be due to alterations in brain development. In order to elucidate associations between white matter (WM) development and cognitive outcome following VPT birth, this study will investigate: 1.WM micro- and macro-structure in VPT and term-born children; 2.associations between WM structure and cognitive outcomes; 3.neonatal WM microstructure and childhood cognitive outcomes in VPT children. Participants are 32 VPT children (median gestational age: 29.79 weeks) who participated in the Evaluation of Preterm Imaging Study (Eudra: CT 2009-011602-42). At term-equivalent age (median postmenstrual age: 42.43) they received multi-modal MRI, including diffusion and T1-weighted MR images. VPT participants and 22 term-born controls (median gestational age: 40.21 weeks) underwent childhood neurodevelopmental assessments (median age: VPT: 8.38 years, term-born: 8.42 years). Children completed the Wechsler Intelligence Scale for Children and underwent MR imaging on a 3-Tesla system, including T1 MPRAGE (TR 7.9ms, TE 3.6ms, flip angle 8°, 1mm isotropic) and diffusion-weighted MR images (108 volumes, 12 b=0, 32 b=700, 64 b=2000s/mm2, TR 3800ms, TE 94ms, 2mm isotropic). Neonatal MRI: Tract-specific analysis was performed to produce whole-tract average diffusion tensor metrics. Childhood MRI: will be analysed using fixel-based analysis (FBA). General linear models

will assess a)group differences in FBA-derived WM micro- (fibre density) and macrostructure (fibre bundle cross-section), b)associations between FBA metrics and cognitive scores and c)associations between neonatal WM microstructure (diffusion tensor measures) and cognitive scores in VPT children. An increased understanding of the biological substrates associated with the cognitive sequelae of VPT birth could inform the development of new, targeted interventions for vulnerable samples

2-H-125 Microstructural maturation of language networks in early childhood

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Early childhood is a dynamic period of white matter maturation, with continuous axonal growth and myelination. Developmental patterns of microstructure are generally studied with diffusion magnetic resonance imaging (dMRI) using voxel-based values averaged over entire fibre pathways. Recent tract-profiling approaches provide a means to study more subtle variations in microstructural properties at distinct points along a pathway. In this study, we quantify age-related profiles of tract development in fibre pathways that are involved in language skills both in childhood and adulthood. We included 322 dMRI scans from 103 participants aged 2-8 years (170M;152F) from the longitudinal Calgary Preschool MRI dataset. Data were pre-processed in MRtrix3, correcting for Gibbs ringing, eddy and motion artefact. Automated subject-specific tractography was performed using TractSeg to delineate three segments of the superior longitudinal fasciculus (SLF_I, SLF_II, SLF_III) and the arcuate fasciculus (AF). Along-tract profiling was performed and fractional anisotropy (FA) values were mapped at 20 equidistant points in each tract and compared across ages in 1-year bins. Evidence for a group difference was determined by non-overlapping 95% confidence intervals. We observed the expected age-related increases in FA for all tracts. However, the left SLF_II, SLF_III and AF showed distinct "jumps" in FA between 4-5 years, rather than smooth development across age groups. These discontinuous patterns may correspond with increased language acquisition during this period of development. Future work will include additional microstructural metrics, model the degree of lateralization, and evaluate longitudinal age- and sex-relationships across tract segments. Overall, our findings suggest that white matter microstructural properties along the length of language-network tracts may develop in a stepwise manner rather than smoothly across early childhood.

2-H-126 The influence of stressful life events on trajectories of subcortical structural brain development from adolescence to early adulthood ? A latent curve model approach

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Adolescents often experience stressful life events (SLE), e.g. spanning illness or family conflicts. In line with a recent adversity model (McLaughlin et al., 2019), experiencing threat may reduce amygdala and hippocampus volume during adolescence, which in turn may lead to psychopathological symptoms. Currently, only few longitudinal studies covered this topic with small sample sizes and few time points per participant, which limits disentanglement of the influence of SLE on brain volume at a specific time during adolescence and its change over time. Hence, the aim of this study is to elucidate effects of negatively perceived SLE (assessed with a life events questionnaire) on amygdala and hippocampus volume from early adolescence until young adulthood in a four-wave investigation using structural equation modeling. We assessed structural magnetic resonance imaging data from 247 adolescents at

ages 14, 16, 18, and 22, which we quality controlled and processed using the longitudinal stream of FreeSurfer 6.0.0 Data analysis plan: Using R's toolbox lavaan, we will first test developmental trajectories during adolescence with univariate latent curve models, expecting slight increase in amygdala and hippocampus volume. Similarly, we will investigate latent change of negatively perceived SLE, hypothesizing decrease over time as adolescents might learn to better cope with SLE. Second, we intend to investigate the cross-domain relationship between SLE and amygdala/ hippocampus volume at age 14 and their change until age 22, fitting a parallel latent curve model. The time-invariant covariates sex and socioeconomic status will be taken into account in each model. Result could shed light on how SLE might affect structural brain development during adolescence and thus inform interventions to prevent negative effects on brain structure and thus finally the development of psychopathology.

K - Methods

2-K-127 The longitudinal dynamics between neurobiological correlates of self-referential processing and daily identity formation processes across adolescence

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Aim: Adolescence is a key period for the development of a strong personal identity. Being unable to develop strong identity commitments is predictive of a range of psychosocial adjustment problems. Therefore, it is vital to increase our understanding why some adolescents are able to develop a strong identity whereas others do not. In the present study we therefore examined whether adolescents with daily high identity uncertainty showed differential structural brain development across adolescence and young adulthood compared to adolescents with strong identity commitments. **Method:** To this end, adolescents (N = 150, mean age T1 = 15.92 years, age range 11-21 years) were followed across three waves, covering 4 years. Self-reported daily identity and structural brain data of lateral, medial prefrontal cortex (PFC), and nucleus accumbens (NAcc) was collected across three waves. All hypotheses were pre-registered. **Results:** Latent class growth analyses (LCGA) confirmed 2 identity subgroups: an identity synthesis class (characterized by strong commitments, and low uncertainty), and an identity moratorium class (stable high daily identity uncertainty). Latent growth curve models revealed, on average, delayed maturation of the lateral and medial PFC and stable NAcc. Yet, adolescents in identity moratorium (high daily levels of identity uncertainty) showed lower baseline levels and less decline in NAcc volume. Lateral and medial PFC trajectories did not differ between identity formation subgroups. Additional exploratory analyses revealed that adolescents with higher levels of lateral and medial PFC volume, surface area, and cortical thickness and delayed maturation in these regions reported higher baseline levels and stronger increases of in-depth exploration. **Conclusion:** These results provide insight into how individual differences in brain development relate to fluctuations in identity development across adolescence and young adulthood.

L – Clinical populations

2-L-128 Neurobiological correlates of antisocial behavior across adolescence: a multi-sample, multi-method study

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Background: Adolescents who display antisocial behavior are at high risk of developing a wide range of problems for themselves and for society. Neurobiological measures, such as indices of autonomic nervous system (ANS) and neuroendocrinological functioning, have been linked to antisocial behavior in adolescents. However, findings are mixed, often limited to small case-control studies, within narrow age ranges, and neurobiological measures are rarely studied together. **Methods:** We combined data from 1492 participants (9-27 years, 67% male), from six heterogeneous samples, and tested associations between antisocial behavior and Autonomic Nervous System (ANS) activity, HPA axis activity, and testosterone. Antisocial behavioral measures were derived from a Principal Component Analyses conducted on various self-report measures. **Results:** Three factors emerged: 'psychopathic/callous-unemotional traits', 'reactive/frustration-based aggression', and 'impulsivity/irresponsibility/irritability'. Psychopathic traits were related to shorter pre-ejection period (PEP), and higher levels of testosterone and cortisol. Reactive aggression was related to shorter PEPs, higher respiration rate, and a higher cortisol awakening response. These effects were stable across age. Impulsivity was not related to the neurobiological measures. **Conclusions:** These findings suggest that heightened arousal, reflected in higher SNS and HPA-axis activity, are developmentally-stable markers of psychopathic traits and reactive aggression, while testosterone differentiates between these two behaviors by uniquely predicting psychopathic traits. Although future work should also include psychosocial factors, this study offers a promising starting point for understanding underlying neurobiological factors and the possible use thereof in assessment of specific forms of antisocial behavior in practice.

2-L-129 Development of brain white matter and maths performance in children born very preterm and full-term

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Background: Children born very preterm (VP; <32 weeks' gestation) typically have alterations in brain white matter (WM) and poorer maths performance than full-term (FT; ≥37 weeks' gestation) peers. Cross-sectional diffusion tensor imaging studies suggest a link between WM microstructure and maths in VP and FT children, though longitudinal studies using more advanced diffusion models are lacking. We aimed to analyse associations between fixel-based WM measures and maths at 7 and 13 years and to investigate how WM maturation from 7 to 13 years is associated with development of maths performance across this interval. For both aims we expected these relationships would differ between VP and FT children. **Methods:** Participants completed brain magnetic resonance imaging and the Math Computation subtest of the Wide-Range Achievement Test at 7 and 13 years (n=103 VP; n=21 FT). Fixel-Based Analysis was undertaken to investigate relationships between WM fibre density (FD), fibre bundle cross-section (FC), and combined fibre density and bundle cross-section (FDC) and maths, at 7 and 13 and longitudinally between 7-13. **Results:** As expected, VP children had poorer maths than FT children at

both timepoints, and showed less improvement from 7 to 13. FD, FC and FDC in widespread tracts, including the corpus callosum, corona radiata, corticospinal tract and inferior fronto-occipital fasciculus, were positively associated with maths at 7 and 13 years. Longitudinally, faster development of FDC in the corpus callosum was associated with greater improvement in maths. Associations were similar between groups. **Conclusions:** VP children do not appear to have altered cross-sectional or longitudinal associations between maths and white matter micro and macrostructure, compared to FT peers, despite having poorer performance. In both VP and FT children, the axonal density and cross-sectional area of major WM fibre tracts are associated with maths performance and development in childhood.

2-L-130 Social influence on impulsive choice in adolescents and young adults with attention deficit/hyperactivity disorder

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Impulsivity is a core feature of attention-deficit/hyperactivity disorder (ADHD). Previous work that employed the temporal discounting task to assess ADHD-related impulsivity suggests that children and adolescents with ADHD prefer a smaller-immediate reward over a bigger-delayed reward. However, ADHD-related impulsivity often declines with age, and it is unclear if this differential preference remains into young adulthood. In addition, real-life decision-making often happens in a social context, and peers have a major influence on decisions. When young adults observe peer responses that favor the smaller-immediate reward, their own decisions also become more impulsive. The aim of the current study was to examine temporal discounting and the effects of social influence in male adolescents and young adults (ages 13-23; N = 115) with and without ADHD. We utilized a temporal discounting task, in which participants received manipulated peer feedback on a subset of decisions. Results yielded no differences in baseline temporal discounting between youth with and without ADHD. However, we found a significant interaction between type of peer feedback (impulsive or non-impulsive) and impulsive choice, such that impulsive peer feedback did not alter decision-making, while non-impulsive peer feedback resulted in decreased impulsive choices. This suggests that youth with and without ADHD were more responsive to non-impulsive peer feedback than impulsive peer feedback on their choice behavior. Our findings implicate that peer feedback can lead to decreases in impulsive choice in youth with and without ADHD and may be a promising component in interventions for ADHD.

2-L-131 Residual hippocampal subregions disrupt spatial perception and recall in developmental amnesia

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BACKGROUND: Early-life episodes of hypoxia-ischemia can damage the hippocampus and lead to developmental amnesia (DA). Patients with DA exhibit severe episodic memory impairment while semantic memory is largely preserved. It is not clear however whether the residual hippocampus plays a role in encoding and/or retrieval of new information, or other cortical networks compensate to rescue hippocampal function after early injury. **AIMS:** We aimed to investigate anatomo-functional correlations

between cognitive performance and the volumes of residual hippocampal subregions. **METHODS:** We used manual segmentation on MRI acquisitions to estimate the volume of the Uncus, CA-DG (including CA fields and dentate gyrus) and Subiculum, in an exceptionally large cohort of 21 patients with DA and 23 controls of comparable age. The groups were assessed on: i) the Four Mountains test, which provides measures of spatial perception and immediate spatial memory, and ii) the Doors and People test, which provides equated measures of recognition and recall. **RESULTS:** The level of atrophy was greater in the CA-DG and lower in the Uncus. Patients' spatial perception and spatial memory performance correlated negatively with the volume of the Subiculum. Also, patients' recall, but not recognition memory performance, correlated negatively with the volume of the Uncus. **CONCLUSIONS:** In patients with DA, memory processing is compromised as a function of extent of atrophy in hippocampal subregions, such that the greater the damage, the more likely that extra-hippocampal structures compensate for its putative functions. This leads to the paradoxical finding that greater subregion atrophy results in improved task-dependent memory function.

2-L-132 White matter fiber density and morphology are associated with poor motor performance in children with and without ADHD

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Objective: Although children with attention deficit hyperactivity disorder (ADHD) often present with motor difficulties, few studies have considered the neurobiological basis of poor motor skill in ADHD. We leverage fixel-based analysis (FBA), a fiber specific framework, to test the hypothesis that poor motor performance in ADHD is associated with altered white matter organization of sensorimotor tracts. **Methods:** Diffusion weighted imaging data (b = 700 s/mm2, 2 x 32 directions) were collected on a 3T MRI scanner in a large pediatric cohort (N = 267, 86 children with ADHD, 181 typically developing (TD) children, aged 8-12 years). White matter tracts were reconstructed using TractSeg, a novel and semi-automated tractography method. FBA derived measures of fiber density and morphology were obtained in several sensorimotor tracts of interest. Connectivity based fixel enhancement and permutation-based inference tests were used to examine the association between white matter properties and a standardized assessment of motor function, assessed using the Movement Assessment Battery for Children (MABC-2). **Results:** Relative to TD children, children with ADHD showed reduced overall performance on the MABC-2, as well as all three subscale measures of manual dexterity, balance and aiming/catching. Across the entire cohort, white matter fiber density and/or morphology were positively associated with MABC-2 scores in sensorimotor tracts, including the corticospinal tract, fronto-pontine tract, cerebellar peduncles, superior longitudinal fasciculus and corpus callosum. No significant associations were found in comparison tracts, including the cingulum and fornix. **Conclusions:** This has been the first study to apply FBA to examine the association between white matter architecture and general motor performance in children with and without ADHD. Results suggest that low motor skill across children with and without ADHD is associated with white matter properties of sensorimotor tracts.

M - Attention

2-M-133 Development of attention networks from childhood to young adulthood

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The attention systems model, typically measured using the Attention Network Test (ANT), outlines three subsystems of attention referred to as executive control, orienting and alerting attention. Previous developmental studies have shown improvements in the efficiency of executive control and alerting through childhood, while orienting has been found to be relatively stable across middle childhood. Less is known about how these attention functions develop through adolescence and into young adulthood. Using a mixed cross-sectional (n = 166) and accelerated longitudinal sample (n = 121), yielding total of 408 observations,(n=287, n observations=408, age range = 9-27 years) and linear mixed models, we investigated the development of the efficiency and intraindividual variability (IIV) of the three attention networks following the ratio procedure. Further, in a subsample with structural magnetic resonance imaging data from up to 2 time points (n=143, n scans=205) we examined the relationship between ANT performance and cortical thickness across the whole brain to probe the brain structural correlates of attention networks during development. The results showed a decelerating improvement of executive control efficiency with age, stabilizing around late adolescence. Orienting efficiency improved into young adulthood, with girls outperforming boys. Alerting efficiency showed a linear decrease with age. IIV in executive control did not change with age, while IIV in both orienting and alerting showed age-related changes. Finally, executive control IIV was negatively related to cortical thickness in the right visual cortex, while increased orienting IIV was related to faster thinning in the right superior parietal cortex. The study suggests that executive control, orienting and alerting attention exhibit differential developmental trajectories from childhood to young adulthood, but show limited associations with cortical thickness and developmental thinning.

N - Language

2-N-134 Grey matter volume changes following early intervention in pre-readers at risk for dyslexia

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Recent findings suggest that remediation in dyslexia is most effective if it takes place during the early stages of reading development. At the same time, evidence from MRI studies in several domains provides support for experience-dependent grey matter plasticity. Despite these efforts, the impact of early literacy intervention remains relatively unexplored, particularly when it comes to changes in brain structure. By means of a longitudinal intervention design, we examined intervention-related changes in grey matter volume in pre-readers with an increased cognitive risk for dyslexia. Fifty-two at-risk kindergarteners received tablet-based intervention for a period of 12 weeks. Of those, twenty-eight received an adapted version of GraphoGame, which aimed at training early literacy skills, while the rest received an active control training. An additional group of children without a cognitive risk (n=25) was included to compare the effect of intervention to the typical developmental pattern. The three groups were matched for gender and age. A range of behavioral tests as well as T1-weighted anatomical images

were administered before and after the intervention. Following image pre-processing, volume measures were extracted for six bilateral regions of interest, focusing on areas important for reading development and speech processing. Our analyses revealed literacy intervention-specific changes in temporal cortical regions that were not present in the at-risk children receiving the control intervention and that resembled the typical developmental pattern. We plan to extend these findings by linking volume change and behavioral outcomes as well as by utilizing a longitudinal image-processing pipeline. Our study provides important insights on early intervention-related grey matter plasticity and on the dynamic changes that occur in brain structure throughout early reading development.

2-N-135 Language exposure and brain structure in early childhood

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Language exposure predicts children's linguistic and cognitive skills, but linguistic input varies across different socio-economic status (SES). Conversational experience has been associated with greater white matter across language areas in childhood but is not known from how early impacts brain structure. Here, we investigate the relationship between language exposure and brain development at 6 and 30 months of age. We will focus on the white matter tracts most associated with language processing and cognitive control, the superior longitudinal fasciculus (SLF) and the arcuate fasciculus (AF) but still consider whole-brain myelination. Hypotheses: H1) At both ages, amount of adult input and measures of conversational experience will be positively related to white matter concentrations along SLF and AF. H2) Measures of conversational experience will be more relevant at older ages as language production increases at 30 months. This should strengthen the relationship between conversational turns and white matter concentrations in SLF and AF. To measure language exposure, we used the LENA software, focusing on the maximum hourly adult word count, child vocalisations and turns across several days of home recordings. Myelination in the brain will be assessed using myelin water fraction values following the MRI protocol mcDESPOT. We have collected LENA and MRI data from 78 children. We plan to run linear models on: a) Language input measures (IV) and myelination in SLF and AF (DV). For each region of interest, we will create a hemispheric score based on the difference between myelin on the left versus the right region. b) Language input measures (IV) and whole-brain myelination (DV). Models will include gender as covariate and control for SES and age. Studying the relationship between environmental factors and brain development in infancy is crucial, since neural plasticity in early childhood would allow to implement early intervention programs.

2-N-136 The fetal auditory response to maternal voice

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It has been known for many years that newborn children recognize their mothers voice among other voices. But it is still not clear how and when the fetus learns to discriminate the voice of its mother from other voices. We performed a fetal magnetoencephalography (fMEG) study with 40 pregnant women to investigate the fetal response to maternal voice. We measured auditory event-related (AER) brain activity during stimulation with maternal and a female stranger voice at four timepoints during pregnancy and once after birth. AERs of each subject were calculated on the averaged fetal brain activity for every subject. The average was built on each speech onset time-point after at least 500 ms of silence

during both maternal and stranger stimulation sequences, respectively. We found no difference in AER amplitudes to maternal /stranger voice in the first age-group (26-31 weeks of gestational age (GA); n = 17). For age-group 2 (32-34 weeks GA; n = 16) and age-group 3 (35-37 weeks GA; n = 21) we found significantly higher responses to maternal voice. For age-group 4 (38-42 weeks GA; n = 20) and age-group 5 (newborn; n = 24) we found significantly higher responses to the stranger female voice. Significant time-windows varied between the different age groups. While all four groups that showed significant differences did so in the window between 750 - 1000 ms only age-groups 3 and 5 showed differences in the first 400 ms after speech onset. These results support the hypotheses that voice discrimination in fetuses starts around 31 weeks GA. Additionally, we see a switch in AER amplitudes between maternal and stranger voice, which leads us to the assumption that something changes in fetal valuation of the perceived speech around the 37th week. This change could be based on an emotional or attentional component. A change in fetal reaction around 37 weeks GA was also visible in studies that investigated the fetal heart-rate during maternal speech stimulation.

O – Brain function

2-O-137 Neural correlates of fetal learning of second-order regularities over the course of gestation

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During the last trimester of pregnancy, visual and auditory event-related responses as well as auditory mismatch responses can be recorded non-invasively with fetal magnetoencephalography (fMEG). By using a more complex - hierarchical - auditory oddball paradigm, this method allows to investigate the neuronal correlates of rule learning before birth. fMEG was recorded in 56 participants from 25-40 weeks of gestation during a "local-global" auditory oddball paradigm. The paradigm consists of sequences of four tones (500Hz/750Hz) which can be four same tones or three same tones and one deviant (first-order "local" regularity). In addition, the sequences themselves can be frequent or rare (second-order "global" regularity). After preprocessing and extraction of fetal brain signals, datasets from 43 participants were included. By comparing responses to the forth tone with responses to the third tone of the sequences, we found that fetuses showed a significantly different response towards second order standards or deviants. While a habituation-like response decrement was seen towards standards, responses towards deviants rather increased. This differential response mainly occurred between 400-600ms after stimulus onset. A follow up analysis showed a development over gestation, as this differential response was present in a group of fetuses in weeks 34-40 but not in weeks 25-33. These results show that learning of second-order regularities is already possible in the last trimester of pregnancy and most likely starts a few weeks before birth. Within the framework of the "local-global" paradigm, this form of hierarchical rule learning is seen as a neuronal correlate of conscious processing. Investigating this correlate before birth can give us valuable insights into early cognitive development.

2-O-138 A replication study of neural correlates of aggression following social feedback in middle childhood

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There is much interest in reproducibility in neuroscience, but little is known about replicability of neural activity in childhood. This study examined replicability of social evaluation sensitivity and subsequent aggression, given that social processes are sensitive to individual differences and therefore may be sample specific. We recruited 354 twin participants (7-9 years old) to replicate prior findings by Achterberg et al. (2020). All participants performed the Social Network Aggression Task, in which they received positive, neutral or negative feedback on personal profiles. Subsequently, they could send a noise blast to the peer providing the feedback. We replicated prior behavioral findings, with similar effect sizes: mean noise blast duration was longest after negative feedback and shortest after positive feedback. On the neural level (N=195), four predefined regions of interest showed similar valence effects as previously reported: in the anterior insula (AI), ventrolateral prefrontal cortex (VLPFC) and dorsomedial prefrontal cortex (DMPFC) increased activation was found during negative compared to neutral feedback and to a lesser extent during positive compared to neutral feedback (only significant in AI). We could not replicate condition differences in dorsolateral prefrontal cortex (DLPFC) activity. Brain-behavior analyses, however, demonstrated a replication of an effect previously reported in 9-11 year old twins: children with higher levels of DLPFC activation showed less aggression following negative relative to neutral feedback. Thus, our study replicates prior research in the salience network of bilateral insula-ACC, but partly replicates DLPFC effects. This may indicate that DLPFC activity in response to social feedback is partly sample specific, consistent with the finding that activity is dependent on behavioral differences. Together, findings demonstrate the presence of a neural regulatory mechanism that is in place already in middle childhood.

2-O-139 Global motion evoked potentials in autistic and dyslexic children: a cross-syndrome approach

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Atypicalities in psychophysical thresholds for global motion processing have been reported in many neurodevelopmental conditions, including autism and dyslexia. Cross-syndrome comparisons of neural dynamics may help determine whether altered motion processing is a general marker of atypical development or condition-specific. Here, we assessed group differences in N2 peak amplitude (previously proposed as a marker of motion-specific processing) in typically developing (n = 57), autistic (n = 29) and dyslexic children (n = 44) aged 6 to 14 years, in two global motion tasks. High-density EEG data were collected while children judged the direction of global motion stimuli as quickly and accurately as possible, following a period of random motion. Using a data-driven component decomposition technique, we identified a reliable component that was maximal over occipital electrodes and had an N2-like peak at ~160 ms. We found no group differences in N2 peak amplitude, in either task. However, there was evidence of atypicalities in later stages of processing for both autistic and dyslexic children that require follow up in future research. Our results suggest that early sensory encoding of motion information is unimpaired in dyslexic and autistic children. Group differences in later processing stages could reflect sustained global motion responses, decision-making and/or response generation, which may also distinguish between autistic and dyslexic individuals.

2-O-140 The emergence of self: Neural analyses and heritability estimates of self-evaluations in middle childhood

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How the emergence of the concept of self is influenced by environmental versus genetic factors is a long-standing question. We investigated heritability estimates of behavioral and neural underpinnings of self-concept. To do so, a validated fMRI task was applied in a twin sample of 345 (150 complete twin pairs) participants aged between 7-9 years. Participants were asked to indicate to what extent academic and social traits applied to them by responding with 'yes' or 'no' (self-concept condition). In a control-condition, participants were asked to categorize the trait sentences into 'School' or 'Friends'. The fMRI analyses revealed stronger mPFC activation for self than for control conditions. This effect was more pronounced in the social condition. Stronger DLPFC activation was observed for academic self-evaluations versus social self-evaluations. Genetic modeling revealed that variation in academic self-evaluations was explained for 16-27% by genetic factors, whereas social self-evaluations were explained for 0-20% by genetic factors and for 9-24% by shared environmental factors. Moreover, we report differential genetic and environmental influences on mPFC and lateral PFC for academic (genetic and unique environment) and social (genetic, shared environment, and unique environment) self-evaluations. This is the first study demonstrating in a young twin sample that self-concept development depends on both genetic and environmental factors, depending on the specific domain.

2-O-141 Longitudinal development of self-concept in adolescence: domain differentiation, internalization of perceived peers' opinions and underlying neural activation

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There is a longstanding interest in self-concept development and the underlying neural changes, but earlier studies covered a small age-range or were cross-sectional. In this 3-wave longitudinal fMRI study we examined domain differentiation of self-concept in two conditions: direct- and reflected self-concept. Participants (189 adolescents, 10-24years) rated to what extent a trait in academic, physical, or prosocial domain described them (direct self-concept), or to what extent they think peers would say a trait described them (reflected self-concept). Preregistered (https://osf.io/8gc6x) behavioural analyses showed that in general, self-concept positivity follows a negative quadratic development, with this pattern being most prominent in academic self-concept. Analyses based on the difference score between direct and reflected self-concept indicate that the initial difference between the two (with direct self-concept being more positive than reflected self-concept in young adolescents) declines into and stabilizes after late adolescence. Furthermore, the difference score for academic direct versus reflected self-concept (wave 1) predicted later self-concept clarity (wave 2, 3), whereas the difference score for physical direct versus reflected self-concept predicted later fear of negative evaluation (wave 2, 3). We showed that at the first timepoint, self-evaluations were associated with increased activity in medial PFC, whereas academic and physical domain evaluations additionally activated the lateral PFC. At the time of FLUX congress, we present the results of our preregistered fMRI hypotheses across three waves. This is the first large longitudinal study investigating self-concept development across adolescence, providing great insight into the complex processes regarding behavioural and neural development of self in this turbulent life stage.

2-O-142 The neural correlates of self-evaluations and self-regulation following social feedback in young adulthood

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Self-evaluation is a critical skill to monitor one's own thoughts, traits and actions relative to others. Accordingly, self-evaluations are informed by our own internal reflection of ourselves and by evaluations of the self by others (i.e. social evaluations). Interestingly, the mPFC has been implicated in both types of evaluations, suggesting an intertwined function in monitoring self in relation to others. However, up to now, it remains unclear to what extent these functions overlap in young adults. In the current fMRI study, we used two well-validated experimental paradigms (Self-concept task and Social Network Aggression Task (SNAT)) to (1) replicate previous findings obtained by using these paradigms, with a specific focus on the mPFC activation, and (2) test for overlap between the neural correlates of self and other informed self-evaluations. For both tasks, we replicated previous neural activity findings using region of interest analyses. For the SNAT task, we additionally replicated a brain-behavior association between aggression regulation following negative social feedback and DLPFC activity, possibly indicative of a regulation system. In addition, we found overlapping activity in mPFC for positive self-evaluation and for receiving positive social feedback by others. Taken together, this study (1) further corroborates that the self-concept and SNAT tasks are valid paradigms to measure the neural and behavioral correlates of self- and social evaluation and (2) confirmed an overlapping role of medial PFC in self-evaluation and social feedback processing. By complementing earlier studies in middle-childhood and adolescence and replicating findings in (early) adulthood, our study adds to our understanding of self- and social evaluations across development. In our follow-up study, we will examine whether these behavioral and neural mechanisms can be used to differentiate between developmental trajectories of young adults with a history of antisocial behavior.

2-O-143 Validating valence effects of an emotional go/nogo fmri task in children

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Understanding early neurobiological and behavioral markers of emotion regulation and processing and their impact(s) on cognitive processes are important targets for developmental research. Despite the notable increase in neuroimaging studies investigating biological underpinnings of both behavior and emotion regulation, there are a lack of studies utilizing these paradigms in samples of children. Our objective is to investigate the neural substrates of emotion regulation in a sample of children via a modified emotional Go/NoGo fMRI task. We aim to validate valence-specific effects of this paradigm in children (7-9 years old) and explore individual differences (e.g., SDQ, RCADS) mediating neural and behavioral responses. The task consists of happy, sad, and neutral child faces from the Dartmouth Database of Children's Faces. As our main interest is emotional processing, we adapted Ho and colleagues' (2018) block design with Go blocks consisting of only "go" trials and NoGo blocks having both "go" (75%) and "no-go" trials, each block separated by emotional face type, for robust data acquisition. Using SPM12, pre-processing steps will include realignment of functional volumes, co-registration to an

age-appropriate template for segmentation and normalization, and spatial smoothing. Analyses will consist primarily of per-voxel general linear modelling examining the effects of block type (Go, No-Go) with regressors (e.g., age, sex) and the brain regions associated with valence (i.e., greater right amygdala activity in response to sad vs. happy). Validating valence-specific brain region associations and linking these responses to behavioral and mental health factors in children will provide greater insight into developmental foundations of emotion and individual differences.

2-O-144 Happy for us not them: Neural processing of vicarious rewards for parents and strangers and its links with prosocial behaviors

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The ability to empathize with and feel for others plays an important role during adolescent development of prosocial behavior. In this functional magnetic resonance imaging (fMRI) study, we investigated the neural processing of vicarious reward, in 142 adolescents (age 9-18). In the scanner, participants played a false-choice vicarious reward task, where they could win money for themselves, their mother, father, and a stranger. The results showed bilateral activation in the ventral striatum when winning for oneself. A more specific region-of-interest (ROI) analysis revealed higher activation within Nucleus Accumbens when winning for parents compared with winning for a stranger, independent of rewards to the participant. In our current analyses, we are investigating the relationship between these neural responses and cooperative behavior outside of the scanner environment by employing a prisoner's dilemma task for all three targets (mother, father, stranger). We find age-related effects dependent on who participants play with. Whereas cooperative behavior increases with age for parents, for the stranger it increases until age 14 before it drops and decouples from the behavioral pattern we see when cooperating with parents. This study underlines the importance of taking social factors into account when investigating neural processes involved in vicarious rewards and its links with prosocial behavior. Results will be discussed in relation to their implications for developmental changes in relationships across adolescents.

P – Brain connectivity

2-P-145 What is an adaptive pattern of brain activity? It depends on one?s environment

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Prior research indicates that certain patterns of functional connectivity are more adaptive--for example, associated with better cognitive test scores. One such pattern thought to be adaptive is an anti-correlation between lateral frontoparietal network (LFPN; supports executive functions), and Default Mode Network (DMN; supports internally-directed thought). Lower LFPN-DMN connectivity has been linked to higher cognitive test performance, leading to a view that it in order to focus on a cognitively demanding task, the LFPN must operate independently of the DMN. However, most studies are based on non-representative samples of individuals from higher-socioeconomic status backgrounds. Children living in poverty are at the greatest risk of low performance on cognitive tests, yet we know little about the neural underpinnings of success for them. In a pre-registered study, we analyzed 1034 children ages 9.0-10.9y (M=9.9y) living below poverty, identified from a larger sample (ABCD study). We did not find this expected relation. Further testing confirmed an interaction (p=0.003), such that for children in the

larger sample living above poverty (N=5805), high test performance was related to lower LFPN-DMN connectivity (B=-1.41, p=0.002), replicating prior studies, whereas for children living below poverty, this relation trended in the opposite direction (B=2.11; p=0.060). Follow-up cross-validated predictive analyses revealed that the relation between LFPN-DMN connectivity and test performance varied systematically depending on children's environments. For children living in dangerous neighborhoods, for example, more positive LFPN-DMN connectivity was linked to better test performance; for children living in safe neighborhoods, this relation was in the expected, negative, direction. This pattern indicates that adaptive brain function depends crucially on adolescents' environments, highlighting the need for more diverse representation in developmental cognitive neuroscience.

2-P-147 Metacognition using child-parent perspectives scale: The cortical thickness and functional mri connectivity contribution

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Our recent study suggests that the best way to access the child's metacognition without using the self-reference alone was through the Congruence-based Metacognition Scale (CMS) metacognitive ability, which used the congruence scores between the self-report of the child from the third-person perspective (3PP) and the parent's report from the first-person perspective (1PP). In addition, 3PP involves brain regions of the mentalization system, however, the combination of the 3PP and 1PP with the cortical morphometric and function connectivity (FC) level has not yet been explored. Specifically, whether the FC between the frontal regions (i.e., medial prefrontal cortex, anterior cingulate cortex (ACC), anterior insular cortex (AIC), rostral prefrontal cortex, and lateral prefrontal cortex) supports metacognition. To do so, we examined the cortical morphometry and the FC with a focus on CMS metacognitive ability. Thirty-six child-parent pairs (child, mean age = 21.1 years; parent, mean age = 51.7 years) completed a CMS metacognition, and underwent structural and resting state functional magnetic resonance imaging (rsfMRI). Whole brain cortical volume, area, and thickness were correlated with the CMS metacognition. For the rsfMRI, whole brain seed-to-voxel connectivity analysis was conducted using the seeds described above to examine associations between CMS metacognition and connectivity ($p < 0.001$, uncorrected). High metacognition was associated with decrease in the left supramarginal cortical volume (partial $r = 0.63$), area (partial $r = 0.62$) and thickness (partial $r = 0.62$). Further, FC revealed that left posterior supramarginal gyrus and left superior parietal lobule (SPL) are functionally connected to the right ACC. In addition, the left SPL is also functionally connected to the right AIC. This finding suggests that the salience network, critically through its prefrontal regions, supports introspective processing.

2-P-148 Connecting the dots: Linking peer connections in the classroom to white matter connections in the brain

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Objective: Peer connections in school classrooms play an important role in the social-emotional development and psychiatric outcomes. However, research on how a child's peer relations might

manifest in the brain has been scarce. We studied associations between peer connections in the classroom and white matter connections in the brain in a pediatric population-based sample. **Methods:** Network structures of bullying, victimization, and rejection and acceptance were estimated with the PEERS, a computerized peer nomination task administered in the classrooms of the children at age 7 in a sample of 625 children. White matter connectivity (fractional anisotropy (FA), mean diffusivity (MD)) was measured with diffusion tensor imaging on a 3T magnetic resonance imaging system at age 10. Tract-Based Spatial Statistics were employed to study white matter tracts voxel-wise, and linear regression analyses were adjusted for sex, age, handedness, ethnicity (model 1), intelligence, socio-economic status (model 2), behavior problems (model 3). **Results:** Peer victimization was associated with higher FA and lower MD and peer rejection with lower MD in all three models. These white matter differences were found throughout the brain: in the corpus callosum, corona radiata, and superior and inferior longitudinal fasciculi. Associations remained after dichotomization of peer victimization and rejection measures; and after adjusting models for selection bias. **Conclusions:** Findings imply that children who are victimized or rejected by their peers potentially have more-developed white matter microstructure in certain brain areas. These data suggest that negative peer experiences may advance maturation, and thus longitudinal data are necessary to unravel this complex interplay of peer connections, maturation and brain development.

2-P-149 Unraveling the consequences of childhood maltreatment: Deviations from typical functional neurodevelopment mediate the relationship between maltreatment history and depressive symptoms

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Background: Childhood maltreatment is associated with lifelong psychiatric sequalae. However, our understanding of neurobiological mechanisms responsible for this association is limited. One way childhood maltreatment may confer risk for psychopathology is by altering neurodevelopmental trajectories during childhood and adolescence. However, longitudinal research, which is essential for examining this question, has been limited. **Methods:** In the current study, associations between childhood maltreatment and the longitudinal development of resting state functional connectivity (rsFC) were examined in 130 community residing adolescents. fMRI data was acquired at age 16 (T1; M age = 16.46 years, SD = 0.52, 66F) and age 19 (T2; mean follow up period: 2.35 years). Childhood maltreatment history was assessed prior to T1 and we used whole-brain functional connectivity analyses to examine maltreatment-associated alterations in the development of neural circuitry. **Results:** We found maltreatment to be associated with widespread longitudinal increases in rsFC, primarily between default mode, dorsal attention, and frontoparietal systems. We also found sex-dependent increased maltreatment-associated rsFC in males in salience and cortical limbic circuits. Cross-sectional analyses revealed a shift in maltreatment-related rsFC alterations, which were localized to subcortical and sensory circuits at T1 to frontal circuits at T2. Finally, longitudinal increases in rsFC connectivity mediated the relationship between childhood maltreatment and increased depressive symptoms. **Conclusions:** To our knowledge, this is the first study to longitudinally examine maltreatment-related alterations in rsFC in adolescents. Our findings shed light on the neurodevelopmental consequences of childhood maltreatment, and provide evidence for their role in risk for psychopathology.

2-P-150 Developmental trajectories of dynamic brain connectivity

Monica Lopez-Vicente[1], Oktay Agcaoglu[2], Laura Perez-Crespo[3], Rosa Mulder[1], Fernando Estevez-Lopez[1], John Flournoy[4], Tonya White[1], Anna van Duijvenvoorde[5], Berna Guroglu[5], Vince Calhoun[2], Henning Tiemeier[6], Ryan Muetzel[1]

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Dynamic brain connectivity is a novel functional MRI analysis technique that allows correlation patterns amongst networks to vary over time. Cross-sectional work has shown that these patterns are sensitive to age in children, however few studies used longitudinal designs. Our objective is to characterize the developmental trajectories of dynamic brain connectivity in a population-based pediatric sample. Resting-state MRI data were acquired repeatedly at the ages of 6-to-9 (n=964), 9-to-12 (n=3448), and 12-to-14 years old (n=2048). A spatially constrained group-independent component analysis (ICA) was applied to the second visit data using 51 reference components grouped in 7 networks (Agcaoglu et al., 2019 Hum Brain Mapp). Dynamic functional network connectivity (FNC) between all ICA time courses were computed using a sliding window approach. We used k-means to cluster 171 dynamic FNC windows of 44 seconds in 5 dynamic states. Preliminary cross-sectional results showed that sensorimotor, default-mode, and cognitive control network connections were the most variable. Dynamic states 1, 4 and 5 were modularized connectivity patterns, that is, the components showed intra- and internetwork connectivity. In state-2, the components were heterogeneously connected in a non-modularized pattern. State-3 was a globally disconnected pattern. The next steps are to include the data from the first and third visits into the ICA and dynamic FNC analyses and to conduct multilevel linear mixed-effects regression models to study how dynamic connectivity patterns change as children grow. We hypothesized that variability in connections among networks will increase and children will gradually spend more time in modularized states. Longitudinal analyses will provide individual growth trajectories of dynamic brain connectivity from childhood into adolescence, which is key to understand the influence of the environment on brain development.

2-P-151 Executive function behaviours and the developing functional connectome

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Executive function difficulties manifest as behaviours that are seen as hallmarks of many neurodevelopmental conditions. Although atypical functional connectivity has been observed in these conditions, little is known about how the functional organisation of the brain may underpin variability in these behaviours during childhood. The aim of the current study is to investigate whether and how executive function behaviours are associated with functional brain organisation. Utilising advancements in network science, we propose to use community detection to identify profiles of executive function behaviour in an intentionally heterogeneous sample of 957 children aged 5-15. Functional connectomes will be constructed from resting-state functional Magnetic Resonance Imaging (fMRI) data for 238 children. We then plan to use partial least squares regression, a multivariate dimension reduction technique, to identify components that maximally explain covariance between the behavioural profiles and functional connectomes. The analyses will be conducted at three topological levels of the

connectome, including: global graph metrics, connectivity within and between networks, and regional connectivity. Finally, we will examine how functional brain organisation develops with age.

2-P-152 Sex dimorphic adolescent brain network development is co-located with imaging and transcriptomic phenotypes of depression

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Adolescence is a period of critical development of the brain, that coincides with a sexually dimorphic increase in risk of depression for females. We hypothesised that sexually dimorphic brain network development may underlie the sexual dimorphism in depression. To investigate this hypothesis, we modelled neurotypical functional connectivity brain network development in 298 adolescents, aged 14-25 years, scanned a total of 520 times. We first tested for sex differences in maturational index (MI), a measure of brain network maturation. We found that females showed a more 'disruptive' pattern of development, as indicated by a negative MI, in default mode and limbic functional networks. Disruptive changes in these cortical and subcortical brain regions indicated that connections that were strong at age 14 became weaker over the course of adolescence, more strongly so in females. Second, we biologically and clinically validated this dimorphically developing system. We used partial least squares regression to find the weighted gene expression pattern in post mortem brain tissue that was most closely co-located with the sexually dimorphic fMRI network. Genes that were most strongly expressed in disruptively developing brain regions were enriched for X chromosome genes, as well as genes specialised for perinatal and adolescent phases of cortical and subcortical development. Finally, we showed that genes strongly expressed in the sexually dimorphic system were enriched for major depressive disorder (MDD) risk genes identified by a genome wide association study, and the cortical map of MI was significantly correlated with a cortical map of MDD-related differences in functional connectivity from an independent case-control fMRI study. We conclude that disruptive development of the DMN and limbic system is biologically plausible as a sexual dimorphism in human brain development, which could be relevant to the increased risk of depression in adolescent females.

2-P-153 Communities in the brain structural network moderates the link between environment and cognitive outcomes

Roma Siugzdaite[1], Danyal Akarca[1], Amy Johnson[1], Edwin Dalmaijer[1], Giacomo Bignardi[1], Alexander Anwyl-Irvine[1], Tess Smith[1], Stepheni Uh[1], Duncan Astle[1]

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The quality of a child's social and physical environment is a key influence on cognitive development and educational attainment. Whilst income and education do not determine children's educational outcomes, data show that they shape the environments in which children live and learn. As a group, children from more deprived environments perform more poorly on cognitive tests. But this relationship is highly variable. We wanted to know whether the relationship between the environment and cognition changes as a function of brain connectedness. In this study we investigated 138 children (9.3±1.4 years) from different SES using parental questionnaires and T1 and DTI scans. To evaluate the link between 37 environmental variables and the educational and cognitive outcomes PLS regression was used. Adding the measures of structural brain organization (global efficiency, nodal degree, assortativity and

modularity) to the environmental and cognitive/educational factors we conducted a moderation analysis between Environment, Educational/Cognitive Outcome and Brain Network Topology. Cognitive and educational performance (WJ Reading and Maths, WASI Vocabolary and Maths) was significantly associated with multiple environmental measures (parental education, income, parent occupation, eating unhealthy food per day, SES, time spends playing outside and shares bedroom). Moderation analysis showed a significant interaction between environment and brain modularity. Children with fewer neural communities (more integrated brains) show stronger environment-outcome relationships. This cuts both ways: these children achieve better than average outcomes when immersed in 'good' environment, but achieve disproportionately poorly when immersed in 'poorer' environments.

2-P-154 Pre-reading differences along white matter tracts in children at risk for dyslexia

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Purpose. Reading is a complex ability relying on a widespread neural network in the left hemisphere. Diffusion imaging allows for investigation of white matter pathways implicated in reading and dyslexia. Previous studies have shown different white matter organization in the left arcuate fasciculus (AF) in adults and children with dyslexia, even prior to reading onset. However, longitudinal studies in pre-readers are biased towards persons with a family risk (FR). Given that recent studies suggested that brain differences in auditory and phonological regions of the temporal lobe are driven by FR rather than reading outcome, we aim to determine the influence of FR in the pre-reading stage. **Method.** We selected pre-reading children with and without FR and/or cognitive risk (CR) for dyslexia. We acquired diffusion-weighted MRI scans in 134 pre-readers: 35 FR^+CR^+, 22 FR^+CR^-, 28 FR^-CR^- and 49 FR^-CR^+. Using Automated Fiber Quantification, we determined fractional anisotropy (FA) along the the bilateral AF and inferior fronto-occipital fasciculus (IFOF) considering their importance in reading development. Additionally, we selected a control tract where no reading-related differences are expected, the bilateral anterior thalamic radiation (ATR). **Results.** We found group differences in several segments of the bilateral AF and IFOF. Analyses revealed that these differences were driven by CR and not by FR. However, similar effects were visible in the bilateral ATR, suggesting that this finding is not necessarily specific to reading tracts in early developmental stages. **Conclusion.** The current findings suggest that structural connectivity differences in white matter tracts, including reading tracts and tracts outside the reading network, underlie pre-reading cognitive deficits. Longitudinal follow-up, with classification based on reading status, will reveal which white matter tracts serve as risk, protective or compensatory factors.

Q - Other

2-Q-155 Individual alpha frequency not related to iq in healthy primary school children: A bayesian linear mixed models analysis

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Individual Alpha Frequency (IAF), an EEG metric, is stable and correlated with general intelligence in healthy adults (Grandy, 2013). This study aimed to assess IAF as a marker of brain development in children. EEG and cognitive data were collected twice, 12 months apart, from 96 healthy children at T1

(50f; aged 6-9 years [x̄=7.8y]) with 91 completing T2. As part of a larger cognitive battery, the Wechsler Intelligence Scale for Children - 5th Edition: Block Design, Vocabulary, Matrix Reasoning and Similarities tasks yielded a 4-subtest full scale IQ (FSIQ). IAF was measured from 2 minutes of eyes closed rest, with a 32 channel EEG. Average IAF was 8.7hz [SD .84] at T1, 8.9 [SD .88] at T2. FSIQ ranged from 68-150 at T1, with x̄=111 [SD 13.5], improving at T2 with Δx̄=3.44, indicating a small practice effect. Analysis with Bayesian linear mixed models showed a relationship between age and IAF (β=.19, 95% CI=.14, .24, Bayes Factor (BF)>20,000). As timepoint (TP) was correlated with both IAF and FSIQ, IAF was regressed against TP and the residuals used in the final model, with TP as a covariate. Bayesian priors were derived from a previous study (Dickinson et al., 2018) with 38 children aged 2-12 years, using estimates for verbal and non-verbal IQ (VIQ/NVIQ) from several different batteries, and IAF from 38 seconds of data over 6 electrodes, divided into frontal, central (C-) and occipital (O-) IAF. Replicating this approach on our data, using one-sided hypothesis tests (βIAF >0), we found C-PAF vs NVIQ showed the most evidence for a positive relationship (β=.11, 95% CI=-.19, .41, BF =2.6), and IAF vs VIQ the most evidence against (β=-.72, 95% CI=-1.03, -.41, BF <1/20000). For O-IAF vs FSIQ specifically, there was strong evidence against a positive relationship (β=-.48, 95% CI=-.8, -.16, BF =.007). Future research should investigate when IAF emerges as a marker of ability, why the relationship is not seen at these ages, and whether an alternate metric exists.

2-Q-156 Are children genetically predisposed to poor sleep? A polygenic risk score study in the general pediatric population

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Twin studies show that sleep traits are highly heritable: 46% for sleep duration and 40% for insomnia symptoms. Recent large-scale genome wide association studies (GWAS) have identified numerous common genetic variants involved in insomnia and sleep duration. These GWASs have however been conducted in adults. The influence of these genetic variants on sleep during childhood is thus unknown. We aim to assess whether an individual's polygenic risk scores (PRS) for insomnia (PRS-I) and sleep duration (PRS-SD) derived from adults are associated with sleep in childhood and early adolescence. We included 2,458 children of European ancestry from the Generation R Study for whom genotype and sleep data were available. PRS-I and PRS-SD were based on the largest GWAS studies to date, calculated at multiple p-value thresholds. Sleep problems were reported by mothers at child's age 1.5, 3 and 6 years using the Child Behavior Checklist, and assessed with actigraphy in a subsample of 975 adolescents between 10-16 years of age. Higher PRS-I was associated with more mother-reported sleep problems at 6 years (B=0.1, 95%CI:0.02;0.2) and using more inclusive thresholds also with sleep problems at 1.5 years (B=0.1, 95%CI:0.04-0.2). PRS-SD was not associated with mother-reported sleep problems in childhood. Adolescents with polygenic propensity for longer sleep (PRS-SD) had longer total sleep time (B=0.05, 95%CI: 0.001;0.1), and using more inclusive thresholds also more wake after sleep onset (B=0.3, 95%CI:0.04;0.5). Polygenic risk scores based on GWAS studies of sleep in adults are associated with sleep patterns in an independent sample of children followed up to adolescence. These associations were more pronounced later in development. Children who are genetically predisposed to insomnia

have more insomnia-like sleep problems, whereas those that are genetically predisposed to longer sleep, sleep longer in adolescence.

2-Q-157 Explaining brain research with children to children

Laura Bell[1], Vanessa Reindl[1], Jana Kruppa[1], Alexandra Niephaus[1], Simon Kohl[2], Kerstin Konrad[2]
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Many scientists have difficulties in making their work accessible in an easily understandable way. Yet, bridging the gap between our "developmental cognitive neuroscience world" with its daily jargon-heavy terms and complicated concepts and the "general, non-scientist public world" is crucial. The more we talk about science to a variety of people, including the next generation of developmental cognitive neuroscience researchers, the more we create a society that understands what we do and why that is important. Very recently, the involvement of children and young people in participatory action research as researchers rather than merely subjects has become increasingly popular. While in the past the "voice" of children and adolescents has largely been ignored, participative research aims to produce knowledge in a social constructionist way that is useful to those people whose situation is being researched (Dodson, & Baker, 1995). However, involving children into participatory approaches in the field of developmental neuroscience research requires, at first step, an introduction of highly complex neuroscientific methods in a way that can be understood by teenagers as well as by a 6-year old! In this talk, we will propose one way how to communicate to children, exemplified by research with functional near-infrared spectroscopy. We demonstrate how to explain to children how they can help us to find out numerous things about their brains and how we can use this information to assist children that face difficulties in their daily lives. Finally, we will discuss methodological, practical, and ethical considerations that are important when involving children as researchers into developmental neuroscience, including issues of power and empowerment.

Poster session 3

Friday September 11, 2020

D – Rewards/Motivation

3-D-158 A person-centered examination of regulation, sensitivity to threat and impulsivity among children and adolescents: An ERP study

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The imbalance model suggests that asynchrony in the maturation of interconnections between the prefrontal cortex (i.e., regulation) and the limbic striatal regions (i.e., socioemotional processing) contributes to adolescents being more sensitive to emotionally salient events than children. Adolescents may be more susceptible than children to bottom-up processing (i.e., impulsivity, IMP; or sensitivity to threat, ST) in emotionally-arousing situations, as their ability to regulate these emotions is not yet fully mature. At the same time, there may be individual differences among adolescents in both bottom-up

(IMP & ST) and top-down regulation. Latent class analysis (LCA) was used to identify distinct groups of youth who differ in these processes. We also investigated group differences on the error-related negativity (ERN, an ERP) during an inhibitory control task that requires top-down control over bottom-up responding. The ERN is thought to be associated with motivational significance of errors; IMP has been associated with a smaller ERN, while ST is associated with a larger ERN. Children and adolescents (N=1313, Mage=11, range=7-14 years) completed a survey assessing their dysregulation (DYS), ST, and IMP. A subsample (N=483) also completed a go/no-go task while EEG was recorded. The LCA identified four groups with differential levels of DYS, ST, and IMP. In line with imbalance models, adolescents had greater odds than children of being in the (1) high DYS/ST_lowIMP or (2) moderateDYS/ST_high IMP groups, compared to two other groups that had lower scores on these measures (OR:1.6-2.7). The highDYS/ST_lowIMP group had the largest ERN, while the moderateDYS/ST_highIMP group had the smallest ERN ($p<.05$). Adolescents are more likely to be in groups with greater DYS; at the same time there are differences in whether they have greater IMP or ST. The ERN may be a biomarker that distinguishes between the different types of bottom-up processing that adolescents might use.

F - Memory

3-F-159 Prefrontal-striatal circuitry supports adaptive memory prioritization across development

Kate Nussenbaum[1], Daphne Valencia[1], Jamie Greer[1], Nora Keathley[1], Catherine Hartley[1]
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Previous work has revealed that the ability to strategically encode high-value information may improve gradually over development, as the systems supporting cognitive control processes mature. However, studies of value-directed memory have relied on explicit cues that signal the importance of information, which are rarely present in real-world contexts. Here, using a novel fMRI paradigm, we examined whether individuals across a wide age range (N = 90; ages 8 - 25 years) could learn the relative frequency of items in their environment and prioritize memory for information associated with higher frequency items, which would ultimately enable them to earn more reward. We found that from childhood to early adulthood, individuals improved both at transforming their experiential learning into explicit representations of information value and at using these value estimates to strategically modulate encoding. Memory prioritization for high-value information was supported by increased engagement at both encoding and retrieval of the caudate, putamen, and lateral prefrontal cortex - regions that have been implicated in value processing and the implementation of cognitive control mechanisms. Our results suggest that developmental improvements in the ability to dynamically adjust memory based on the statistics of the environment are supported by a wide network of brain regions that support both the recognition and use of information value to implement strategic control over encoding.

J – Mechanisms (hormones, neurotransmitters, physiology)

3-J-160 Maturational covariance of cortical thickness during puberty

Nandita Vijayakumar[1], Emma Sciberras[1], Vicki Anderson[2], Daryl Efron[2], Philip Hazell[3], Jan Nicholson[4], Timothy Silk[1]
[1]Deakin University, [2]Murdoch Children's Research Institute, [3]The University of Sydney, [4]La Trobe

University

Structural covariance conceptualises how morphological properties, such as cortical thickness, of different brain regions relate to each other. We extend this model to study the network properties of longitudinal cortical development, to better understand the coordinated maturation of brain regions during puberty. We used structural MRI data from a longitudinal study of typically developing children and adolescents (N = 78, aged 9 to 14 years) sampled up to three times over three years (n scans = 206). The sample was split into "advanced" and "delayed" pubertal groups based on within-subject changes in pubertal stage. For each pubertal group, we estimated standardised linear rate of change (per participant) for 148 regions, and correlated change across regions to construct a "maturation" matrix for each group. Network metrics were used to compare global, regional, and modular properties (involving decomposition of networks into functional modules) of the "advanced" and "delayed" pubertal matrices. While global network properties did not differ between pubertal groups, the precuneus and posterior cingulate exhibited greater maturational covariance with other regions (based on number and strength of correlations) in the "advanced" pubertal group. The "advanced" pubertal group exhibited greater within-network covariance in the default mode network, as well as stronger covariance between this network and the dorsal attention and ventral attention networks, compared to the "delayed" pubertal group. Findings highlight coordinated maturation of regions and networks that support social and higher-order cognitive processes during puberty, in line with normative behavioural changes occurring during this developmental period. This study illustrates the value of moving beyond (mass-)univariate analyses to improve our understanding of the role of puberty in brain development.

L – Clinical populations

3-L-161 Identifying sensitive markers of myelination in adolescent depression

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DTI metrics index white matter organization based on water diffusivity and not myelin per se. We posit that R1 (1/T1 signal) may be a more clinically useful MRI metric for early detection of psychiatric disorders that are characterized by myelin-related changes, including depression. Here, we tested whether R1 in a major white matter tract is a better predictor of depression than are DTI metrics in depressed adolescents. 45 depressed and 39 nondepressed adolescents (13-18 years old) completed a 60-direction diffusion-weighted MRI, from which bilateral cingulum was segmented using deterministic tractography, and an inversion-recovery spin-echo EPI scan, from which whole-brain voxel-wise R1 maps were derived. Given the high collinearity among these predictors, we used elastic net regression to determine which cingulum metric best predicted depression, with age and sex as covariates. In both the 7- and 10-parameter solutions, R1 in bilateral cingulum outperformed all other predictors (left: all Bs>3293; right: all Bs>3468; all other Bs<5.7). These results were consistent with results of linear regression models, which demonstrated that R1 was significantly higher in the depressed than in the nondepressed adolescents (left: B=0.31, t(80)=2.62, p=0.01; right: B=0.35, t(80)=2.99, p=0.004). The two groups did not differ in diffusivity metrics with the exception of left cingulum AD (p=0.027) and right cingulum MD (p=0.030). We show that R1 is more robustly associated with depression than are diffusivity metrics in adolescents with depression. Given that myelin increases throughout adulthood,

our findings also highlight the importance of considering development when assessing myelin in depression.

3-L-162 Microstructure of the Dorsal Anterior Cingulum Bundle in Very Preterm Neonates predicts the Preterm Behavioral Phenotype at 5 Years

Rebecca Brenner[1], Christopher Smyser[1], Rachel Lean[1], Jeanette Kenley[1], Tara Smyser[1], Peppar Cyr[1], Joshua Shimony[1], Deanna Barch[1], Cynthia Rogers[1]

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Background: The cingulum bundle (CB), specifically the dorsal anterior portion of the CB, plays an important role in psychiatric illnesses; however, its role during early development is unclear. This study investigated whether neonatal white matter microstructure in the CB and its subregions is associated with subsequent preterm behavioral phenotype symptoms (internalizing symptoms, inattention, and social deficits) in very preterm (VPT) children. **Method:** Diffusion MRI data were obtained on a 3T scanner in 138 sleeping, non-sedated neonates, including 55 full-term (FT) neonates (gestational age (GA) at birth ≥36 weeks) and 83 VPT neonates (GA at birth <30 weeks). The CB was tracked using probabilistic tractography and split into anterior and posterior portions. At 5 years of age, parents (n=81) and teachers (n=63) of VPT children completed questionnaire measures of preterm behavioral phenotype symptoms. Linear regression models were used to relate measures of neonatal CB microstructure and childhood preterm behavioral phenotype symptoms (n=56 parent report, n=45 teacher report). **Results:** Mean diffusivity in the anterior and posterior CB was increased in VPT neonates compared to FT neonates. Increased fractional anisotropy and decreased mean diffusivity in the right anterior CB, but not the posterior CB, were related to increased preterm behavioral phenotype symptoms as reported by both parents and teachers in VPT children. **Conclusion:** Aberrations in the anterior portion of the right CB may underlie the early development of the preterm behavioral phenotype. This finding provides the foundation for future mechanistic and therapeutic investigations into the role of the anterior cingulum in the development of psychopathology in VPT infants.

3-L-163 Inhibitory control circuitry and externalizing psychopathology in a large sample of higher-risk youth

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Disinhibition has been proposed as a common factor underlying many forms of externalizing psychopathology. Though there is consistent evidence that behavioral response inhibition performance relates to externalizing psychopathology, neuroimaging studies have produced conflicting results. Prior work has frequently used clinical samples or small convenience samples of affluent participants, limiting generalizability of results. Thus, there is a need for additional clarity regarding the relationship between inhibitory circuitry and externalizing, particularly using a large sample of higher risk youth. The present study will examine the relationship between go-no/go-related inhibitory control activation and externalizing behavior, and test whether behavioral measures of inhibitory control mediate this association. We will use data from a sample of 708 twins in 354 families who completed a go/no-go fMRI task as part of the Michigan Twins Neurogenetics Study (MTwiNS), which uses an epidemiologic sampling frame (birth records) to focus directly on families residing in modestly-to-severely disadvantaged neighborhood contexts. We will create an inhibitory control latent factor using go/no-go

efficiency, stop-signal reaction time, and the Inhibitory Control subscale of the Early Adolescent Temperament Questionnaire. To isolate inhibition-related inferior frontal gyrus (IFG) activation, we will extract values for the no-go>go contrast from a bilateral anatomical IFG mask. We will quantify externalizing using well-validated parent-, child-, and teacher-report measures of rule breaking, aggression, ADHD, and substance use. We will use structural equation modeling to test for an indirect effect of IFG activation on an externalizing latent factor via a behavioral inhibitory control latent factor while adjusting for the non-independence of the twins. Our findings will have implications regarding inhibitory control circuitry as a potential marker for externalizing psychopathology.

3-L-164 Neural correlates of emotion reactivity and regulation and youth suicidal ideation: Examining cross-sectional and longitudinal links

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Prior research links neural responses underlying emotion reactivity and regulation with suicidal ideation (SI) among youth (e.g., Miller et al., 2017). It is unknown if neural correlates of emotion reactivity and regulation predict future SI. Here, we examined cross-sectional and longitudinal associations between neural correlates of emotion reactivity and regulation and SI. Hypotheses: Youth with SI will exhibit reduced activation in prefrontal regions supporting emotion regulation (e.g., dorsolateral prefrontal cortex; dlPFC) during reactivity trials, which will predict presence and severity of SI. Youth (N=151, 8-16, M=12.76) completed a baseline fMRI scan and clinical interview assessing presence and severity of SI. Two years later, 123 youth (81%) completed a follow-up interview. A well-known fMRI task assessed reactivity and regulation (via cognitive reappraisal) to negative stimuli. Whole brain and ROI analyses (dlPFC, anterior cingulate cortex (ACC)) examined associations between SI and neural activation during reactivity and regulation. Models controlled for age, sex, and maltreatment severity. Longitudinal models also controlled for time and past SI. Baseline whole brain analyses revealed a positive association between lifetime SI severity and activation in the posterior insula, postcentral gyrus, and superior and middle temporal gyrus during reactivity. Follow-up whole brain analyses revealed a negative association between presence of SI at follow up and activation in the motor cortex, precuneus, and occipital cortex during regulation trials. Consistent with hypotheses, less activation in the dlPFC ROI during reactivity predicted more severe SI at follow-up, $b = -.24$, $p < .05$. This is among the first studies to longitudinal link neural correlates with future SI. Results partially support hypotheses suggesting that neural correlates of emotion reactivity and regulation may predict future SI among youth.

3-L-165 Neural correlates of risky decision-making in youth at risk for anxiety

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Anxiety is common in adolescence and associated with a pattern of behavioral avoidance. Importantly, behavioral avoidance directly contrasts with crucial aspects of healthy adolescent development such as increased risk-taking and exploration. While most studies in anxious youth focus on threat sensitivity, less work has examined how threat- and reward-related neural systems interact to influence risk-taking and the emergence of anxiety in adolescence. Here, we aim to answer two main questions: 1) Do behavioral and neural responses to risky decision-making differ as a function of anxiety in sub-clinical youth? 2) Does reward-related neural response during risk-taking moderate the association between

anxiety and risk-taking behaviors? 149 youth ages 9-13 (MAge = 10.79) completed the Screen for Child Anxiety Related Disorders (SCARED) to assess anxiety symptom severity and played the Driving Game--a risky decision-making task involving driving on a simulated track and trying to finish quickly to maximize reward--during fMRI. Plan of Analysis: We will test the association between SCARED score and risk-taking frequency and then conduct group-level whole-brain analyses for the Driving Game using SCARED score as a covariate of interest. Independent ROIs will be used to examine striatal response to risky decision-making. Hypotheses: SCARED score will be associated with risk-taking frequency, with higher anxious youth taking fewer risks. Anxiety will be positively associated with amygdala activity and negatively associated with striatal activity during risky decision-making. Striatal recruitment during risk-taking will moderate the influence of anxiety on behavior such that youth with higher striatal response during risky decision-making will show a weaker link between SCARED score and risk-taking frequency. These results will help elucidate the mechanisms underlying the emergence of anxiety in adolescence and inform potential interventions for youth at risk for anxiety.

3-L-166 Neural correlates underlying irritability and emotion dysregulation in children with and without ADHD

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Irritability and emotion dysregulation are common in children with Attention-Deficit/Hyperactivity Disorder (ADHD). Given evidence for distinct neural correlates underlying irritability and emotion dysregulation, we examined irritability- and emotion dysregulation-related brain network organization in children with and without ADHD. Forty-five children aged 8-12 years (21 with ADHD and 24 without ADHD) completed an fMRI resting-state scan, and their parents completed measures of irritability and emotion dysregulation. We derived irritability and emotion dysregulation networks from a functional brain atlas using elastic net regularized regressions. Regions of interest (ROIs) whose mean activation was significantly correlated with irritability or emotion dysregulation were included in the networks. Next, we estimated the functional connectivity of these networks and calculated graph theory metrics of global efficiency and modularity to characterize the integration and segregation of irritability- and emotion dysregulation-related networks with respect to the whole-brain system, and whether they differed based on ADHD status. Results indicated that children with ADHD exhibited greater irritability and emotion dysregulation relative to children without ADHD. Mean activation analyses revealed distinct and shared ROIs associated with irritability and emotion dysregulation, with much of the overlap occurring in the default mode network. Additionally, children with ADHD exhibited an irritability-related brain network that was more integrated (higher global efficiency) and less segregated (lower modularity) than in children without ADHD. These findings suggest that irritability and emotion dysregulation are composed of distinct and shared neural correlates. Further, disruption to irritability-related brain network organization in children with ADHD may underlie the observed differences in irritability and emotion dysregulation between children with and without ADHD.

3-L-167 The effects of methylphenidate on the functional controllability of the brain in children with ADHD

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Methyphenidate (MPH) is a common first-line treatment for ADHD. Previous research among children with ADHD has demonstrated that administration of MPH leads to normalization of brain function in terms of both activation and connectivity, with corresponding normalization of core ADHD behavior. The current study aims to extend extant literature by implementing controllability analysis, a method that seeks to examine how brain regions interact to form a dynamical system, to characterize the neural response to MPH. We conducted a randomized, double-blind, placebo-control, MPH crossover study with 22 medication naïve children with ADHD and 27 typically developing (TD) children. Both groups underwent resting state and go/no-go fMRI scans. The functional controllability of the whole-brain during rest and task was operationalized using average controllability, a measure of how much activation throughout the whole-brain changes in response to a change in activation in a single network. Results revealed that while on placebo, children with ADHD had higher average controllability than TD children in the somatomotor-dorsal and cingulo-opercular networks during both rest and the go/no-go task, with additional higher average controllability in the dorsal attention, medial temporal, default mode, and reward networks during the go/no-go task. MPH normalized all average controllability differences between the two groups. These results indicate that a change in activation of specific networks results in more whole-brain activation in children with ADHD in a context-dependent manner and that MPH normalizes this sensitivity. This reinforces the notion that ADHD is a neurodevelopmental disorder characterized by disrupted brain function and highlights the need to examine brain activity as a dynamical process. These findings also indicate that disruptions to brain function in ADHD are context-dependent, emphasizing the need to examine function during both rest and cognitive tasks.

3-L-168 Disrupted brain network reconfiguration between resting and cognitive control states across changing cognitive demands in children with attention-deficit/hyperactivity disorder

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Deficits in cognitive control in children with ADHD have been associated with atypical organization of distributed brain networks during an intrinsic resting state. It is unknown, however, whether children with ADHD show similar atypical patterns of functional network organization during cognitive control task performance. To probe this question, children with ADHD (n=33, 16F, 8-12y) and typically developing (TD) children (n=36, 19F, 8-12y) underwent fMRI during rest and two go/no-go (GNG) tasks: a "simple" version with straightforward stimulus-response mappings and a "complex" version that added a 1-back working memory component to response decisions. To delineate ADHD-specific disruptions in brain network reconfiguration, we used graph theory to compare the integration and segregation of specific networks across the tasks between ADHD and TD children. Examining for an effect of task state, we found that across ADHD and TD children, modularity, the degree to which the brain segregates into distinct networks, significantly decreased from rest to simple GNG, but not from simple to complex GNG. Thus, consistent with findings in adults, we observed greater communication across networks during GNG tasks as compared to rest in children regardless of diagnosis. Examining for an effect of diagnosis, we found that across rest and GNG task states, modularity was significantly lower in ADHD relative to TD children, which was driven by significantly greater integration between the

default mode network (DMN) and task-positive networks (TPNs). Thus, consistent with findings during rest in ADHD, we observed stronger integration between the DMN and TPNs in ADHD across both resting and cognitive control states. Findings indicate similar patterns of disruption to functional brain network organization in ADHD during cognitive control and during rest. This increased DMN-TPN integration across task states may provide a mechanism for impaired behavioral and cognitive control in ADHD.

3-L-169 Altered maturation of gray and white matter following preterm birth: Longitudinal data from children 5 to 7 years of age

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Background: Children born preterm birth are at risk for diffuse injury to cerebral white matter, subcortical gray matter, and altered cortical architecture. These abnormalities in brain development are associated with later neurodevelopmental disabilities. This study's objective was to examine brain development in children born preterm without significant neonatal brain injury at 5 to 7 years of age. **Methods:** Participants were 47 children born preterm (<33 weeks gestational age) and 29 children born full-term. None of the children born preterm had significant brain injury (e.g., intraventricular hemorrhage grade 3-4, cystic periventricular leukomalacia). Children were received structural and diffusion weighted MRI scans at ages 5, 6, and 7 years. Fractional anisotropy (FA), mean diffusivity (MD) and subcortical volumes were compared between groups. **Results:** Preterm birth was associated with smaller subcortical grey matter volumes, particularly of the left and right thalamus and brain stem. Volume of cerebellar white matter and some cerebral fiber tracts were smaller, and ventricles were larger following preterm birth. Group differences in diffusivity were limited. Children born preterm had lower FA in the uncinate fasciculus and cingulum and higher MD in the forceps major and corpus callosum. Despite developmental changes and growth, group differences were present at all three ages, and there was no significant group by time interaction. **Conclusion:** Even in the absence of significant neonatal brain injury, preterm birth has a persistent impact on early brain development. There was reduced growth of subcortical structures and white matter tracts, and more limited abnormalities in white matter microstructure. The lack of a group by time interaction effect hints towards a similar but delayed developmental trajectory. Abnormal development of these structures is likely to influence the cognitive and motor functioning of children born preterm.

3-L-170 Behavioral and structural neural correlates of non-suicidal self-injury in adolescent girls

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This study examines neural correlates of non-suicidal self-injury (NSSI), and its risk factors, including impulsivity, ineffective emotion regulation, and hopelessness in adolescent girls. The right inferior frontal gyrus (rIFG) is implicated in impulsivity and inhibitory control, and impulsivity predicts NSSI. Reduced cortical volume in the insula and rIFG have been found in girls with NSSI, and these reductions correlate with ineffective emotion regulation (Beauchaine et al., 2019). Further, cognitive vulnerabilities,

such as hopelessness, predict NSSI. Cognitive vulnerabilities are associated with reduced cortical volume in the left precentral gyrus (Zhang et al., 2012). We hypothesized that NSSI history would be associated with (a) higher impulsivity, expressive suppression, and hopelessness and (b) reduced cortical surface area and thickness in the rIFG, insula, and left precentral gyrus, and that (c) cortical thinning in the rIFG would be associated with higher impulsivity. Full preregistration: https://osf.io/aj2wf/. Girls (N=138), ages 9-16 (M=12.53), at increased risk for psychopathology completed a structural MRI scan. Freesurfer was used to estimate cortical surface area and thickness. NSSI was assessed by clinical interview. Youth self-reported expressive suppression, hopelessness, and impulsivity; 29% of the sample reported a history of NSSI (n=40). NSSI was positively correlated with impulsivity, expressive suppression, and hopelessness (p's<.05). Preliminary whole-brain analyses on a subset of participants (n=49) showed a smaller cortical surface area in the left insula in girls with (vs. without) NSSI (p<.05). Data cleaning is ongoing; final analyses will include all subjects following the optimization of cortical boundaries. We will also examine associations between the rIFG, insula, left precentral gyrus and behavioral measures using region of interest analyses. Initial results suggest promise in identifying neural correlates of NSSI.

3-L-171 Bariatric surgery alters cortical thickness in adolescents with severe obesity

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Pediatric obesity is associated with impaired neurocognitive function, which may be underpinned by structural alterations of the cortical mantle. Bariatric surgery is increasingly used to treat obesity in adolescents, and we have demonstrated favorable neurocognitive functional changes. Whether surgery-induced structural cortical change is observed in adolescence is unknown. Adolescents with severe obesity (OB, BMI %tile ≥ 95; n= 18) or healthy weight (HW; n=17) underwent T1-weighted MPRAGE (Time1). A subset was scanned 3 months later (Time 2):, 6 adolescents who underwent surgery (VSG), 9 who were waitlisted (WL), and 11 HW. Cortical thickness was assessed with Computational Anatomical Toolbox 12 and the Desikan-Killiany atlas (p< .05 corrected). Time1 t-test showed that relative to HW, OB had thinner cortex in L precentral gyrus, bilateral precuneus and superior parietal gyri, and R posterior cingulate and lateral occipital cortex (LOC). Thinner cortex at baseline in OB parallels adult findings. Time-related change was assessed with Group x Time (controlled for age, sex) interaction, which was observed in reward (bilateral medial orbitofrontal extending to R anterior cingulate cortex), sensorimotor (bilateral pre/postcentral gyri) and sensory integration (bilateral lingual/fusiform gyri and LOC, R supramarginal, and superior/middle temporal gyri) regions. VSG showed thinning in most regions, while WL and HW did not change over time. VSG showed thickening in L precentral gyrus and bilateral lingual/fusiform gyrus and LOC. Regions where VSG-related thinning occurred subserve neurocognitive processes that improve after weight loss, but did not overlap with Time 1 suggesting differing mechanisms of thinning. These preliminary results highlight neuroplasticity in adolescents and should be followed up with studies in larger samples.

3-L-172 The relationship between greater depression symptom severity and reduced whole brain volume in preschool age children is driven by reduced lateral OFC surface area

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Previous MRI studies suggest a correlation between elevated symptoms of externalizing disorders, such as ADHD, and reduced whole brain volume. These reductions are generally thought to be linked to deficiencies in self-regulation and attention common in externalizing psychopathology. However, there is substantial comorbidity between internalizing and externalizing symptoms in childhood, and no work to date has investigated the relationship between whole brain volume and internalizing symptoms in young children. Here, we investigated the relationship between whole brain volume and depression symptom severity in a sample of 46 young children (Mage= 5.91, SD= .75; 37% male). All children were medication naïve. 33% displayed elevated depression symptoms. There was a significant negative relationship between depression symptom severity and whole brain volume, controlling for maternal depression, maternal education, child IQ, child age, and child sex (B= -.0001, β= -.40, t(39)= -3.59, p< .001). A statistically significant relationship between whole brain volume and externalizing symptoms was not observed, and the relationship between depression symptom severity and whole brain volume held when controlling for externalizing symptoms. Further analysis revealed that this relationship was driven by reductions in cortical surface area, particularly in the lateral orbitofrontal cortex (OFC). The lateral OFC is implicated in reward learning and helps establish the relationship between environmental cues and their reward value. The current findings support a relationship between early emerging features of depression and alterations in brain regions important for reward learning. Future research should investigate if reductions in surface area in the lateral OFC lead to impairments in function.

3-L-173 Brain white matter after pediatric mild traumatic brain injury: A diffusion tensor and neurite orientation and dispersion imaging study

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Introduction: Mild traumatic brain injury (mTBI) affects millions of children annually and can have lasting negative effects, yet no biomarkers for diagnosis and prognosis exist. Neurite Orientation Dispersion and Density Imaging (NODDI) is a diffusion model that estimates the complex microstructure of the axons and dendrites in the brain and provides measures of neurite density (NDI) and orientation dispersion that are more specific than diffusion tensor imaging (DTI). We used DTI and NODDI to investigate white matter alterations in children with mTBI compared to orthopedic injury (OI) post-acutely. **Method:** Children (mTBI n=91, OI n=42) aged 8-16.99 (M/SD=12.76/2.32) were recruited from the emergency department at a children's hospital and returned for MRI on average 9 days post-injury (M/SD=8.98/3.57). Semiautomated tractography provided DTI and NODDI metrics for brain tracts. Repeated measures ANOVA examined group differences in these metrics. **Results:** At p<0.05, uncorrected, NDI was lower in the mTBI than OI group in the right uncinate fasciculus (UF). Fractional anisotropy (FA) in the body and genu of the corpus callosum (CC) was higher in mTBI than OI group among the oldest children (adolescents). Group differences in mean diffusivity varied significantly by age in the UF and arcuate fasciculus (mTBI>OI at younger, mTBI<OI at older ages), but were not significant at any age. No results survived multiple comparison correction. **Discussion:** Lower NDI in the UF may indicate decreased neuronal density. The UF is an association tract involved in emotion and behaviour regulation. Children with mTBI exhibit pre-morbid and post-concussive symptoms in these domains. We also identified altered FA in the genu and body of the CC in adolescents with mTBI compared to OI. This

may reflect that biological substrates underpin the prolonged recovery reported after mTBI in adolescents. Our findings suggest UF and CC alterations may have diagnostic and prognostic utility for mTB

3-L-174 Neural correlates of ADHD and exposure to adversity: A resting state EEG study

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Attention-deficit/hyperactivity disorder (ADHD) is a highly prevalent neurodevelopmental disorder that is associated with negative life outcomes. Research suggests that early adverse experiences may contribute to increased risk of ADHD and are associated with related changes in neural function. In the current work, we examine associations between ADHD symptoms, adversity exposure, and neural function in early childhood. Given previous evidence of the association of electroencephalogram (EEG) power with ADHD symptoms and early adversity, we hypothesized that ADHD symptoms and adversity exposure would be associated with relative power in alpha and theta. We collected EEG data in 50 medication naïve children with ADHD and 50 age- and gender-matched controls (3-7 years). We calculated relative power based upon individual alpha peak frequency bands. We tested for group differences in power and the associations of ADHD symptom severity, family socioeconomic status (SES) and family conflict with relative alpha and theta power. We also tested if the association between ADHD symptoms and power was robust to controls for adversity exposure. The ADHD group had increased alpha power over 20 electrodes that were primarily clustered in frontal and parietal regions and increased ADHD symptoms were associated with increased parietal alpha power (p's<0.05). There was no effect of family SES or conflict on power; however, the association of ADHD symptoms with alpha power was robust to controls for adversity exposure. In sum, ADHD diagnostic status and increased ADHD symptoms are associated with increased relative alpha power, and neither family SES nor conflict are associated with this signal. This work highlights that relative alpha power may serve as a neural marker of ADHD that is robust to the family environment.

3-L-175 Impaired response control in childhood predicts adolescent ADHD symptoms in boys, but not girls, with ADHD

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ADHD-related sex differences in response control have shown that boys, but not girls, with ADHD show improvements in response inhibition and variability with age, relative to their typically-developing peers. However, little is known about the relationship between impaired response control and ADHD symptoms across development. This study combined cross-sectional and longitudinal data from a sample of children with ADHD ages 8-17 (n=340, 96 girls; 81 with multiple visits at least 1 year apart), most of whom had a baseline visit prior to age 13 (n=330). Correlations revealed that poor response control (inhibition errors and variability) was associated with greater inattention (IA) and hyperactive/impulsive (HI) symptoms (rs range from .154 to .284, ps<.002). Linear mixed-effects models indicated that age moderates the relationship between response variability and HI symptoms, with an

increase after age 10 among children with ADHD (p=.041), with a significant effect among boys (p=.028; girls: p=.523). Additionally, baseline response inhibition was found to moderate the relationship between age and IA symptoms (p=.012) among boys (p=.006; girls: p=.356). The moderation in boys revealed that for those with poor baseline response inhibition there was no significant relationship between age and IA symptoms. In contrast, children with ADHD with good response inhibition at baseline showed a decrease in IA symptoms with age. Consistent with this result, linear regression models conducted with longitudinal data only (n=70, 21 girls) revealed that, after controlling for baseline IA symptoms, poor response inhibition in childhood predicts greater IA symptoms in adolescence (p=.016) and less improvement in IA symptoms from childhood to adolescence (p=.031). When examined within sex, this relationship remained significant for boys (p=.021; girls: p=.190). These findings suggest that response control in childhood may be an important predictor of ADHD symptoms in adolescent boys.

3-L-176 Behavioral and neural mechanisms of trauma symptomatology in autism spectrum disorder in the ABCD study

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Objective: Youth with autism spectrum disorders (ASD) are more likely to experience adverse childhood experiences (ACEs) and trauma and may be at greater risk for developing post-traumatic stress disorder (PTSD) following such events. Our research aims to utilize the longitudinal Adolescent Brain Cognitive Development (ABCD) study to assess the prevalence and underlying mechanisms of increased risk of ACEs, trauma and PTSD in ASD youth. Hypotheses: Subjects with ASD experience higher rates of ACEs and are more likely to develop post-traumatic sequelae following traumatic experiences versus matched typically-developing (TD) peers. Functional connectivity (fc) MRI in networks related to fear learning, sensory and emotion regulation will mediate the relationship between group status, ACEs and PTSD symptoms. Methods & Analysis Plan: 201 ASD participants were identified by parent-reported ASD diagnosis. After exclusion based on missing data, a control group of 5:1 TD:ASD peers was established using nearest neighbor greedy matching on gender, MRI scanner, composite IQ, and socioeconomic status. Through the use of the Youth and Parent Family Environment Scales, K-SADS, Family History, and Longitudinal Parent Demographics Survey, we will compare ACEs and PTSD symptoms between groups utilizing logistic regression. FcMRI measures provided by the ABCD consortium - seeded in the anterior insula (salience network), amygdala, and thalamus - will be linearly regressed with ACEs and PTSD symptoms and compared between groups to examine atypical relationships between functional connectivity and symptoms. Implications: Differences in the way that people with ASD develop and present PTSD symptoms can drastically impede current diagnostic and treatment strategies for PTSD. If youth with ASD are more likely to experience higher rates of ACEs and subsequently develop PTSD, it is crucial that we understand this comorbidity and make clinical adjustments accordingly.

3-L-177 Predictive modeling of ADHD diagnostic category using cognitive and neurobiological measures of executive function

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Given the negative trajectories of early behavior problems associated with Attention-

Deficit/Hyperactivity Disorder (ADHD), as well as its high public health cost, early diagnosis of ADHD is considered very critical for its potential to foster early intervention and treatment opportunities. To this end, the current investigation employed computational modeling to evaluate the relative predictive value of behavioral and neural measures of executive function in predicting ADHD diagnostic category in a sample consisting of 171 young children (ages 4 to 7). Among the executive function measures assessed in the current study, our model identified the Head-Toes-Knees-Shoulders task (HTKS) as the most important feature in predicting diagnostic category. These results are encouraging towards the potential application of this task for early diagnosis of ADHD. Among the target neural measures of cortical thickness, the left superior frontal gyrus, the left anterior cingulate, and the left intraparietal sulcus were implicated as important neural features in predicting diagnostic category. Future research evaluating the importance of these regions using complementary neural measures (e.g., other structural measures such as volume, area and curvature, as well was diffusion weighted imaging measures such as neurite density) would provide further insight into their potential importance for ADHD diagnosis.

3-L-178 Examining the impact of adversity on adolescent psychopathology and the role of cognitive control and reward learning interactions

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While childhood adversity is associated with adolescent psychopathology (Tottenham & Galván, 2016), there may be dissociable effects of different adversity exposures on cognitive control and risk for psychopathology. Deprivation, defined as the absence of expected cognitive inputs, has been related to altered "cold" cognitive control, whereas threat, defined as the presence of harm experiences, has been related to altered affective control (Sheridan et al., 2019; Machlin et al., 2019). As such, the current study aims to identify dissociable pathways of these adversity exposures to psychopathology to inform intervention. N = 138 adolescent girls aged 9-16 years old (M = 12.5, SD = 2.01) completed a functional MRI scan. The Conditioned Appetitive Response Inhibition Task (CARIT; Winter & Sheridan, 2014) was used to assess inhibitory control over imbued value. Previously conditioned cues were used as No-Go stimuli in a Go-No-Go paradigm. We define inhibitory control over imbued value as inhibition to Previously Rewarded relative to Previously Unrewarded stimuli. We define response inhibition as inhibition to Previously Unrewarded relative to Go stimuli response. Index scores will be created for deprivation and threat, and a factor analysis will be used to identify an internalizing and externalizing factor. See https://osf.io/nc3aw/ for full preregistration. We predict that threat will be associated with reduced inhibitory control over imbued value and reduced activation in attention and salience regions when inhibiting responses to stimuli with imbued value. We predict that activation in these regions will mediate the relationship between threat and greater internalizing symptoms. We predict that deprivation will be associated with reduced response inhibition and reduced activation in cognitive control regions during response inhibition. We predict that activation in these regions will mediate the relationship between deprivation and greater externalizing symptoms.

3-L-179 Sexually-dimorphic patterns of anomalous brain anatomy in ADHD spanning childhood and adolescence: Findings from a mixed cross-sectional/longitudinal cohort

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Volumetric reductions in subcortical and cortical regions in children with ADHD have been consistent in cross-sectional studies; however, few have examined developmental volumetric trajectories in children with ADHD compared to TD children, and none have reported sex differences. This study leveraged cross-sectional (across age) and longitudinal volumetric data from children ages 8-17 years old: 292 with ADHD (71% male) and 275 TD controls (68% male). Repeated scans were obtained from 141 participants at least 1 year apart. Volumetric data was harmonized for scanner batch effects using ComBat. All analyses controlled for total cerebral volume, IQ, socioeconomic status. Linear regressions examined effects of diagnosis (Dx), sex and their interaction collapsing across age. For cortical regions, left anterior cingulate volume was reduced in girls with ADHD compared to TD girls ($p<.0001$), whereas there were no significant effects of diagnosis in cortical volumes for boys. In addition, girls with ADHD showed greater left premotor volumes than boys with ADHD ($p=.0004$). For subcortical regions, there were no main effects of diagnosis for either boys or girls. However, within the ADHD group there were main effects of sex in the left ($p=.0003$) and right ($p=.005$) amygdala and the right ($p=.001$) hippocampus in which boys with ADHD had greater volumes than girls with ADHD. Next, we examined whether age-related change in cortical and subcortical volumes differed between girls and boys with and without ADHD using non-linear (quadratic) mixed models. Results suggest that age-related changes in cortical and subcortical volumes did not differ among the diagnosis x sex subgroups in this cohort. Findings reveal sexually dimorphic patterns of volumetric reductions in ADHD that span childhood and adolescence, such that girls with ADHD show abnormalities in limbic regions while boys with ADHD show abnormalities in premotor regions.

3-L-180 Underlying biological mechanisms of sensory over-responsivity in youth with autism and anxiety disorders

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BACKGROUND Individuals with Autism Spectrum Disorder (ASD) or anxiety disorders (ANX) often display sensory over-responsivity (SOR), an extreme aversive response to sensory stimulation (Tavassoli et al., 2013; Conelea et al., 2014). While anxiety and SOR symptoms are highly correlated (Green et al., 2010), the biological mechanisms of how these two symptoms interact or overlap across diagnostic groups is not well understood. Thus, this study aimed to investigate whether SOR and anxiety symptoms uniquely contribute to physiological responses to aversive sensory stimuli in ANX compared to ASD, using skin conductance response (SCR) and heart rate (HR) as measures of arousal. **METHODS** Participants were 49 ASD, 20 ANX, and 30 typically-developing (TD) youth aged 8-18. SOR severity was measured using tactile/auditory SOR subscales from the Short Sensory Profile and Sensory Over-Responsivity Inventory (Dunn, 1999; Schoen et al., 2008). Participants experienced six 15-sec blocks each of mildly aversive

tactile/auditory/joint (tactile auditory) stimulation during SCR and HR acquisition with a 2-min baseline period. **RESULTS** After controlling for baseline HR, ASD-high-SOR participants showed greater mean HR responses during stimuli compared to ASD-low-SOR/ANX groups. Both ASD and ANX youth had higher SCR compared to TD youth. Though SCR decreased across trials, indicating habituation to the aversive stimuli, ANX participants showed a rise in SCR halfway through the trials, possibly indicating sensitization. **CONCLUSION** Results suggest that SCR may capture higher general physiological arousal in ASD and ANX, whereas HR may be more sensitive to SOR severity in youth with ASD. We expect that differences in physiological response to sensory stimuli relates to distinct neural mechanisms underlying SOR vs. anxiety and future studies will examine the relationship between physiological and neural responses to aversive stimulation.

3-L-181 Social support in a pandemic (covid-19): pregnant women and new mothers

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The Covid-19 pandemic has dramatically altered our daily social interactions. A uniquely impacted segment of our population is pregnant women and new mothers, who are not receiving the support and care typical at this sensitive stage in life. Social support is known to be particularly important for maternal well-being during pregnancy and in the postpartum period. Recent research reports a positive association between perceived Covid-19 impact and perceived social support (Tull et al., 2020). The current study will assess how the Covid-19 pandemic has influenced means by which pregnant women and new mothers receive social support. 678 women (54% pregnant; 46% new mothers) from the New York City area were recruited from medical records and enrolled in a longitudinal survey study between April and June 2020. At baseline, participants reported on access to social support, Covid-19 test results, and Covid-19 symptoms. Every 2-4 weeks they receive follow-up surveys assessing Covid-19 symptoms, test results (validated with medical records), and a standardized social support measure (Sherbourne & Stewart, 1991). Here, we will explore how women are meeting their social support needs during the pandemic: how they receive social support, who they seek social support from, and whether perceived level of social support has decreased or increased due to the pandemic. Second, we will examine how Covid-19 infection status influences social support. Specifically, we hypothesize that women with Covid-19 infection (presumed or confirmed) will show an increase in informational support, but decreases in positive social interactions, affectionate, and tangible support. This study will provide insight into the ways that pregnant women and new mothers are receiving social support and coping with Covid-19 related stressors. This study has important implications for understanding mental health and perinatal social support in a way that can directly inform suggested future practices.

3-L-182 Altered Network Organization and Screen Media Use in Childhood Attention-Deficit/Hyperactivity Disorder (ADHD)

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Objective: A surge in screen media use in childhood has generated much curiosity regarding the effects on brain development and attention. However, it remains an open question whether increased screen time use (ST) is contributing to symptoms of ADHD and altered network connectivity in the developing

brain. The current study examined connectivity between large scale networks associated with cognitive control, measures of executive function (EF), and screen time use in children with ADHD. **Methods:** Participants were 11,874 children, ages 9-11 from the ABCD study, which released two years of phenotypic data, and one year of cognitive/neuroimaging data at the time of this study. Psychiatric symptoms were assessed using a structured interview and informant report. Resting state fMRI scans were processed using standard preprocessing methods and strict motion censoring methods, including global signal regression. Multilevel modeling was used to account for differences in collection sites and analyze multivariate relationships between network metrics, including modularity (a metric indexing discrete brain networks), screen time use and symptoms of EF deficits with ADHD. **Results:** Screen time (ST) was consistently associated with EF deficits and ADHD at baseline. In addition, ST at baseline predicted ADHD severity at the follow-up visit even when controlling for baseline ADHD, gender, age, financial adversity, and motion (β= 0.005, t= 2.704, p<0.01). Reduced modularity was associated with ADHD as well as measures of EF. Furthermore, ST and ADHD were associated with reduced modularity in a model controlling for gender, age, financial adversity and motion (ST: β= -0.02, t= -2.71, p<0.01). Additional analyses examining which individual network associations contributed to reduced modularity resulted in mixed findings which were frequently nullified by motion covariates. These results will be reported in detail with recommendations for future research.

3-L-183 Associations between COVID-19 lifestyle impact and maternal perinatal depression

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The perinatal period is sensitive to psychosocial environmental change. Specifically, perinatal mental health is imperative to the health and behavior outcomes of both mother and child. Studies suggest that children born to mothers who endure heightened psychological stress during pregnancy demonstrate adverse effects permeating across physiological and neuropsychiatric domains. Due to the COVID-19 pandemic, women have experienced unprecedented changes to their daily lives, increasing risk for perinatal psychopathology. We aim to address this issue by examining factors causing the greatest disruption for pregnant women during the pandemic. In the current study, we recruited 929 pregnant women through medical records to complete an online survey during the acute peak of the COVID-19 outbreak in the NYC metropolitan area. The survey was developed to assess COVID-19 related impacts on multiple domains of daily life and self-reported distress associated within each category. We also administered a standardized questionnaire to assess mental health (Brief Symptom Inventory). First, we will evaluate maternal distress by using data-driven approaches to develop a multi-domain "Cumulative COVID-19 Impact Factor", reflecting life events and health behaviors most altered as a result of COVID-19. We will also isolate within which domains participants report the greatest amount of disruption. In a third step, we will examine how cumulative and individual factor scores are associated with self-reported maternal depressive symptoms. In secondary, exploratory analyses, we will evaluate potential mediating factors in these relationships (e.g. socioeconomic status). These findings have potential to directly inform clinical practices to support pregnant women during the COVID-19 pandemic. Understanding increased risk in perinatal mental health during the pandemic is essential to preventing the embedding of known physiological and psychological risk for the developing infant.

3-L-184 Default mode network coherence is associated with implicit suicidal ideation in adolescents

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Background: Suicidal ideation (SI) is an important precursor to attempts and other self-harming behaviors; however their measure lacks reliability in adolescence. Implicit suicidal thoughts have benn proposed as an alternative mesure of suicide risk, but their neurobiological correlates remains poorly defined. Here, we examined the relation between adolescents' implicit SI and default mode network (DMN) coherence, a network marker previously associated with self-referential processing, depressive symptoms and explicit SI. **Methods:** 49 depressed (15 boys, 16.26±1.33 years) and 21 healthy (9 boys, 15.96±1.06 years) adolescents completed a resting-state fMRI scan, and clinical assessment of explicit and implicit SI. Implicit SI were measured with a validated computerized assessment, the death-version of the Implicit Association Test (IAT). We used independent components analysis followed by dual regression to compute within-network coherence of the DMN across all subjects. We used linear regression to test the association between DMN coherence and explicit/implicit SI, covarying for age, sex, motion, depression severity, and current medication usage across all subjects. **Results:** The groups did not differ in IAT scores or demographic characteristics (all ps>0.36). Higher IAT scores, which indicate stronger implicit SI, were associated with stronger DMN coherence (B=0.16±0.05, t(62)=3.02, p=0.004, ΔR^2=0.13); DMN coherence was not associated with explicit SI scores (p=0.49). **Conclusions:** Stronger within-network coherence of the DMN has been shown to underlie ruminative, negative self-referential processes. Importantly, we found that stronger DMN coherence is associated with implicit SI above and beyond depression severity. Future longitudinal research with larger samples is needed to test whether DMN coherence predicts subsequent suicidal thoughts and behaviors in high-risk adolescents.

3-L-185 Marijuana use in adolescents and young adults with ADHD and neural activation for working memory

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Objective: Early experimentation with marijuana (MJ) is common and could lead to long term use, as well as impact cortical development. MJ use is more prevalent amongst adults with Attention Deficit Hyperactive Disorder (ADHD), but less is known about MJ use in adolescents and young adults (AYA) with ADHD. Moreover, MJ use is linked to reduced executive functioning. Differential brain activation for working memory (WM) is found amongst neurotypical (NT) AYA MJ users, compared to non-users, despite similar behavioral performance. WM is a critical impairment in ADHD and linked to greater risk-taking behavior. **Methods:** We compared rates of MJ use, frequency and age of initiation in AYA with ADHD (N=57, Mean Age=18.83) and NT group (N=79, Mean Age=18.62). Items for MJ use from the Youth Risk Behavior Survey questionnaire were used. Neural activation and behavior for verbal WM using an fMRI paradigm were compared for a subset of the sample (ADHD: N = 44; NT: N = 66). Each analysis controlled age. **Results:** We found, controlling for age, rates (p = 0.038) and frequency of MJ use (p = 0.011) were higher in ADHD, while start-age was lower (p = 0.015). Brain activation for WM, controlling for age, between MJ users versus non-users in NT group showed an under-activation in frontal regions, but in ADHD, featured over-activation of the thalamus and cerebellum (p < 0.005), with no behavioral

performance differences. **Conclusions:** The connection between WM, MJ use and ADHD could elucidate the risk for substance use in these populations, as well as help target interventions for this sensitive developmental stage. The thalamus has featured in other studies of MJ use while the cerebellum is significant in ADHD. Together they suggest different compensatory mechanisms in ADHD as performance is intact. Future work in our longitudinal project will investigate these connections longitudinally over time

M - Attention

3-M-186 Nonverbal behavior predicts social rejection elicited aggression in late adolescents

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Background: Peer-based aggression is a transdiagnostic symptom of several psychiatric disorders. Interventions targeting those at risk for aggression due trait-based measures of aggression and exposure to harsh parenting have had only limited success. This may be because peer-based aggression is a complex process influenced by current states of attention and arousal. We used machine learning to test the capacity of eye gaze and pupillary response, reliable indices of attention and arousal, to predict peer-based aggression. **Methods:** Participants (n=89; 70.8% female; 20.76±2.56 years) underwent eyetracking during a Virtual School paradigm where they interacted with purported peers who were 'nice', 'unpredictable', or 'mean'. Next, they completed an aggression paradigm where they could withhold or deliver a noise blast to those peers. Aggression was operationalized as the volume of noise chosen. We used a Support Vector Machine to test the predictive link between eye response patterns and aggressive behavior. Trait aggression and exposure to harsh parenting were also assessed. **Results:** Eye gaze and pupil response patterns during social interactions were predictive of subsequent aggressive behavior (accuracy=57%; chance at 33%). Importantly, eye response patterns were more predictive of aggressive behavior than trait aggression, harsh parenting, or the combination of those measures (p's<0.0001). **Conclusion:** This is the first study to show that eye response patterns during peer interactions predict aggression, and suggest these patterns may be more powerful predictors than trait aggression and exposure to harsh parenting. This study lays the groundwork for interventions utilizing nonverbal behavioral precursors to prevent peer-based aggression.

3-M-187 Identifying early risk of impulsivity: Evidence of sign-tracking behaviors in children

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Individual differences in response to environmental stimuli can be captured using a Pavlovian conditioned approach paradigm and may identify process dysfunctions that increase vulnerability to risky behaviors. Rats can be classified as goal-trackers (GTs) or sign-trackers (STs) based on the conditioned response that emerges following repeated cue-reward presentations. GTs approach the location of reward delivery at cue presentation; whereas STs approach the cue itself. We measured sign-/goal-tracking behavior in children and identified associations between these and externalizing behaviors. Participants (N=17, male=10) were psychiatrically healthy 9-10-year-olds. Two response

boxes were present; one housed a conditioned stimulus (CS)-an extended lever; the other housed an unconditioned stimulus (US)-a $0.20 token delivered at lever-CS retraction. Sessions were 4 blocks of 10 trials each. MATLAB software recorded contacts with the CS/US. The Pavlovian Conditioned Approach (PavCA) index was calculated based on the propensity to approach US or CS, ranging from -1 (GT) to 1 (ST). Externalizing (Child Behavior Checklist; CBCL) and self-regulation (Early Adolescent Temperament Questionnaire; EATQ) were assessed. Preliminary data show successful PavCA measurement with a bias toward STs (mean=.56, sd=.40, range=-.06-.95). Higher PavCA (ST) was marginally associated with increased aggression (EATQ; r=.54, p=.05; CBCL; r=.48, p=.09) and rule-breaking (CBCL; r=.50, p=.07), and decreased attentional control (EATQ; r=-.52, p=.07). These results provide some evidence of translational value of the sign-/goal-tracker model. The skew towards STs may reflect age-appropriate neurocognitive control. Though marginal, the association between sign-tracking behavior and impulse/attentional control aligns with data from rodent models. Measuring sign-/goal-tracking tendencies in children may help identify neural systems and treatment targets for children at risk for externalizing behaviors.

3-M-188 Affect influences social attention captured via mobile eye-tracking during dyadic play in young children

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Social attention may facilitate connection during social interactions. However, most research assessing social attention relies on static computer-based paradigms, overlooking the dynamics of social interactions. Naturalistic work highlights that in dynamic settings, individuals look at people infrequently. However, research has not examined how changes in affect throughout a social interaction may alter how attention is deployed. The current study took an exploratory approach to examine how affect influences social attention during play. 14 children (7 sex-matched dyads; oversampled for behavioral inhibition (BI); M = 6.10 years, SD = 0.59) completed a 5-minute dyadic free play while mobile eye-tracking data were collected. Gaze metrics (AOIs: peer, toys, other) and affective coding (negative, neutral, positive) were extracted at the second-by-second level. We examined if changes in affect influenced later social attention allocation. Data were modeled using a multilevel multinomial regression with AOI as the outcome. Both child affect and dyad partner affect were entered as predictors at time intervals from concurrent to 5 second before a given AOI. Although children spent most of their time gazing at toys (61%), three seconds after a child expressed positive affect, they were twice as likely to gaze at their peer than at the toys (odds ratio: -0.52, p = .032). Dyad partner affect did not significantly influence gaze. Furthermore, BI did not relate to gaze or change how affect influenced gaze. Conversely, in a model where gaze predicted affect, we found no significant influence of child or dyad partner gaze. BI was positively associated with affect such that with each unit increase in BI score there was a 5% increase in the odds a child would display negative, rather than positive, affect (odds ratio = 1.05, p = .018). Our results suggest an influence of positive affect on social connection via social attention and set the stage for future confirmatory analyses.

3-M-189 Rhythmic properties of attention across development

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Classically, attention has been understood as a constant and continuous process. However, recent evidence suggests that attention alternates rapidly between states of enhanced and diminished perceptual sensitivity. This rhythmic property, which facilitates environmental sampling during the allocation of attention, allows attention to be flexibly applied to the most relevant target at any moment. Importantly, these dynamic attentional state alternations can be measured at the behavioral level. In adults, this rhythmicity occurs in the theta range (3-8 Hz). While adult and non-human primate studies have shaped our understanding of these dynamic properties of attention, little is known about this rhythmicity during development. In this study we aim to determine the developmental trajectory of rhythmic properties of attention at the behavioral level and hypothesize that it becomes more adult-like with age. A barrier to studying this in childhood has been that tasks for revealing the rhythmicity of attention are long and demanding. We've implemented a foveal task that is accessible for children, yet still captures this rhythmicity. During this task children fixate on a central point while a blue dot cloud followed by a red dot cloud appears on the screen. The appearance of the red cloud serves as a cue and is followed by a random cue-target interval that varies between 250-750ms after which time, one of the two clouds changes slightly in contrast. The ability to detect this contrast change depends on the phase of attention at the time it occurs, thereby allowing us to quantify the frequency at which attention is rhythmically oscillating. We are collecting data for ages 6-8 and 11-13, and have so far collected data from 11 children in the older group, to determine if there is a significant difference in peak frequency between these age groups. If so, we will include more ages to get a more holistic picture of the developmental trajectory of rhythmicity in attention.

3-M-190 Early emergence of EF using neural and behavioral measures

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Executive Function (EF) refers to an interrelated set of neurocognitive systems that underlie behavioral control and cognitive flexibility. EF has pervasive influences on cognition and later development. In recent years, there has been a growing interest in exploring how executive functions develop in the first three years of life. The present project aims to contribute to this literature by exploring how early attentional control, in the form of attentional orienting and executive attention, develops to support forms of complex functioning with an eye toward understanding how EF develops at two levels: brain and behavior. We collected optical imaging data (fNIRS) while participants completed a battery of well established looking tasks measuring attentional control in 30-month-old toddlers (n = 76). Outside of the imaging procedure, participants completed additional measures of 'hot' (Gift Wrap and Delay) and 'cool' EF (MEFS). Additionally, we collected parent-reported effortful control (CBQ) at 42-months. Results show that attentional control is related to effortful control but not executive function. Specifically, efficiency of disengagement and the interaction between age and the probability to produce an anticipatory look at 30-mo are predictors of effortful control at 42-mo. These results provide evidence that measures of basic attentional dynamics relate to longitudinal changes in executive control. Consistent with previous work, we found task-relevant brain activity in canonical attentional networks. Critically, activation patterns in DLPFC and TPJ were predictive of later executive control and may serve as biomarkers of emerging cognitive control. Our results set the stage for future work to measure

looking dynamics in infancy to predict longer-term executive control outcomes. Furthermore, this work furthers our understanding of how changes in brain function lead to specific developmental cascades from 30- to 42-months.

3-M-191 Preliminary analysis of basal ganglia tissue-iron concentration in children with Attention Deficit/Hyperactivity Disorder

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Iron plays an important role in neurodevelopment and has been linked to childhood disorders such as ADHD. Studies have explored associations between ADHD and iron deficiency, with mixed findings and iron supplementation has been linked with reduced ADHD symptom ratings. Iron plays a key role in dopamine synthesis/regulation and multiple lines of evidence suggest abnormalities in dopamine in the basal ganglia/substantia nigra regions may be involved in the pathophysiology of ADHD. However, few studies have explored tissue-iron concentration in these regions in children with ADHD. Addressing this gap, quantitative magnetic susceptibility, an iron imaging marker, was measured using 3T MRI in 53 children (Mage=10.5, SD=1.1): 15 ADHD (40% female) and 38 typically-developing (TD) children (42% female). The effects of diagnosis on iron levels were assessed using MANCOVA, covarying for age. In children with ADHD, tissue-iron concentration was significantly higher in the right globus pallidus (p=0.042) with a trend-level increase in the left globus pallidus (p=0.087). Additionally, lower iron concentration levels were observed in the right caudate (p=0.058) in children with ADHD, who also showed greater asymmetry in iron concentration (p=0.025), with weighting towards greater iron deposition in the left caudate and lesser in the right caudate. Pearson correlations revealed, among children with ADHD, a significant correlation between increased iron deposition in the left globus pallidus and increased symptom severity on the Conners ADHD Inattention Scale (r=0.609, p=0.035). There was also a significant correlation between decreased iron deposition in caudate (left/right combined) and increased total severity on the DuPaul ADHD Rating Scale (r=-0.674, p=0.023) among children with ADHD. These preliminary findings shed light on the possible role of altered brain iron deposition in children with ADHD and suggest a potentially novel biomarker for mitigating ADHD symptom severity.

3-M-192 Linking fronto-amygdala functional connectivity to in vivo attentional biases towards social threat in adolescence

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Heightened sensitivity to social threat in adolescence may be supported by altered activity in brain networks implicated in attention and emotion regulation. We used novel, ecologically-valid methods to test the hypothesis that girls displaying preferential attention to social threat in vivo would also show weaker negative amygdala-prefrontal cortex (PFC) connectivity during a peer rejection fMRI task. Healthy girls (n=79; 11-13 years) gave a speech to a positive judge and a potentially critical judge while wearing mobile eye-tracking glasses. Eye tracking data were processed using Tobii Pro Glasses Analyzer. Total duration of visits to each judge across the speech was examined, creating an attention bias score (i.e., fixation duration on potentially critical judge-fixation duration on positive judge). Participants also completed the fMRI Chatroom Interact Task (Silk et al., 2012), in which they believed they were being

rejected by peers in an online chatroom. The CONN toolbox for SPM12 was used to examine associations between attention bias scores and fronto-amygdala connectivity during rejection feedback. A seed-to-voxel approach was used with anatomically-defined left and right amygdala seeds. Analyses were restricted to the frontal lobe, with small volume correction at a p<.005 voxel-wise threshold and application of the false discovery rate to resulting clusters to correct for multiple comparisons. We found positive associations between attention bias scores and functional connectivity between the right amygdala and two clusters in the bilateral medial PFC (left: x,y,z=-28,54,4, k=188, t(77)=3.81, pFDR=.036; right: x,y,z=18,50,-10, k=193, t(77)=4.26, pFDR=.036). Girls with stronger attention biases towards a potentially critical judge in vivo showed less negative fronto-amygdala coupling to peer rejection in the scanner. Findings may suggest less effective downregulation of an emotional response to rejection among girls with attention biases to social threat.

N - Language

3-N-193 Social communication in adolescence: Linguistic features of internalizing symptoms

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Emerging evidence suggests that linguistic markers detected in naturalistic language may indicate internalizing psychopathology. Existing research suggests that depression and anxiety symptoms are positively associated with first-person singular pronouns (Edwards & Holtzman, 2017; Sonnenschein et al., 2018), absolutist words (Al-Mosaiwi & Johnstone, 2018), and negative sentiment (Rude et al., 2004). Knowing whether these associations are present during social communication in adolescence, a developmental period characterized by significant changes in social processes (Crone & Dahl, 2012; Pfeifer et al., 2013; Somerville, 2013), would provide a novel method through which potential social cognitive links to internalizing symptoms may be explored. In this preregistered study, we propose to assess the extent to which social communication expressed through daily text messages (n=53,032 messages) differentially relates to internalizing symptoms in adolescent females (n=45; ages 11-15 years). We will analyze the linguistic features of all smartphone keyboard data entered into social media and text messaging apps over one month using the Effortless Assessment Research System (Lind et al., 2018). We hypothesize that internalizing symptoms will be positively associated with first-person singular pronouns, negative sentiment, and absolutist words. Second, in exploratory within-person analyses, we hypothesize that daily self-reported well-being will be negatively correlated with use of the linguistic features above. We will also explore the temporal order of fluctuations in daily well-being and linguistic features. Our future aim is to explore how linguistic features unique to internalizing symptoms relate to neural correlates of self-perception. The present study's sample is from a larger longitudinal neuroimaging study that will allow us to investigate the link between naturalistic social communication, brain function, and internalizing symptoms in adolescents.

3-N-194 Gray matter volume differences in bilingual compared to monolingual children

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Some, but not all behavioral studies have reported better executive control (EC) in bilinguals, thought to

be the result of a constant need to select one language while suppressing the other. We previously reported more gray matter volume (GMV) in bilingual relative to monolingual young adults in brain regions known to be involved in EC (bilateral prefrontal and right parietal cortices) suggesting that greater use of executive control in bilinguals manifests in experience-dependent anatomical differences (Olulade et al., 2016). However, behavioral studies have shown that the EC advantage is more reliably found in children than in young adults, suggesting that GMV differences between bilingual and monolingual children will be more pronounced or widespread than similar GMV differences in young adults. To test this hypothesis, we compared GMV in 35 English-speaking monolingual and 20 Spanish-English bilingual children. A whole-brain between-group comparison revealed more GMV in bilingual compared to monolingual children in regions associated with EC (right middle and inferior frontal gyri, superior parietal lobule, and precuneus). Next, we submitted both groups of children to an ANOVA with 42 English speaking monolingual and 26 Spanish-English bilingual adults to test for an interaction of Language Experience by Age Group at the level of the whole brain. The left superior frontal gyrus (BA6), precuneus (BA7), and right superior parietal lobule (BA1), revealed an interaction in which bilingual>monolingual GMV in children was greater than any bilingual>monolingual GMV (or bilingual=monolingual GMV) in the adult groups. No regions indicated that bilingual>monolingual GMV is more pronounced in adults. These results provide further evidence for GMV differences in early bilinguals in regions associated with EC and indicate that more GMV differences exist between bilingual and monolingual children than adults.

3-N-195 Environmental Noise, Language Skills, and Language-Related Brain Structure in Childhood

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Many studies have documented the effects of environmental noise (EN) on children's development. In particular, exposure to higher EN levels has been related to poorer language and reading skills in children. However, few studies have examined the underlying neurobiological mechanisms that may account for EN related differences in reading. In this study, we aimed to examine whether higher EN was associated with 1) children's reading and phonological skills and 2) cortical differences in language-related brain structure. Based on prior work, we hypothesized that greater EN exposure would be associated with poorer reading and phonological skills and with differences in language-related brain structure. A socioeconomically diverse sample of children aged 5-9 (N = 94) completed standardized language assessments and completed an MRI scanning session. Digital language processors (LENA) were used to measure average EN levels over the course of a typical day (n = 43 with complete LENA, MRI, and behavioral data). All models controlled for age, sex, conversational turns, and parental education. EN was not related to language scores. However, higher EN was associated with higher surface area in the precentral gyrus and superior parietal lobule, areas of the brain associated with motor skills and visuospatial processing, respectively. These areas were not significantly related to reading or phonological skills. Although not supporting our initial hypotheses, these results suggest that increased EN exposure may be related to brain development. This study is among the first to examine EN-related differences in children's brain structure and has implications for identifying the neural mechanisms through which increased EN exposure may affect children's development. Future analyses will focus on

the longitudinal relations between noise exposure and brain development, as well as potential moderators of this association.

O – Brain function

3-O-196 Associations of violence exposure with behavioral and neural indices of in-group bias in young children: a preregistration

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Accurately classifying individuals as members of one's in-group or an out-group confers safety and social benefits. Prior work demonstrates implicit and explicit behavioral preferences and associated neural activation for novel in-group members in adults (van Bavel et al., 2008) and adolescents (Guassi et al., 2017). We examine how violence exposure influences these group classification processes in young children. Childhood violence exposure predicts heightened neural reactivity to threat in youth (McLaughlin et al., 2019), and may also influence heuristic processes informing classification of new individuals as in-group (i.e., "safe") or out-group (i.e., "unsafe") members. The present study examines associations of violence exposure with group bias and associated neural activation in a preregistered analysis of data we have collected but not analyzed. 76 youth aged 6-8 with varying levels of violence exposure were randomly assigned membership to one of two novel groups and subsequently participated in behavioral tasks measuring implicit and explicit preferences for in- vs. out-group members, and an in-group/out-group member viewing fMRI task. We hypothesize that violence-exposed youth will exhibit: (1) heightened neural activity in the amygdala, OFC, and fusiform gyrus when viewing novel out-group vs. in-group members, (2) more positive explicit and implicit preferences for novel in-group members and (3) heightened neural reactivity to out-group members will mediate the association between violence exposure and in-group bias. Results from this study will have implications for understanding how violence exposure impacts neural and behavioral markers of implicit classification of new individuals and explicit preferences.

3-O-197 Evoked and intrinsic brain network dynamics in children with autism spectrum disorder

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Objective Brain dynamics underlie flexible cognition and behavior, yet little is known regarding this relationship in autism spectrum disorder (ASD). We examined time-varying changes in functional co-activation patterns (CAPs) across rest and task-evoked brain states to characterize differences between children with ASD and typically developing (TD) children and search for relationships with social behaviors and restricted and repetitive behaviors. **Methods** 17 children with ASD and 27 TD children ages 7-12 completed a resting state fMRI scan and four runs of an attention task. Metrics indexing brain dynamics were generated from dynamic CAPs computed across three major large-scale brain networks: midcingulo-insular (M-CIN), medial frontoparietal (M-FPN), and lateral frontoparietal (L-FPN). **Results** Five time-varying CAPs representing dynamic co-activations among network nodes were identified across rest and task fMRI datasets. Significant Diagnosis x Condition interactions were observed for the dwell time of CAP 3, representing co-activation between nodes of the M-CIN and L-FPN, and the

frequency of CAP 1, representing co-activation between nodes of the L-FPN. A significant brain-behavior association between dwell time of CAP 5, representing co-activation between nodes of the M-FPN, and social abilities was also observed across both groups of children. **Conclusions** Analysis of brain co-activation patterns reveals altered dynamics among three core networks in children with ASD, particularly evident during later stages of an attention task, suggesting these networks may function differently in children with ASD during prolonged periods of task engagement. Dimensional analyses demonstrating relationships between M-FPN dwell time and social abilities suggest that the metrics of brain dynamics may index individual differences in cognition and behavior in both children with ASD and TD children.

3-O-198 Charting trajectories of neural noise across the first two years of life

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Noisy neuronal communication may disrupt synchronization between networks in the developing brain and contribute to cognitive dysfunction. Noisy processing can be measured by two aperiodic EEG power spectrum components--the spectral slope and offset (y-intercept of the model fit). A flatter slope and smaller offset indicate more random neuronal activity and reduced broadband power, respectively. This is the first study to chart how these neural properties change across the first two years of life. Given known developmental shifts from low to high spectral power, we predicted that spectral slopes would become flatter and offsets would decrease across infancy. Families were drawn from an ongoing multisite longitudinal study examining infant temperament and attention (N = 350). Aperiodic parameters were estimated from resting EEG via FOOOF. Preliminary data are available for infants at 8- (N=124), 12- (N=88), and 18-months (N=72) of age. Multilevel models showed that both parameters decreased over time (ps < .04), suggesting reductions in broadband power (lower offset) and increases in neural noise (flatter slopes). Male infants had a marginally larger decrease in spectral slopes over time relative to female infants (p = .07). Infants differed in their initial spectral slope and offset values as well as change in each parameter over time (ps < .05), suggesting within-person variability that may be accounted for by contextual factors. Our preliminary results are the first to chart trajectories of noisy neural processing across infancy. Observed patterns in neural change resemble known developmental shifts in the distribution of spectral power, which studies have shown reflect changes in spectral slope rather than narrowband activity (e.g., He et al., 2020). Final analyses will examine whether changes in maternal psychopathology modulate neurodevelopmental trajectories, as well as if deviations in either aperiodic parameter predicts problem behavior at 24-months.

3-O-199 Adolescent pleasure and novelty seeking is associated with greater neural response in reward and control circuitry during evaluation of greater risk and reward

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Adolescence is a period during which risky behaviors tend to increase. Previous studies suggest there are individual differences in adolescent risk taking, attributable to a variety of factors, including temperament. This study investigated the neurobiological underpinnings of risk and reward evaluation as they relate to self-reported pleasure derived from novel experiences on the Early Adolescent Temperament Questionnaire (EATQ). Healthy participants (N = 265, ~50% male) ages 12-17 years-old,

underwent functional magnetic resonance imaging during a modified Wheel of Fortune task, where they evaluated a series of choices: "1090", (10% probability of winning $7 vs. 90% probability of winning $1) and "3070", (30% probability of winning $2 vs. 70% probability of winning $1). Whole brain and a priori region-of-interest regression analyses revealed that greater EATQ was associated with greater activation in the ventral striatum, posterior cingulate cortex, and left middle frontal gyrus when evaluating the 1090 wheel. Behaviorally, there was a significant EATQ by wheel type interaction. Adolescents with low EATQ scores made significantly fewer risky selections on the 1090 wheel than the 3070, whereas those with higher EATQ score showed no significant differences in behavior between wheels. While behavior on the 1090 wheel was also related to ventral striatal brain response, when controlling for behavior, the association between brain response and novelty seeking remained. Together, these findings suggest that adolescents who enjoy novel experiences have greater reward-related brain response in situations with greatest potential for risk and reward, and also show greater activation in regulatory control regions, potentially counterbalancing the bottom-up driven reward response. More research is needed to determine whether individual differences in brain activation related to novelty seeking are related to decision making in more ecologically valid settings.

3-O-200 Stress in "Quaranteens": The role of frontolimbic connectivity in emotion and stress during the COVID-19 pandemic

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Frontolimbic connectivity has been associated with stress reactivity and emotion regulation; dysfunction in these processes increases risk for depression and anxiety in adolescence. The recent COVID-19 pandemic has led to profound changes in adolescents' routines (e.g., school closures, social distancing), likely elevating stress levels and emotional problems. In this longitudinal study, we examined whether frontolimbic connectivity assessed prior to the pandemic predicts adolescents' vulnerability to emotional and stress-related symptoms assessed 2-4 weeks after the regional shelter-in-place order in March, 2020. One hundred fifty-three adolescents (F=96; age: M±SD=16.58±1.48 years) from the San Francisco Bay Area, recruited from two independent studies, who varied in their clinical history completed the Coronavirus Health Impact Survey (CRISIS) during the initial weeks of quarantine. Exploratory factor analysis of this questionnaire yielded a two-factor solution of COVID-19-related distress: mood change and stress reactivity. 91 of the 153 survey responders underwent resting-state fMRI scanning and reported on their level of depressive symptomatology 1 year M/SD=1.29±0.51 years) prior to the COVID-19 assessment. In all statistical models, we controlled for sex, age, and baseline levels of depression. Ventromedial prefrontal cortex (vmPFC; BA14m) and subgenual anterior cingulate cortex (BA25) connectivity with the striatum (nucleus accumbens, ventral caudate) predicted more emotional problems during the pandemic (ΔR: 4.25%-8.62%, p<.05). Similarly, vmPFC connectivity with the right basolateral amygdala predicted greater stress reactivity during the pandemic (ΔR2: 6.58-6.64%, p<.05). Our findings highlight the importance of assessing adolescents' stress levels and emotional well-being during the current pandemic and suggest that frontolimbic connectivity is a predictive biomarker of stress and emotional vulnerability during large-scale adverse events.

3-O-201 Social cognition in expectant fathers: Does prenatal neural activity during theory of mind and action perception reflect preparation for fatherhood?

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Introduction. Social cognition may facilitate sensitive caregiving behavior and support the developing father-infant bond. This study is the first to use a standardized task to assess fathers' prenatal neural activity during two forms of social cognition: theory of mind and action perception. **Methods**. Expectant, first-time biological fathers (N = 39) completed an fMRI scan when their cohabiting female partners were in mid-to-late pregnancy (m = 27.84 weeks pregnant). They performed the Why-How fMRI task (Spunt & Adolphs, 2014), designed to elicit neural activation in the theory of mind and action perception networks. This was done by asking participants to judge "Why" an action is being performed (theory of mind) vs. "How" the same action is performed (action perception). Expectant fathers also reported on their exposure to stressful life events and their prenatal attachment to the fetus. **Results.** We found that as their partners progressed in pregnancy (weeks pregnant), fathers showed stronger neural activity during the "Why" condition in the lateral occipital cortex, precuneus, and posterior cingulate during the "Why" condition contrasted with the "How" condition. Fathers who had experienced more stressful life events showed greater neural activity in the prefrontal cortex and precuneus during the "How" condition contrasted with the "Why" condition. Prenatal attachment was not associated with neural activity during the task. **Discussion.** Studying expectant fathers before the birth of their first child can elucidate whether fathers experience neural changes during pregnancy. Expectant fathers' neural changes during the postpartum period may reflect neurobiological preparation for parenthood. These findings demonstrate distinct neural patterns among expectant fathers who have experienced more stressful life events. Further work is needed to understand the implications of fathers' social cognition for shaping the subsequent parent-infant relationship.

3-O-202 Reward- and threat-related neural activity associated with risk and presence of depression in adolescents in a middle-income country

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Objective: Although 90 percent of adolescents live in low- and middle- income countries (LMIC), most neuroimaging studies on adolescent depression have been conducted in high-income countries (HIC). Moreover, few studies have compared the neural activity of adolescents with Major Depressive Disorder (MDD) to controls who are stratified by high risk for depression (HR) and low risk for depression (LR), thereby limiting conclusions that can be drawn from this research. To address this gap, this study aimed to investigate neural activity associated with the risk and presence of depression in adolescents in Brazil. **Method:** Brazilian adolescents aged 14-16 years were classified as LR (N=50), HR (N=50), and MDD (N=50). Risk status was determined using a risk calculator that incorporated multiple sociodemographic risk factors and clinical assessment. During functional magnetic resonance imaging (fMRI) scanning, adolescents performed a gambling task and a face-matching task. **Results:** The HR and MDD groups, compared to the LR group, showed reduced activation of the lateral prefrontal cortex (LPFC) when receiving reward and reduced threat-related left amygdala connectivity with other brain regions such as the thalamus, supplementary motor area, inferior parietal lobule (IPL), and precentral gyrus when

viewing fearful faces. In addition, the HR group, compared to other groups, showed reduced threat-related connectivity between right amygdala and IPL. **Conclusions:** Our results suggest that reduced reward-related LPFC activity and threat-related left amygdala connectivity are associated with both risk and presence of depression. Meanwhile, reduced threat-related right amygdala connectivity is uniquely associated with risk of depression. Comparing neural activity in adolescents with MDD to HR and LR groups can help to clarify the neural risk factors and neural outcomes of adolescent depression in LMIC.

3-O-203 Delayed development of prefrontal regulation in Autism Spectrum Disorder during aversive sensory exposure

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Background: Sensory over-responsivity (SOR) in autism spectrum disorder (ASD) is related to increased fMRI responses and reduced habituation in sensory processing regions/amygdala during exposure to aversive sensory stimuli (Green et al., 2015; 2019). Prefrontal regulation of the amygdala increases with age and is thought to underlie improvements in emotion regulation (Gee et al., 2013; Bachevalier & Loveland, 2006) and reduced SOR in ASD (Green et al., 2019). The development of sensory regulation in ASD, however, is not well-understood. Objective: To examine potential mechanisms of sensory regulation development in ASD vs. typically developing (TD) youth by comparing regions where neural activity during sensory exposure is correlated with age. **Methods:** Participants were 54 youth with ASD and 40 TD controls, aged 8-18. While undergoing fMRI, participants experienced six blocks each of auditory/tactile/joint (auditory+tactile) aversive sensory stimulation. Age was used as a regressor in a bottom-up, whole-brain analysis to examine its relationship to neural activation. Contrasts were thresholded at $z>2.3$, corrected for multiple comparisons at $p<.05$. **Results:** In ASD, age correlated with increased activity in the insula, temporal/frontal poles, and orbital frontal cortex (OFC) and decreased activity in the postcentral gyrus, precuneus, and posterior cingulate. Both groups showed a negative correlation between age and activity in the occipital cortex/superior parietal lobule. For the TD group, age was also negatively correlated with activity in the angular gyrus/insula/frontal pole/OFC. **Conclusions:** ASD/TD youth showed opposite associations between age and prefrontal activation in response to sensory information. In TD youth, the decrease in prefrontal activation with age may indicate that sensory regulation is becoming more implicit (Denny, 2015), whereas for ASD youth, increased prefrontal activation may relate to delayed but improving sensory regulation with age.

3-O-204 Age-related change in stimulus-elicited amygdala-prefrontal circuitry: a longitudinal multiverse approach

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There has been considerable interest in the developmental course of the amygdala and its connections with medial prefrontal cortex (mPFC) given the central role of both regions in emotion generation,

learning, and regulation. While several studies have suggested that this circuitry exhibits developmental changes in function across the first two decades of life, these studies have typically employed cross-sectional designs, and findings on developmental change in amygdala-mPFC circuitry described by the literature have been mixed. Recent work has also highlighted that fMRI analytic choices may contribute to such discrepancies across studies. Here we used an accelerated longitudinal design to examine stimulus-elicited changes in amygdala-mPFC circuitry from 4-22 years of age (N = 97; 182 total scans; 1-3 scans per participant). Participants completed an event-related emotion discrimination task with fearful and neutral faces, and we used 'multiverse' analyses to examine the robustness of our findings to fMRI analysis choices. A preregistered pipeline together with an additional 2800 parallel analyses (each using many distinct preprocessing and modeling choices) found evidence for age-related decreases in amygdala reactivity on average, though such decreases may represent between-participant differences rather than developmental growth. Larger amygdala reactivity at younger ages was likely attributable to elevated amygdala responses to the first few trials relative to later trials. Across analysis decision points, we did not find consistent evidence of age-related change in amygdala-mPFC connectivity through psychophysiological interaction (gPPI) and beta-series connectivity (BSC) methods. These findings highlight both the challenges in estimating developmental change in longitudinal cohorts and the value of multiverse approaches for developmental neuroimaging.

3-O-205 Disentangling being correct from social reward: investigating age group differences

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During adolescence, brain regions implicated in reward processing undergo maturational changes while peer relationships become increasingly important. Despite the importance of peers, neural response to reward is largely examined in the monetary domain. Most paradigms also confound the intrinsic reward of being right with the extrinsic reward of positive outcomes. We developed well-matched fMRI- based social and monetary tasks that disentangle these aspects of reward. We previously demonstrated that ventral striatal response to correctly predicting outcomes varied by domain (social/monetary) and valence (positive/negative) of outcomes (Quarmley et al., 2019). Here, we test whether these differences vary by age. Adolescents (N=34;M=13.40±1.20 years) and adults (N=44;M=21.40±3.9 years) underwent fMRI while they predicted which of two doors or age-matched peers would provide positive or negative feedback. An age (adolescent/adult) x domain (monetary/social) x valence (positive: monetary-win/social-like, negative: monetary-loss/social-dislike) x outcome (correct/incorrect) repeated measures ANOVA demonstrated a significant interaction in right ventral striatum ($F(1,76)=4.045$; $p<.05$). This was qualified by an age × domain × outcome effect for negative valence trials ($F(1,76)=7.408$; $p<.05$). Specifically, in the social domain, adults had greater engagement to correctly vs. incorrectly predicting that a peer disliked them, compared to adolescents who failed to differentiate between correct and incorrect predictions ($t(58)=2.332$; $p<.05$). No interactive effects were observed in the monetary domain. Thus, in the social domain the intrinsic reward of being correct varies based on age. For adolescents, the salience of social rejection may override the intrinsic reward of being correct, whereas the salience of intrinsic reward may override the experience of social rejection in adults. This mechanism may contribute to the deleterious effects of social rejection in adolescence.

3-O-206 C-reactive protein levels and frontocingulate activation to emotional faces in adolescents

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Introduction Higher levels of peripheral inflammation, measured by blood markers such as C-reactive protein (CRP), have been linked to increased negative reactivity. Studies in clinical samples show that this relation is explained in part by altered neural processing; it is unclear, however, whether this association is evident in typically developing adolescents. Here, we examined the relation between CRP levels and neural activity in adolescents as they completed an affective processing task. **Methods** 46 adolescents (30F; 15.47±1.18 years) recruited from the community participated in an fMRI scan while performing an affective label task with emotional faces. We operationalized negative reactivity as the contrast in BOLD activation during Negative Label vs. Positive Label conditions. CRP levels were obtained from dried capillary blood spots. To identify brain areas in which CRP was related to negative reactivity, we conducted a whole-brain analysis with CRP levels and task conditions as regressors, and motion, age, and sex as covariates. Statistical images were cluster-thresholded at Z>2.3 with a corrected cluster significance threshold of α=0.05. To interpret the linear contrast, we extracted parameter estimates (PEs) from Positive Label and Negative Label trials relative to baseline from the resulting regions. **Results** CRP levels were significantly associated with activation during the Negative Label vs. Positive Label contrast in a left frontal cluster spanning the superior frontal gyrus and the anterior cingulate cortex (k=782; mean Z=2.70). Extracted PEs indicated that this effect was driven by decreased activation during the Positive Label condition. **Discussion** Our results indicate that the association between peripheral inflammation and neural processing of emotional information is evident in typically developing adolescents. Furthermore, inflammation appears to increase negative reactivity by dampening frontocingulate responses to positive stimuli.

3-O-207 The development of neural responses to faces in infancy

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We examined the development of the N290 and P400 event-related potentials (ERPs) and their source during the first year of life by comparing upright vs. inverted (Experiment 1) and intact vs. phase-scrambled (Experiment 2) faces and houses. We predicted that developmental changes would occur in the inversion effect for faces for both ERPs. Infants would exhibit larger N290 and P400 ERPs to intact faces than houses by 12 months of age. The source generator of the N290 would be in the middle Fusiform Gyrus (mFG), while the P400 would be localized in the Posterior Cingulate (PC). In Experiment 1, N290 and P400 amplitude values were analysed as a function Stimulus Type (face, house), Orienatation (upright, inverted) for each age group (3, 4.5, 6, 7.5, 12 months). Six- and 7.5-month-old infants showed larger N290 amplitudes for inverted than upright faces, and upright than inverted houses (ps < .037). At 12 months of age, there was a significant inversion effect for faces (p = .007), but not for houses (p = .179). Only the mFG showed the same face-specific inversion effect at 12 months (Faces: p= .011; Houses: p = 0.06). Starting at 6 months of age, the P400 was larger in response to inverted than upright stimuli (ps < .001). Both mFG and PC sources showed larger responses to upright faces than houses (ps<.006). Neither region showed the face-specific inversion effect. In Experiment 2,

peak amplitude of the N290 and P400 were analysed as a function of Stumilus Type (face vs. house), Texture (intact, scrambled) for each age group (6, and 12 months). Only at 12 months of age both the N290 and P400 were larger for intact faces than intact houses (ps<.001). Face-specific P400 responses were localized in the PC (p<.001). Intact faces showed larger risponses than both intact houses and scrambled faces. Overall, these results revealed developmental changes in face-sensitive ERP responses. Infants showed adult-like neural responses to faces by the end of the first year of life.

3-O-208 Neurobiological markers of resilience to depression following childhood maltreatment: The role of neural circuits supporting the cognitive control of emotion

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Childhood adversity is strongly linked to negative mental health outcomes, including depression and anxiety. Leveraging cognitive neuroscience to identify mechanisms that contribute to resilience in children with a history of maltreatment may provide viable intervention targets for the treatment or prevention of psychopathology. Here, we examined neurobiological mechanisms of resilience to depression and anxiety following childhood adversity. Specifically, we investigated whether neural circuits underlying the cognitive control of emotion may promote resilience, wherein a child's ability to recruit the frontoparietal control network to modulate amygdala reactivity to negative emotional cues--such as during cognitive reappraisal-- buffers risk for internalizing symptoms following exposure to adversity. A longitudinal sample of 151 participants aged 8-17 years with (n=79) and without (n=72) a history of childhood maltreatment completed a cognitive reappraisal task while undergoing fMRI. Among maltreated youth, those who were better able to recruit prefrontal control regions and modulate amygdala reactivity during reappraisal exhibited lower risk for depression over time. By contrast, no association was observed between neural functioning during reappraisal and depression among youth without a history of maltreatment. These preliminary findings support the hypothesis that children who are better able to regulate emotion through recruitment of the frontoparietal network exhibit greater resilience to depression following childhood maltreatment. Interventions targeting cognitive reappraisal and other cognitive emotion regulation strategies may have potential for reducing vulnerability to depression among children exposed to adversity.

3-O-209 Test-retest reliability of adolescent brain response during cognitive conflict and error processing in the Eriksen Flanker task

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Quantifying the test-retest reliability of tasks used in research is at the center of recent debates in both psychology and neuroscience. In neuroimaging, test-retest reliability is critical to understanding individual differences in brain responses and to identifying potential biomarkers for therapeutic interventions. The current study examines the test-retest reliability of neural responses during a cognitive control task, Flanker, in a sample of adolescents. Method. 36 youth (8-17 years old, M=13.88, SD=2.59) completed an Eriksen Flanker task during fMRI (Time 1) and completed a second scan (Time 2) using the same task (M days between scans = 53.5). The task required participants to press a button indicating which direction a center arrow, flanked by two arrows on each side, is facing. The flanking

arrows either faced the same (congruent) or opposite (incongruent) direction of the center arrow. Analyses focused on neural responses to cognitive conflict (correct congruent vs. incongruent trials) and errors (vs. correct responses) on incongruent trials. Data was analyzed using a voxel-wise Bayesian linear mixed effects model (AFNI 3dLME -ICCb). Separate models were run to test reliability during cognitive conflict and error processing. In each model, subject and visit were entered as random variables. ICCs were modeled with absolute agreement. Results. The whole brain analysis of cognitive conflict revealed moderately reliable activation (>.40) in the visual and primary motor cortices. Reliability was higher and more widespread for error processing with reliable activation in the visual and motor cortices as well as the temporoparietal junction, insula, and ventrolateral prefrontal cortex. Conclusions. These findings suggest that in the Flanker task adolescent brain responses may be more reliable during error processing than during cognitive conflict.

3-O-210 Event representations become more stable and predictive with age

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As their knowledge about the world increases, children develop expectations about the orderly succession of events. For instance, at bedtime, a child might expect to hear a bedtime story, then get tucked into bed, and then finally expect the caretaker to leave the room. We hypothesized that, as they age, children's representation of events will become more stable and consistent with other children, and that they will be able to predict upcoming events further into the future. To test this theory, 205 children with ages ranging from 5 to 19 years old watched a 10 minute movie while functional magnetic resonance images were acquired. A Hidden Markov Model was used to identify stable patterns of multivariate activity as well as the timing of event shifts. We found that older children had more coherent event structure and anticipated further into the future than younger children in primary visual regions, as well as in theory of mind regions such as the temporoparietal junction, with neural anticipation of up to several seconds. Surprisingly, younger children had more consistent and stable event structure in the posterior cingulate cortex, possibly due to heterogeneity in this region with age. These results demonstrate that, during development, experiences are increasingly organized into stable and predictive neural event representations.

3-O-211 Converging neural mechanisms of social and non-social threat monitoring: a multimodal approach.

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In adolescence there are sex differences in threat elicited by unpredictable social interactions. Yet, threat monitoring is largely probed in non-social contexts using the error-related negativity (ERN; measured via EEG). fMRI studies show greater activation in brain regions implicated in threat processing while anticipating unpredictable social interactions, but the effects of sex and self-reported social threat are poorly mapped. Thus, it is unclear the extent to which enhanced ERNs confer risk for greater neural response to, and self-report of, threat in social situations, and if these relations are moderated by sex. Using a multi-modal approach, we tested the relation between neural responses to non-social threat (EEG-based Flanker Task), neural responses to- and self-reported ratings of- elicited social threat (fMRI-based Virtual-School (VS) task), and if these relations differed between sex in 11-14-year olds (N=69;

Male=34). ERNs were quantified via a Flanker Task. More negative ERNs indexed greater threat-vigilance. During the VS, youth anticipated social feedback from purported peers who were 'unpredictable', 'nice', or 'mean'. VS-elicited social threat was quantified by the degree of feeling bullied during the VS. High ratings indexed greater social threat. Linear mixed-effects models tested the interactive effect of ERN, sex, and task-elicited social threat on brain function while anticipating peer feedback. Whole-brain analyses revealed engagement of left precentral, medial temporal, and inferior frontal gyri varied as a function of ERN, sex, VS-elicited social threat, and peer reputation (F's>7.835, p's<.005). Specifically, among males with more threat-vigilant ERNs, greater social threat during the VS was associated with increased activation when anticipating feedback from unpredictable-vs-mean or nice peers. Thus, for males with more vigilant threat processing in non-social contexts, unpredictable social contexts may be particularly threatening on the

3-O-212 Individual differences and developmental changes in perspective-taking in adolescent girls*: Evidence from brain and behavior

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The few studies investigating neural correlates of mentalizing and social-self-evaluation among adolescents suggest that both perspective-taking and its neural foundations are developing during adolescence. Understanding both individual differences in, and changes in, perspective-taking tendencies as they relate to neural activation of mentalizing regions during social-self-evaluation among adolescents may offer a novel means of understanding pathways to, and individual differences in, health and well-being in adolescence. This project asks the following questions: Do behavioral perspective-taking tendencies correlate with age in adolescent girls*? Does activation in mentalizing regions (dmPFC, vmPFC, rTPJ, lTPJ, and precuneus) during social-self-evaluation correlate with age in adolescent girls*? Do girls* with greater perspective-taking tendencies elicit greater activity in mentalizing regions during social-self-evaluation? Do latent changes in tendencies to take others' perspectives correlate with latent changes in neural activation of mentalizing regions during social-self-evaluation? 174 girls* aged 10.00-12.99 years (*at study enrollment, 171 identified as female and 3 as non-binary) participated in a longitudinal study on social and neural development. At each of 2 waves (18 months apart), the participants completed a self-report of perspective-taking tendencies, and a social-self-evaluation fMRI task in which they decided whether 50 traits relevant to social status and relationships describe them, as well as a high-level control condition. Analyses will be pre-registered; preprocessing will be performed with fMRIPrep, first-level models will be run with SPM12, and multi-level models and bivariate latent change score analysis (Kievet et al., 2018) will be conducted in R. Scripts will be made available at https://github.com/dsnlab/TAG_scripts. This abstract does not present preliminary results to limit the negative consequences of running interim analyses.

3-O-213 Brain function in the dorsal visual stream during visual motion processing in children with and without math disability.

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Prevailing research supports the theory that the reading disability (RD) developmental dyslexia is due to

a deficit of phonological processing. However, some have argued under the "magnocellular hypothesis" that a dorsal visual stream deficit instead interferes with learning to read. The math disability (MD) developmental dyscalculia is thought to be due to poor quantity representation. However, evidence suggests that children with MD may also have a magnocellular/dorsal visual stream deficit based on poorer visual motion discrimination (Sigmundsson et al., 2010). Neuroimaging studies of RD have shown relative underactivity in the dorsal stream (specifically, area V5/MT) during visual motion perception, but this research has not yet been extended to MD. We will fill this gap by comparing function of area V5/MT during a visual motion processing task in children with MD (groups with and without comorbid RD) vs. typically developing (TD) children. The combined MDRD group addresses concerns that prior research in MD did not test reading ability, making it possible that differences identified and attributed to MD were driven by undocumented RD. If MD is associated with a magnocellular/dorsal stream deficit, then during the visual motion task, we expect both MD and MDRD groups to have (1) lower activation in V5/MT and (2) lower functional connectivity (FC) between V5/MT and the intraparietal sulcus compared to the TD group, which will be tested with ANOVAs followed by direct comparisons. If differences emerge only between MDRD and TD groups, these may be attributable to poor reading rather than poor math. We will also assess whether activity and FC values are correlated with individual math scores in all subjects. Our results will illuminate whether the magnocellular/dorsal stream is altered during visual motion processing in MD children and if these functional differences are attributable to MD (not comorbid RD). This will add to our understanding of the etiology of MD.

3-O-214 Longitudinal associations between pubertal development and inhibitory control

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Inhibitory control has been reliably shown to improve with age throughout adolescence, but little is known regarding the role of puberty, which affects neuronal and functional brain processes, in developmental trajectories of cognition. Here, we examined the association between pubertal development and inhibitory control in an accelerated longitudinal cohort. 117 participants, ages 8-18, completed 283 total study visits (1-6 yearly visits) in which pubertal development was assessed via self-reported Tanner stage and inhibitory control was assessed with an in-scanner antisaccade/prosaccade task in a 3T fMRI study. Across subjects, the percentage of correct responses increased with inverse age ($p<0.0001$) but showed no association with puberty. Response latency of correct responses improved with age and with advancing Tanner stage ($p=0.0013$). Furthermore, this association between response latency and Tanner stage remained significant even when controlling for age ($p=0.0051$). Whole-brain voxelwise analysis of brain activation during the antisaccade task, as compared to control prosaccade blocks, yielded bilateral clusters of activation in the mid-cingulate and precuneus ($p<0.005$) positively associated with Tanner stage (controlling for inverse age and sex), while clusters in the dorsolateral prefrontal cortex, middle temporal gyrus, and across the visual cortex were positively associated with age. These results suggest that chronological age may drive maturational trajectories of cognitive brain systems supporting inhibitory control while puberty may have a more generalized effect on brain maturation that supports improved processing speed. The functional connectivity of relevant regions and its relationship to these findings will also be discussed.

3-O-215 Examining associations between the gut microbiome and brain development in infancy

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Associations between the gut microbiome and brain development are well documented in animals. A few studies have documented links between microbiome diversity and composition and neurocognitive development in humans. Specifically, higher Alpha diversity at 12 months has been found to be negatively correlated with measures of neurocognitive development. This study will examine associations between diversity and composition of the gut microbiome at 12 months and resting EEG activity at 15 months in a sample of 26 typically-developing infants. Using 16sRNA sequencing performed on infants' stool samples and adjusted for covariates known to influence the composition of the microbiome, we will calculate Alpha diversity of bacteria present in the gut, and relative abundance of two strains of bacteria: Lactobacillus and Bifidobacterium. These two strains are early colonizers in the infant gut and have been linked to cognition and brain development in animal models. We hypothesize that higher Alpha diversity at 12 months will be associated with reduced EEG Alpha power and reduced Gamma power at 15 months, EEG frequencies that have been associated with attention and high-order cognitive skills. We also hypothesize that higher relative abundance of Bifidobacterium and Lactobacillus will be associated with increased Alpha and Gamma power at 15 months. We do not have specific hypotheses about associations between properties of the gut microbiome and other spectral frequencies. We will use multiple linear regressions to test these hypotheses. This study will be the first of our knowledge to examine associations between the gut microbiome and EEG activity.

3-O-216 Association between neighborhood socioeconomic status and executive system activation in youth

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Objective: Prior work has shown that environmental adversity affects cognitive development. However, it is unclear how these factors impact brain systems underlying cognition, such as the executive system. The current study examined the association of neighborhood socioeconomic status (SES) and trauma exposure with executive system activation during a working memory task. **Methods:** 1,158 participants (622 females, aged 8-22) completed a fractal n-back working memory task during functional magnetic resonance imaging at 3T as part of the Philadelphia Neurodevelopmental Cohort. Neighborhood SES was measured using census-based geocoding variables obtained from participant address, while exposure to traumatic events was assessed in a clinical interview. We assessed how changes in brain activation under working memory load (2-back>0-back) were associated with our estimates of environmental stress using mass-univariate voxelwise analysis. Age, sex, race, and in-scanner motion were included as covariates; in-scanner task performance (summarized by d') was evaluated as a covariate in sensitivity analyses. Multiple comparisons were controlled for at the cluster level (voxel height $z>3.09$, cluster probability of $p<0.05$). **Results:** Task modulation of working memory load robustly activated the executive system, and deactivated non-executive regions such as the default mode system. Higher

neighborhood SES was associated with greater activation of the executive system, including the bilateral dorsolateral prefrontal cortex, posterior parietal cortex, and supplementary motor area. No significant effects were observed in deactivated regions of the default mode system. Observed associations remained significant when controlling for individual differences in in-scanner task performance. No significant associations with trauma exposure were observed. **Conclusion:** Together, these findings emphasize the importance of neighborhood environment in shaping executive system function in youth.

3-O-217 The neurodevelopment of prosocial behavior in adolescence

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Notions of adolescent development have undergone revisions to reframe this stage as a time of opportunity rather than storm and stress. Prior research on prosocial behavior, operationalized as giving to another with the intention of benefitting them, has shown mixed findings in terms of how it evolves in adolescence. The first aim of this study is to clarify developmental changes in prosocial behavior during adolescence to determine if it depends upon the context (i.e. recipient, cost of giving). The second aim is to assess how developmental changes in the neural networks implicated in reward, mentalizing, and cognitive control track with giving behavior. A total of 278 (Age Range = 9-15, 19-20) children, adolescents, and young adults completed 3 rounds of a well-validated charitable giving task while undergoing fMRI scans. Youth made financial decisions for themselves and 1 of 3 targets per run: family member, friend, and stranger. Behavioral data (STATA) and imaging data (SPM) are currently being analyzed. We predict that giving will increase steadily for family and friends, while giving to strangers will decrease with age, and that decisions which come at a cost to the participant but benefit the recipient will be accepted more often for family and friends compared to strangers as a function of age. At the neural level, we anticipate activation while giving in regions that have been found to be associated with prosociality in past research, specifically mentalizing (i.e. DMPFC), cognitive control (i.e. DLPFC), and reward (i.e. ventral striatum) regions. We predict increased differentiation of activation according to recipient as a function of age, with greater activation in the regions for giving to friends as compared to family, and more for family as compared to strangers. We expect similar trends in connectivity between the regions. Findings will clarify the developmental pattern of giving behavior and its neural underpinnings during adolescence.

3-O-218 Not all adversity is created equal: Differential associations of adversity profiles with adolescent cognitive control and psychopathology

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Adverse experiences have profound consequences for psychosocial adjustment, and adolescents may be particularly susceptible due to heightened sensitivity to environmental influences and the protracted development of the prefrontal cortex. We used a person-centered approach to characterize distinct profiles of adversity in early adolescence, and examined associations with later cognitive control and psychopathology. Adolescents (53% male) and their primary caregivers (n=167) participated in a

longitudinal study, with approximately one year between each assessment. At Time 1 (Mage = 14.07 years), we collected reports on seven indicators of adversity: socioeconomic disadvantage, abuse, neglect, household chaos, parent substance use, parent depression, and negative life events. At Times 2, 3, and 4, adolescents' behavioral performance and BOLD response during a cognitive control task were measured. At Time 5, adolescents and their caregiver reported on adolescent internalizing and externalizing symptomatology. Using latent profile analysis, we identified three adversity subgroups: a low risk group, a low socioeconomic status (SES)/high parent substance use (SU) group, and a high risk group. Adolescents in the low SES/high parent SU group had the lowest levels of behavioral cognitive control. Furthermore, both the low SES/high parent SU group and the high risk group had significantly higher levels of psychopathology relative to the low risk group. There were no significant group differences with respect to neural cognitive control, and neither neural nor behavioral cognitive control predicted psychopathology. A cumulative risk approach using a mean score of adversity produced a similar general pattern of results but obscured the unobserved heterogeneity in adverse experiences. These results highlight the utility of a person-centered approach to the characterization of adversity and illustrate distinct developmental consequences for cognitive function and psychopathology.

3-O-219 A sensitive period for visual cortex plasticity: naturalistic auditory narratives synchronize "visual" cortices in congenitally blind but not late blind or sighted people

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In people who are born blind, the "visual" cortices respond during non-visual tasks such as braille reading and sound localization (e.g. Sadato et al., 1996; Collignon et al., 2011). In contrast, in individuals who had functional vision from birth through adolescence and then lost their sight as adults, "cross-modal" activity during these tasks is reduced or absent. Do adult-onset blind individuals recruit "visual" cortices for different cognitive functions? Alternatively, is there a sensitive period that precludes adult repurposing? To answer these questions, we leveraged naturalistic auditory movies and narratives, which engage varied cognitive processes. Congenitally blind (CB, n=18), adult-onset blind (vision loss >18 years-of-age, LB, n=12) and sighted (n=18) participants listened to six-minute auditory excerpts from movies; a spoken narrative; and matched degraded auditory stimuli (i.e., shuffled sentences, backwards speech) during fMRI scanning. We correlated the voxel-wise timecourses of different participants within and across groups. Both within and across all groups, all conditions induced synchrony in auditory cortex, while only the narrative stimuli synchronized responses in higher-cognitive fronto-parietal and temporal regions. Inter-subject synchrony in visual cortices only emerged for the CB group, and exclusively for narrative stimuli. Synchrony was low in visual cortices, both among LB participants and between LB and CB and LB and sighted participants. In the CB but not LB group, visual cortex synchrony varied systematically as a function of stimulus cognitive complexity. Taken together, these findings suggest that visual cortices are consistently reorganized across congenitally but not adult-onset blind people, and provide support for sensitive periods in the cognitive specialization of human cortex.

3-O-220 Parent-child relationship quality is associated with brain and endocrine responses to stress

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Parent-child relationships serve an important role in buffering children from psychological and physiological responses to stress (Hostinar et al., 2014). It is unclear whether the quality of this relationship may affect stress responses even when the child is alone. In the current investigation, we examine whether the perceived quality of parent-child relationships is associated with neuroendocrine or brain responses to social evaluative stress. 43 adolescents (ages 11-14 years) participated. Brain activity and salivary cortisol data were collected during the Minnesota Imaging Stress Test in Children (Herzberg et al., in press), a neuroimaging version of the Trier Social Stress Test that includes a judged, stressful math task and an unjudged math task for comparison. Parent-child relationships were assessed using 3 subscales of the Network of Relationships Inventory: conflict, compassion, and intimate disclosure. Mean activity for each subject was extracted from 14 regions of interest that showed significant task-related activity (judged v. unjudged task performance, cluster corrected to $p<.05$) across the entire sample. Perceived parent-child conflict was associated with elevated anticipatory stress as measured by cortisol ($F(1,29)=7.89$, $p=.009$). Youth with elevated anticipatory cortisol levels also reported finding the task more subjectively stressful ($F(1,29)=6.98$, $p=.013$). Mother-child conflict correlated with greater activity in the anterior cingulate gyrus ($F(1,41)=5.80$, $p=.021$) and the left fusiform gyrus ($F(1,41)=4.11$, $p=.049$) during the social evaluative stress task. These findings suggest that adolescents' perceptions of their relationships with their parents are associated with their behavioral, neuroendocrine, and brain function during social evaluative stress.

3-O-221 The thriving brain: effects of individual child characteristics and environmental factors on self-regulation and associated neural circuitry

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Self-regulation is the ability to regulate one's emotions, behavior and social interactions in daily life, including when faced with difficult circumstances. Given the impact that self-regulation has on mental health and behavior, more insight into the factors that drive its development is necessary. In this study we aim to examine whether and how individual child characteristics and environmental factors affect self-regulation and associated neural circuitry. We included a sample of 673 children (age 8-11 years) from the Dutch developmental YOUth (Youth Of Utrecht) cohort study, part of the Consortium on Individual Development (CID). Exploratory Factor Analysis (EFA) performed on questionnaire data yielded six child characteristics factors (externalizing behavior, impulsivity, anxiety, outgoing/socializing behavior, self-esteem, withdrawal) and seven environmental factors covering parenting style (incompetence, interference, strictness and liberty), stress (conflicts father, conflicts mother) and socio-economic status (SES). All participants performed a Stop-Signal Anticipation Task during fMRI. Increased perception of incompetence in parenting was associated with increased externalizing behavior of the child ($r=.41$, $q=.002$), impulsivity ($r=.26$, $q=.002$) and anxiety ($r=.23$, $q=.002$), and reduced outgoing/socializing behavior ($r=-.13$, $q=.026$) in children. An interfering parenting style was associated with lower self-esteem ($r=-.24$, $q=.006$). Externalizing behavior was related positively to a strict- ($r=.15$, $q=.036$) and negatively to a liberal parenting style ($r=-.14$, $q=.048$). The presence of conflicts in the father's life was associated with child anxiety ($r=.15$, $q=.048$). None of the individual child- or environmental factors were associated with stop-signal reaction time. We will present findings on the

effect of child characteristics and environmental factors on the neural correlates of self-regulation in a larger, imputed dataset of 1060 children at the meeting.

3-O-222 Identification and validation of distinct latent neurodevelopmental profiles in the Adolescent Brain and Cognitive Development study

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Objective: Neurodevelopmental models of risk for addiction presume that, at the population-level, there exist subgroups of individuals with similar patterns of neural function and development, and that these subgroups contribute to vulnerability to substance use disorders. However, the presence of neurodevelopmental subgroups has not been empirically assessed in a large sample. **Methods:** Neurodevelopmental profiles were identified via latent profile analyses (LPA) of fMRI data from 6,757 individuals in the ABCD Wave 1 data release who completed the Monetary Incentive Delay Task, the Stop Signal Task, and the Emotional N-Back task. Data were randomly split into model training and model testing samples and the optimal profile solution from the training data was applied to the testing data. **Results:** LPAs in the training sample showed that a 7-profile solution fit the data best and this replicated to the testing sample. Profiles included a 'majority' profile (66.8%), high reward (4.3%) and low reward (4.0%) profiles, high inhibition (9.8%) and low inhibition (6.7%) profiles, and high emotion regulation (4.0%) and low emotion regulation (4.3%) profiles. The identified profiles differed significantly in sex (2=25.28, p<.0001), race (2=79.46, p<.0001), total family income (2=122.17, p<.0001), cognitive performance (F=14.78, p<.0001), screen time (F=10.27, p<.0001), and several measures of impulsivity (p's<.00625). Relative to the majority profile, the smaller profiles were characterized by more males, higher proportions of individuals from lower-income households, poorer cognitive performance, more screen time, and heightened impulsivity. **Conclusion:** These data support the presence of neurodevelopmental subgroups at the population level that relate to individual differences in clinical features, even at a young age. We propose that these profiles will significantly differ in substance-use and other risk behaviors as assessed in future waves of the ABCD study.

3-O-223 Reward processes during early stages of pubertal development and the association with internalizing symptoms in 9 and 10 year olds in the ABCD Study

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Pubertal development triggers changes in reward circuitry (Ladouceur et al., 2019) that may be linked to risk for internalizing symptoms in adolescence (McGuire et al., 2019). Most studies on these associations have focused on adolescents over 11 years of age (Ullsperger & Nikolas, 2017). However, it is important to also investigate these associations in younger samples to capture the transition from childhood into adolescence: a window of vulnerability. Analyses We will investigate puberty, reward neural and behavioral processes, and internalizing symptoms in the ABCD study: a large, nationally representative sample of 9 and 10 year-olds (Jernigan, Brown, & Dowling, 2018). Analyses will include (1) development: age, parental report of pubertal development, testosterone; (2) reward: task performance and BOLD changes on the Monetary Incentive Delay Task (MID) and reward responsiveness using the Behavioral Approach System scale (BAS-RR; Carver & White, 1994); (3) internalizing symptoms measured by the

Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983). Hypotheses (osf.io/7u3jt/) (1) Advanced pubertal stage will be associated with heightened striatal activation during reward anticipation in MID (Braams et al., 2015) and higher internalizing symptoms (Ullsperger & Nikolas, 2017). (2) Reward related striatal and orbitofrontal cortex activity will be negatively associated with internalizing symptoms (Forbes et al., 2010; Luking et al.,2016). (3) Advanced pubertal status and internalizing symptoms will be more strongly related among participants with attenuated striatal activity in reward anticipation. Implications By focusing on reward-related processes during the transition from childhood into adolescence, we will further our understanding of how pubertal development may present risk for later internalizing symptomology. Importantly, identifying predictors of mental illness in a younger age range could also serve to inform future early interventions.

3-O-224 Infant sleep patterns moderate the association between socioeconomic status and frontal alpha brain activity

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Differences in brain activity by socioeconomic status (SES) have been documented in infancy (Tomalski et al., 2013). Although it is well known that sleep loss affects cognitive abilities (Short & Banks, 2014; Diekelmann & Born, 2010; Tononi & Cirelli, 2014), few studies have examined the interactive influences of SES and sleep on early cognitive development (Bernier et al., 2013; Hoyniak et al., 2018; Buckhalt et al., 2009). The current study examines SES and sleep during infancy using electroencephalography (EEG). Fifty-two 3-month-old infants (25 males) from SES diverse households (maternal ED=10-26 years) were recruited for this study. Five minutes of resting EEG was recorded while the infants watched an engaging, non-social video. Caregivers reported on infant sleeping patterns (Sadeh, 2004). The proportion of night sleep to the total daily sleep was calculated (Night Sleep Ratio, NSR) in an attempt to quantify infant "mature sleep". We posit that higher NSRs represent more mature patterns of infant sleep. In the entire sample, maternal ED did not correlate with NSR, frontal low alpha (FLA; 6-9Hz) activity, or frontal high alpha (FHA; 9-13Hz) activity. Infants were categorized into low (<0.6), medium (0.6-0.75), and high (> 0.75) NSR groups to examine interactive effects. Controlling for gestational age, maternal ED only significantly predicted FHA in the low NSR subset (β=0.66, p=0.03). However, in the medium and high NSR subsets, this association was not statistically significant (p=0.80 and p=0.17, respectively). Additionally, analyses predicting FLA did not yield significant associations in the low, medium, or high NSR subsets. Results suggest that sleep patterns may impact associations between SES and brain activity early in life. Future analyses will include a larger sample size and explore behavioral correlates of FHA (i.e. attention & memory) to test the functional significance of this association.

3-O-225 Examining the neural correlates of engagement: A simultaneous eye-tracking/fMRI study

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Objective: Engagement is a critical mechanism of all human learning: information that fails to engage cognition, may go unprocessed and unlearned (Simon & Chabris, 1999). Despite its importance, the neural mechanisms underlying engagement remain unknown; engagement is an inherently subjective aspect of viewer experience, and therefore, has traditionally been difficult to measure. Here, we use

patterns of eye-blinking - a novel measure of engagement (Shultz et al., 2011) - and fMRI to first identify brain systems involved in engagement and then examine how engagement with the social world (using faces as a proxy) alters the activity of social brain systems. **Methods:** Simultaneous eye-tracking and fMRI data were obtained while children (n=12, ages 8-12) watched videos of naturalistic social scenes. Visual fixation and blink patterns were used to identify events that viewers themselves perceived as 'highly engaging' or 'less engaging' and where viewers were looking during those events (e.g. at a face, body, or object). **Results:** Whole-brain voxel wise regression analyses (z=2.3, p<.05 corrected) reveal increased activation in bilateral supramarginal gyrus, right inferior frontal gyrus, right precentral gyrus, and right insula when viewing 'highly engaging' versus 'less engaging' events. Analyses further reveal increased activation in bilateral occipital cortex, left middle temporal gyrus, bilateral posterior cingulate, left orbitofrontal cortex and inferior frontal gyrus, right angular gyrus, and right fusiform gyrus when viewing 'highly engaging' versus 'less engaging' faces. **Conclusion:** These preliminary findings suggest that engagement increases activation in brain regions implicated in the detection of salient cues and facilitating bodily responses to emotional stimuli. Furthermore, when viewing the same stimulus category (e.g. faces), one's own engagement with the stimulus modulates brain activation, even in canonical face processing areas like the fusiform gyru

3-O-226 Are reading and math inter-related in the brain? An fMRI study on reading and math following reading intervention in children with learning disabilities

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Prior research has shown connections between reading and math: (1) reading and math disability are highly comorbid learning disabilities (LD), and (2) both skills activate inferior parietal and frontal cortices. Determining whether reading and math are bound together at the neural level is important for understanding LD. Here we studied 53 children (age 8-12) with LD before and after a successful reading intervention to test whether behavioral and neural changes underlying reading are yoked to behavioral and neural changes underlying arithmetic (addition and subtraction). If the two are inter-related, one would expect improved reading ability to affect math ability and brain activity during arithmetic. Intervention-related gains in word decoding correlated with fMRI signal decreases during a reading task in the bilateral temporo-parietal cortices, parahippocampal gyri, and cerebellum. Math performance, however, declined during the reading intervention, suggesting that math skills had been neglected or that the intervention was detrimental to math (possibly competing at the neural level). To test the latter, we used the aforementioned regions that correlated with reading gains to examine whether (i) intervention-induced changes in reading and arithmetic (addition or subtraction) activity were correlated, and (ii) whether changes in math performance corresponded to changes in activity during arithmetic (addition or subtraction). Bayesian and frequentist analyses revealed no relationship between intervention-induced changes in reading and arithmetic activity (BF01 1.9-4.7). Further, there were no correlations between math performance and fMRI signal change during either arithmetic task in these regions (BF01 2.3-5.8), nor any other brain region (determined by a whole-brain analysis). These results of independent and unrelated brain-based outcomes after reading intervention indicate that reading and math are not intertwined at the neural level in LD.

3-O-227 Maternal relationship conflict and quality predicts neural response to peer influence during adolescence

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Adolescence is a period of heightened sensitivity to influence from peers relative to parents (Brown, 2004), including at the level of the brain (Somerville, 2014). However, adolescents vary in neural susceptibility to peer influences (Schriber & Guyer, 2016), with the maternal-adolescent relationship implicated as a potential source of difference (Chan & Chan, 2011; Telzer et al., 2015). The present study tested the effects of maternal-adolescent relationship conflict and quality on adolescents' neural response to peer influence on their liking preferences. Participants were 43 adolescents (23 females, Mage=19.2, SD=0.41) recruited from a 10-year, longitudinal study of Mexican-origin youth. At age 16, adolescents self-reported on maternal relationship conflict (10-items; argue, disagree; Gonzalez et al., 2000) and quality (3-items; satisfaction, happiness; Melby & Conger, 2001). At 19, adolescents completed a two-phase fMRI task (Mason et al., 2009). First, they viewed a series of 20 abstract symbols 200 similarly-aged peers purportedly rated as popular or unpopular. Then, during an fMRI scan, they completed 2 task runs of 90 trials, viewing serial presentations of the 20 socially tagged symbols (popular, unpopular) and 10 novel symbols. Higher relationship conflict was associated with greater activity in brain regions involved in salience detection (insula, t=4.08; mid-cingulate, t=3.61, p<.05) when viewing socially-tagged vs. novel symbols, and greater activity in regions linked to reward processing (caudate, t =4.07) when viewing popular vs. unpopular symbols. Higher relationship quality was associated with greater de-activation of salience (ACC, t =-4.05) and reward (caudate, t =-4.47) region response to socially tagged vs. novel symbols. These results suggest that a lower quality relationship with one's parents may heighten adolescents' sensitivity to peer influence in brain regions that code the salience and rewarding nature of peer-endorsed information.

3-O-228 Neural activation to naturalistic emotional events in young children

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Introduction. Recently, naturalistic movie paradigms have been used to probe neural representations in young children (Richardson et al., 2018). Here, we plan to examine how children neurally represent movie events related to emotion, reward, and social cognition, in regions-of-interest (ROIs) including the amygdala, nucleus accumbens, hippocampus, and theory of mind network. We will use a data-driven approach to identify the events that correspond most closely to ROI activity. Since children's early experiences are likely to impact their neural representations, we hypothesize that ROI activity will relate to individual differences in stress exposure and parent-child interactions during an in-lab task. **Methods.** Children ages 4 to 11 watched a 5-minute movie, "Piper" by Pixar, during an fMRI scan. Parents completed questionnaires on socioeconomic status (SES) and their child's experience with stressful life events. A subset of children participated in a parent-child interaction consisting of a series of 5-minute collaborative tasks. We will exclude participants if they exceed our motion criteria (>1mm average motion, or >30% outlier time points). **Analysis.** To relate functional activation to movie events, we will conduct a reverse correlation analysis. At each time point, we will use a one-tailed t-test across subjects

to test whether each ROI response is above baseline. Events (two or more consecutive significantly positive time points) will be rank-ordered based on average ROI response across subjects. In addition to identifying the events most related to ROI activity, we will test whether ROI response during these events is related to children's SES, exposure to stressful life events, and parent-child interactions. **Implications.** This study tests the feasibility of using movie fMRI to examine neural responses to naturalistic emotional events in young children, and whether this method is sensitive to individual differences in children's environmental experiences.

3-O-229 Altered neural activation in response to native language in 1.5-month-old infants at high risk for autism

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Introduction: Language impairments are common in autism spectrum disorder (ASD) (Sperdin et al., 2016). In toddlers with ASD, these language difficulties are related to atypicalities in neural responses to speech (Lombardo et al., 2015). However, it remains unclear how early in development these brain-based differences may emerge. Objective: We examined the neural signatures of language processing in 1.5-month-old infants at high (HR) and low (LR) risk for ASD and asked whether patterns of brain activity could predict altered language development well before the onset of overt behavioral deficits. **Methods:** 35 HR and 28 LR infants underwent fMRI during natural sleep and were presented with speech stimuli in English (native) and Japanese (non-native). Risk status was determined by virtue of having one or more older siblings with ASD. We examined risk group differences in neural activity in response to native vs. non-native speech. Next, we related brain responses to infants' receptive language trajectories across the first 3 years of life, using slopes derived from age-equivalent scores on the Mullen Scales of Early Learning. **Results:** Relative to HR infants, LR infants exhibited greater activation in response to English in regions involved in reward (basal ganglia) and social information processing (R crus I of the cerebellum). Furthermore, within LR infants, increased engagement of frontal cortices and basal ganglia while listening to English relative to Japanese at 1.5 months predicted greater increases in receptive language across the first 3 years of life. **Conclusion:** Early in infancy, HR infants show attenuated neural responses to their native language in key brain regions subserving social and reward processing. This suggests that these infants may be less attentive to the relevant linguistic inputs from their social environment, which may contribute to delayed language profiles seen in ASD.

3-O-230 Characterizing the neural mechanisms of sensory processing in previously institutionalized youth

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Youth who experience institutional caregiving (orphanage care, for example) often display a pattern of symptoms sometimes described as a "quasi-autism," which includes social communication deficits, repetitive behaviors, and sensory hypersensitivity. Importantly, this phenotype can persist for years after adoption. Sensory hypersensitivity in PI youth may be driven by disruptions in habituation, the normative reduction in response to repetitive stimuli over time. Habituation is among the most

fundamental forms of adaptive learning and disrupted habituation has been associated with hypersensitivity in various clinical populations. Although a growing body of literature has evaluated sensory hypersensitivity in previously institutionalized (PI) youth, to our knowledge, the neural mechanisms for sensory differences in this population have not been explored. We investigated the relationship between early deprivation and sensory processing in 37 previously institutionalized (PI) adolescents and 46 comparison youth. Participants were presented with multiple blocks of aversive auditory stimuli while undergoing functional magnetic resonance imaging. Parent-reported sensory measures suggested that PI youth have increased auditory and tactile hypersensitivity (tAud = 4.160, p <.001; tTactile = -2.033, p =.042). Pilot fMRI analyses indicate robust activation of auditory cortex across both groups. However, we did not observe habituation to aversive sounds within task blocks. Planned analyses upon conclusion of data analysis (target N=100) will include exploration of neural spatial variability in auditory cortex (using Gini coefficients), and latent growth curve analysis of habituation across multiple task blocks.

P – Brain connectivity

3-P-231 Differential developmental effects of material hardship on adolescent regulatory white matter connectivity

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Poverty is a risk factor for impaired social, cognitive, and emotional development. Existing literature identifies white matter connections as possible mediators; however, the association between poverty and underlying structural connectivity is still poorly understood. Prior studies showed that stronger white matter connectivity between the prefrontal cortex and the amygdala is associated with less amygdala activation; however, little is known on how this top-down emotion regulatory white matter connectivity is related to developmental timing of poverty experience. Using an open-science approach, we addressed this gap in knowledge by testing the association between material hardship (a measure of children's basic needs such as food, housing, and medication) and adolescent regulatory white matter structure using probabilistic tractography. Participants (N=196) who were followed since birth were recruited from the Fragile Families and Child Wellbeing Study and scanned at age 15. We found that the relation between material hardship and adolescent white matter differs when hardship is experienced during early (age 1, 3, 5) compared to late childhood (age 9, 15). Specifically, greater material hardship in early childhood was associated with reduced orbitofrontal-amygdala white matter connection. Additionally, greater hardship in early childhood was associated with reduced adolescent medial prefrontal-amygdala white matter connection, but greater hardship in late childhood was associated with increased white matter connection between the same regions. These associations are significant after accounting for corresponding age groups (early or late), and remained significant after adjusting for gender, race, maternal education, family structure, current stress, internalizing symptoms, and traumatic experiences. Collectively, these results suggest that developmental timing of poverty experience can have significant differential impact on white matter structure development.

3-P-232 Associations between peripheral inflammation and resting state functional connectivity in adolescents

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Objective: Higher peripheral inflammation may increase risk for depression, but the mechanisms through which this occurs remain unknown. Studies in adults have begun to show that elevated peripheral inflammatory markers are associated with altered resting state functional connectivity (rsFC) in networks associated with depression risk, including the corticolimbic (amygdala-prefrontal), corticostriatal (ventral striatum-prefrontal), salience, and default mode networks. However, few studies have examined these associations in adolescents. **Methods:** In a community sample of adolescents (n=70; age, 12-15 years; 32 female, 36 male, 2 nonbinary), the associations between peripheral inflammation and rsFC were examined. After blood sampling, an fMRI scan was performed to assess rsFC. Assay for inflammatory markers, including IL-6, TNF-α, and CRP, was performed; levels of inflammatory markers were then Z-scored and summed to create a single composite. **Results:** Results indicate that higher peripheral inflammation is associated with altered rsFC between a number of regions, including increased rsFC between the right amygdala and left ventral striatum ($p<.05$ whole-brain corrected using 3dClustSim). **Conclusions:** The amygdala is involved in detecting threatening and salient stimuli and the ventral striatum is involved in integrating information about reward and punishment. These results suggest that higher peripheral inflammation may lead to increased connectivity between these regions, possibly biasing processing towards threatening or punishing stimuli. This is also consistent with prior research finding that acute inflammatory challenge leads to increased amygdala activation to social threat in adults. If future research confirms this association and finds that this pattern of connectivity predicts increases in depression symptoms over time, this could inform the development of preventions for depression targeted at adolescents with higher peripheral inflammation.

3-P-233 Adolescent functional connectivity as a mediator between environmental factors and change in behavior

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Objective: Socioeconomic disadvantage is associated with negative impacts on developmental trajectories of adolescent behavioral self-regulation (Spielberg et al., 2015) and weaker intrinsic neural network connectivity (Weissman, et al., 2018). Aspects of the sibling relationship may buffer these effects on the adolescent brain and behavioral dysregulation (Rogers et al., 2018). Two specific questions we will investigate are: (1) does adolescent functional brain connectivity mediate the relationship between economic disadvantage and later behavioral outcomes; and (2) can positive sibling relations moderate the pathway between disadvantage and functional connectivity, thus reducing the negative effect of disadvantage? **Methods:** The sample included 40 adolescents (Mage=12.19 years; 22 females) who completed resting-state fMRI scans and questionnaires about demographics, perceptions of the sibling relationship, and behavioral inhibition/activation (BIS/BAS; Carver & White, 1994). BIS/BAS were recorded twice, once at the time of scanning and again one year later to detect change over time. **Proposed Analyses:** Analyses will be conducted for group-level seed-based correlations of functional connectivity based on regions of interest implicated in socioemotional behavior and cognitive control.

Regions include the ventral striatum, amygdala, anterior cingulate cortex, and the medial-, ventrolateral-, and dorsolateral prefrontal cortexes (Casey et al., 2019). Extracted values for functional connectivity between brain and seed regions will be included in the current research model as a proposed mediator between economic disadvantage and change in BIS/BAS. Sibling relationship quality will be examined as a buffer between socioeconomic advantage and functional connectivity in the full moderated-mediation model. **Conclusion:** Findings may contribute to understanding environmental and neurobiological influences on behavioral adjustment during the adolescent years.

3-P-234 Positive parenting and parental involvement are associated with adolescents' amygdala activity and amygdala-mPFC connectivity to angry faces

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Objective: Prior research has shown that maltreatment and negative parenting influence neural activity associated with emotion processing and regulation in children and adolescents. However, little research has examined associations between positive dimensions of parenting behavior and adolescents' neural activity. The goal of the present study was to examine associations between variation in positive parenting and parental involvement, and adolescent neural activity and connectivity during an emotional face-matching task. **Method:** Hypotheses were tested in a community sample of 96 adolescents (2 nonbinary, 46 boys, 48 girls) between the ages of 12 and 15 (M=13.57, S.D.=1.07) who met inclusion criteria for fMRI. Participants underwent fMRI scanning while completing a face matching task that included angry, fearful, and happy facial expressions, and shape control blocks. Parents completed the Alabama Parenting Questionnaire to assess dimensions of parenting. We used the amygdala as a region of interest for task-related activity analysis and also as a seed for task-related generalized psychophysiological interaction analysis. Covariates included parent gender, parent age, adolescent gender, and adolescent age. **Results:** We found a marginal negative association between positive parenting and right amygdala activity to angry faces (b=-.20, p<.08), such that higher positive parenting predicted lower amygdala response to angry faces. Parental involvement was positively associated with amygdala-mPFC connectivity when viewing angry faces versus shapes, p<.05. **Conclusion:** Positive parenting was associated with lower amygdala activity to angry faces. Parental involvement was associated with greater connectivity between the amygdala and mPFC when viewing angry faces versus shapes. Results suggest that these dimensions of positive parenting may be associated with functional development of neural circuitry of emotional reactivity and regulation.

3-P-235 Longer screen vs. reading time is related to greater functional connections between the salience network and cognitive control regions in children with reading difficulties

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Introduction: An adverse relationship between screen exposure time and brain functional and structural connectivity was recently reported on in typically developing children and found to be related to altered functional connectivity of reading-related neural circuits. As children with reading difficulties (RD) suffer from impairments in reading and executive functions (EF), we determined the association between screen time duration compared to reading time duration and functional connectivity of the cognitive

control network and the entire brain in children with RD compared to typical readers (TRs), focusing on the salience network. **Methods:** Children with RD (N=29; mean age=9.77 years, SD=1.35 years) and TRs (N=28; mean age=10.0 years, SD=1.33 years) monolingual native English speakers participated in the current study. Reading and EF were assessed and reading/screen times were reported by number of hours per week. Ten minutes resting state data were acquired. A seed-to-voxel analysis using the screen/reading time ratio as a covariate of interest was conducted for the following contrasts: 1) RD only, 2) TR only, and 3) RD>TRs. **Results:** Children with RD showed decreased EF and reading abilities compared to TRs. Positive functional correlations between the salience network and bilateral cognitive control regions and decreased functional connections with sub-cortical cognitive control, and language and visual regions in both children with RD and TRs. Children with RD, showed increased functional connectivity between the salience network and frontal regions compared to TRs. **Conclusions:** A greater screen vs. reading time ratio is related to excessive stimulation of the visual processing system in TRs, which may be related to decreased efficiency of the cognitive control system in children with RD.

3-P-237 White matter properties underlying language and reading abilities in 8-year-old children

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Diffusion magnetic resonance imaging (dMRI) studies in children have repeatedly found significant associations between language and reading abilities and diffusivity of the dorsal and ventral white matter (WM) tracts. However, the tissue properties underlying these neurocognitive correlations have yet to be explained. Investigating which microstructural properties are associated with language and reading requires use of multiple MRI techniques. We assessed language and reading abilities in 8-year old children (N=34) using Core Language from the Clinical Evaluation of Language Fundamentals and the Oral Reading Index from the Gray Oral Reading Tests, respectively. Children underwent two dMRI scans (30 directions (30dir), b=1,000 s/mm2; 96 directions (96dir), b=2,500 s/mm2) and one quantitative T1 relaxometry (qT1) scan. We calculated the degree of association between language or reading skills and FA (30dir), as a global metric of diffusion directionality, R1 (1/T1) (qT1), as a proxy for myelin content, and fiber coherence index (FCI) (96dir), as a measure of tissue organization. Language skills were positively associated with FA in 3 ventral tracts (r=0.42;0.45;0.47) and/or R1 (r=0.41,0.43) in 2 ventral but no dorsal tracts. Language skills were not associated with FCI in any tract. Conversely, reading abilities were positively associated with FA (r=0.50;0.52;0.64) and/or FCI (r=0.31;0.38;0.47) in 3 dorsal but no ventral tracts. Reading abilities were not associated with R1 in any tract. These findings suggest that language and reading abilities rely on a different balance of dorsal and ventral WM tracts and WM properties within these tracts. Secondary regression analyses revealed that FA significantly predicted between 20-26% additional variance in language or reading skills above variance predicted by R1 or FCI, respectively. Our results imply that language and reading skills rely on additional WM properties in addition to myelin content or fiber organization.

3-P-238 Increased interhemispheric somatomotor network functional connectivity and mirror overflow movements in children with ADHD

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Objective: Excessive mirror overflow (mOF) is commonly observed in children with attention-deficit/hyperactivity disorder (ADHD) and is correlated with neuropsychological measures of impaired inhibitory control between right/left motor cortices as well as ADHD symptom severity. However, no studies have reported on the association of mOF with interhemispheric functional connectivity (FC) between the motor cortices. Our objective was to use resting-state fMRI to examine interhemispheric somatomotor network (SMN) FC and its association with mOF in children with and without ADHD. Methods: Analytic sample includes 120 children (8-12 years, 62 ADHD). mOF was quantified using finger twitch transducers during a finger sequencing task. For each participant, right- and left-lateralized SMNs were delineated using independent component analysis. Interhemispheric FC was calculated using Pearson correlations between right and left participant-specific SMN timecourses. ANCOVAs identified effects of diagnosis. Brain-behavior associations were assessed with linear regression and Pearson correlations. Results: Right- and left-lateralized SMN components were localized to primary motor and somatosensory cortices of the respective hemispheres and to contralateral cerebellar motor regions. Children with ADHD showed increased mOF (p=.001) and SMN FC (p=.021) as compared to typically developing (TD) children. There was a significant diagnosis*SMN FC interaction on mOF (p=.029). Follow up correlations revealed mOF marginally increases with FC in children with ADHD (r=.245; p=.061). TD children did not show this association (r=.042; p=.760). Conclusions: Children with ADHD show increased interhemispheric SMN FC. Further, in children with ADHD, FC was positively correlated with mOF, such that children with stronger right-left SMN FC demonstrated greater mirror overflow. The findings suggest that this increased interhemispheric SMN FC may contribute to abnormal persistence of mOF in ADHD.

3-P-239 Searching for a neuromarker of spatial attention bias in school-aged children

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Visuo-spatial attention is a fundamental cognitive function that enables us to navigate visual environments efficiently. We recently found that children at ages 6-8 exhibit a preference for the left-hand side of space over the right-hand side when allocating attention. Such leftward attention biases in children gradually diminished with increasing age (manuscript under review). In adults, a subject's spatial bias indicates an asymmetry in attentional weights generated within the dorsal fronto-parietal attention network (also known as Dorsal Attention Network) to direct attention to the contralateral side (Szczepanski & Kastner, 2013). Thus, our finding suggests a potential hypothesis for the development of the attention network: a subtle hemispheric asymmetry in the attention network gradually achieves a balanced spatial attention control throughout development. To explore this possibility, we first searched for a neuromarker of attention biases in children by building a functional connectivity-based predictive model (Shen et al., 2017) with a priori regions of interest. We measured spatial biases using a landmark task in school-aged children (age 6-12; N = 37 after outlier exclusion) and collected functional MRI data while children were watching a short movie clip. We identified 24 topographic areas in each hemisphere that represent visual space by using a probabilistic atlas (Wang et al., 2015). We found that a predictive model involving all visuo-spatial areas successfully predicted each child's spatial bias. This data-driven model consisted of edges between the main network components, such as Frontal Eye Fields (FEF) and sub-regions of the Intraparietal Sulcus (IPS). Stronger connectivity between the right FEF and IPS areas,

compared to the left, predicted leftward biases in children. Our results provide a lens to better understand the link between attention behavior and the fronto-parietal attention network in typical and atypical development.

3-P-240 Deprivation & threat, resting-state functional connectivity, and psychopathology within the ABCD sample

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To examine the effect of adversity on neural and behavioral correlates, we adopted a dimensional approach, focusing on threat and deprivation. Despite growing attention to the dimensional approach of adversity, it remains to be empirically determined whether threat and deprivation exert differential neurodevelopmental effects on youth. We thus compared the relative effects of threat versus deprivation on resting-state functional connectivity (RSFC) of six major cortical networks, and its linkages to psychopathology, among a national sample of pre-adolescents. This study uses a subset of data from the Adolescent Brain Cognitive Development study. Youths' perceptions of threat and deprivation were operationalized as latent variables. Deprivation included parental acceptance, monitoring, and school quality; threat included family conflict, neighborhood safety, and school safety. Youths' psychopathology was measured using the CBCL. We used Gordon et al. to determine the networks of within-network connectivity. Networks included in analyses consisted of the fronto-parietal (FPN), cingulo-opercular (CON), ventral attention (VAN), dorsal attention (DAN), salience (SN), and default mode networks (DMN). Structural equation models were run in Mplus. Additionally, multi-group analyses were conducted to investigate group differences across child age, sex, and race/ethnicity, adjusting for multiple comparisons. Increased levels of deprivation were significantly associated with decreased connectivity in DMN and VAN. The path from deprivation to (a) DMN coherence was significantly larger in the older group and (b) to DAN was significantly larger among females. Lastly, associations between the DMN, CPN, DAN, and psychopathology were significantly larger among older youth. Threat and deprivation are shown to have a significantly different impact on RSFC among youth; attention to dimensional approach when studying the sequelae of early adversity is warranted.

3-P-241 Mapping longitudinal development of cortical functional connectivity in the healthy mouse and a mouse model of Rett Syndrome

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Individual differences in brain development in both health and disease drive a need to understand longitudinal neurodevelopment in the healthy mouse. Characterization of functional neuroarchitecture development in the healthy mouse would provide an important resource dataset for studies of neurodevelopmental disease such as Rett Syndrome, which varies widely in individuals' disease and symptom progression. To this end, we collected resting-state calcium functional connectivity (FC) data using an optical fluorescence imaging system in both healthy development and in the Mecp2 mouse model of Rett Syndrome. Data were acquired to characterize FC development across 5 longitudinal timepoints (postnatal day 15 (P15), P22, P28, P35 and P60) in healthy C57Bl/6J mice expressing the genetically encoded calcium indicator GCaMP6f directly under the Thy1 promoter. We observed the

largest change in functional connection strength between the earliest time periods (P15-P22) in healthy mice, suggesting that the period of most dynamic developmental FC change occurs before 4 weeks of age. Both sensorimotor and association cortices had developmental trajectories which displayed significant change in FC between P15 and P60, with parietal cortex in particular exhibiting differences across time. We also collected resting-state calcium FC data during development (P35) and following symptom onset in the Mecp2 mouse model of Rett Syndrome as well as Mecp2 mice with a cell-specific rescue-of-function in GABAergic neurons. We then evaluated the correlation between FC measures and their symptom profile, as measured by Bird score and Rotarod metrics. Preliminary analysis suggests that FC values in regions that include visual cortex are altered during development in the Mecp2 model. This examination of healthy brain development as well as perturbations in the Mecp2 mouse provides new insight into how functional brain networks may be altered in Rett Syndrome and other neurodevelopmental disorders.

3-P-242 Parsing heterogeneity in the effects of stress on frontolimbic circuitry

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Background: Delineating the effects of experiential, environmental, and timing-related dimensions of stress is important for explaining heterogeneity in frontolimbic development following stress exposure (see Cohodes et al., 2020 for a review). **Specific Aims and Hypotheses:** The proposed study aims to employ a data-driven approach to examine whether the following features of early-life stress exposure are meaningfully associated with distinct patterns of frontolimbic connectivity in adulthood: age of onset, chronicity, type, severity, caregiver involvement, and whether a stressor was characterized by controllability and/or predictability. Though the proposed study is broadly exploratory, it is hypothesized that specific factors will interact with developmental timing of stress exposure to further predict neurobiological outcomes. **Methods:** Phenotypic and neuroimaging data collection is complete (N = 120). All participants completed a novel, systematic assessment of stress exposure developed by Cohodes and Gee based on the UCLA PTSD Reaction Index (Steinberg et al., 2013) and a resting-state fMRI scan. Analytic Approach: For each dimension of interest (i.e., caregiver involvement in stressor), data will be aggregated to produce indices of each dimension of exposure across development. Based on this approach, each participant will have six distinct variables indexing their exposure: chronicity, type, severity, caregiver involvement, controllability, and predictability. All indices will be submitted to a random forest analysis that aims to predict distinct patterns of frontolimbic functional connectivity. **Implications:** Clear delineation of these multilevel factors that may moderate the impact of stress on neurodevelopmental outcomes is important for understanding the etiology of stress-related psychopathology and for optimizing clinical interventions that target children's developmental stage and specific profile of past stress exposure to promote resilience.

3-P-243 Family conflict and youth adjustment: The moderating role of default mode network resting-state functional connectivity (DMN RS-FC)

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Youth who are exposed to high levels of family conflict are at increased risk for problem behaviors.

However, not all youth exposed to conflictual home environment show maladjustment, many exhibit resilience. Although myriad psychosocial protective factors support resilience, more research is needed on neuroprotective mechanisms that promote resilience in youth. This study aims to test the protective role of the default mode network functional connectivity during resting state (DMN rs-fc) in the link between family conflict and youths' externalizing and prosocial behaviors. We hypothesized that increased DMN rs-fc will attenuate the risk for psychopathology and promote social competence in youth. Data were obtained from the Adolescent Brain Cognitive Development (ABCD) study. Family conflict was measured via the Family Environment Scale. Externalizing behaviors was measured by the Child Behavior Checklist. Prosocial behaviors were measured using the Strengths and Difficulties Questionnaire. DMN rs-fc were drawn from pre-processed ABCD resting-state fMRI data. Structural equation modeling was used to conduct analyses. First, we tested the direct associations between family conflict and youths' externalizing as well as prosocial behaviors. Then, we investigated if DMN rs-fc significantly moderated these associations. Child's sex, age, minority status, and household income were included as covariates. Results revealed that higher levels of family conflict was significantly associated with increased externalizing (B = 1.760, â = .333, p < .001) and decreased prosocial (B = -.033, â = -.159, p < .001) behaviors. Furthermore, DMN rs-fc significantly mitigated the effects of family conflict on youths' externalizing (B = -1.144, â = -.021, p < .05) and prosocial (B = .043, â = .020, p < .05) behaviors. Findings suggest that the DMN re-fc constitutes a significant neuroprotective factor from family conflict and promotive of resilience among youth.

3-P-244 Using connectome-based predictive modelling to determine the relation between resting-state functional brain connectivity and functional outcomes after pediatric mild traumatic brain injury: A pre-registration

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Objective: Mild traumatic brain injuries (mTBI) may result in changes in functional brain connectivity that may be related to post-concussive symptoms (PCS). Although the majority of children recover after mTBI, we are unable to predict those who will go on to experience persistent functional impairment. Therefore, the aim of this study is to investigate whether resting state functional connectivity (RS-fcMRI) can be used to predict functional outcomes 3-months after mTBI. **Methods:** Neuroimaging data have been collected from 423 children with mTBI (8-16 years) recruited from emergency departments across Canada. The fMRI scan, lasting 8 minutes, involved participants resting passively and staring at a fixation cross. fMRI images will be pre-processed according to fMRIprep with modifications (e.g., registration to pediatric template). Denoising will be implemented by regressing out motion estimates and their derivatives, WM, and CSF. Volume censoring will also be included. Next, each participant's connectivity matrix will be constructed using the MIST 325 parcellation. Connectome-based predictive modelling (CPM) using leave-one-out cross-validation will be used in order to investigate RS-fcMRI as a predictor of functional outcomes, measured using a composite score derived from the Pediatric Quality of Life Inventory, Functional Disability Inventory, and the Pediatric Injury Functional Outcome Scale. Briefly, the following steps will be carried out for CPM: 1) feature selection to identify relevant edges in the

connectivity matrix that correlate with functional outcome; 2) build a predictive model in the training set; and 3) test the model on the left out subject with the accuracy of the predictive model evaluated via permutation testing. **Implications:** This study will be the first to investigate the relation of RS-fcMRI to functional outcomes after mTBI in children, because previous research on mTBI has primarily focused on PCS.

3-P-245 A data-driven approach to examine the specificity of anomalous motor system functional connectivity in children with Autism Spectrum Disorder

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The severity of social-communicative deficits is consistently associated with motor skill development in children with autism spectrum disorder (ASD). The findings suggest that anomalous motor system connectivity may mediate both social and motor skill deficits in children with ASD. Spatially constrained ICA was performed using Group ICA of fMRI toolbox (GIFT) to focus on the motor system in 419 children (ASD = 105; typically developing (TD) = 314). First, paired t-tests were used to examine group differences in within-network connectivity (α=0.001), with only one component (right Crus I) showing significantly lower connectivity in ASD vs. TD ($p < 0.001$, FDR). Next, effect of diagnosis on right Crus I between-network connectivity (BNC) with non-cerebellar motor system components (n = 25) was examined using a MANCOVA. The overall model was significant ($p = 0.014$) with post-hocs revealing significant group effects of right Crus I connectivity with four components: left inferior parietal lobule (IPL) ($p = 0.02$, TD > ASD); bilateral dorsomedial M1 ($p = 0.01$, ASD > TD); bilateral dorsolateral premotor ($p = 0.02$, TD > ASD); SMA ($p = 0.02$, TD > ASD). To examine relationships of these BNC findings with autism symptom severity, multivariate linear regression models examined associations with Social-Responsiveness Scale (SRS) and Repetitive Behavior Scale (RBS) scores. We observed a diagnosis-by-connectivity interaction for SRS such that for children with ASD (but not TD) elevated SRS was associated with right Crus I-left IPL hypoconnectivity ($t = -5.144$, $p < 0.001$). We observed a diagnosis-by-connectivity interaction for RBS such that for children with ASD (but not TD), elevated RBS was associated with right Crus I-left IPL hypoconnectivity ($t = -3.262$, $p = 0.001$) but right Crus I-right IPL hyperconnectivity ($t = 3.164$, $p = 0.002$). The findings suggest that anomalous right Crus I-IPL connectivity may be particularly relevant to the development of core autism symptoms.

3-P-246 Sensitivity to early life stress predicts change in amygdala-ventromedial prefrontal cortex functional connectivity across adolescence: A longitudinal investigation

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While early life stress (ELS) affects functional connectivity (FC) between the amygdala and ventromedial prefrontal cortex (vmPFC), it is unknown which specific aspects of ELS underlie developmental changes in this emotion regulatory circuit. Stress sensitivity - the strength of individuals' response to stressful events - is an important construct to consider, in light of research that perceived stress, beyond objective stress, impacts health outcomes. Here, we examined the association between stress sensitivity and longitudinal changes in amygdala-vmPFC FC in adolescents exposed to ELS. At baseline, 127 adolescents (11.4±1.0 years) completed a resting-state fMRI scan and an interview assessing ELS, during

which we obtained subjective ratings of stress severity and subsequently coded the objective severity of each reported stressor. We operationalized stress sensitivity to ELS as the residual variance after regressing subjective stress on objective stress. 4 years later, 83 of these adolescents completed both another resting-state fMRI scan and the self-report Adolescent Stress Questionnaire (ASQ) to assess current stress. We used seed-to-seed connectivity to assess amygdala-vmPFC FC, and linear regression models to test the effects of stress sensitivity on change in amygdala-vmPFC FC, covarying for baseline amygdala-vmPFC, age, sex, pubertal stage, motion, and time interval. Higher stress sensitivity predicted a greater increase in amygdala-vmPFC FC (β=.31; t(75)=2.82, p=.006), even after covarying for ASQ and objective stress severity (p<.005). Objective stress severity was not associated with changes in amygdala-vmPFC FC (p=.60). Given evidence that resting-state amygdala-vmPFC FC increases across adolescence, our results are consistent with "stress acceleration" models of ELS. Importantly, our findings suggest that perceived stress may partially explain the effects of ELS on the development of amygdala-vmPFC FC.

3-P-247 Mapping alterations in resting-state functional connectivity profiles to dimensions of childhood adversity

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Objective: Recent work has proposed two dimensions of childhood adversity, threat and deprivation, that may have dissociable effects on neural development. This study aims to elucidate the associations between adverse environmental experiences and resting-state functional connectivity (rsfMRI) profiles, using data-driven methods. **Methods:** Resting-state functional MRI data was collected from 239 children, and experiences of threat and deprivation were assessed in a multi-informant, multi-method approach. Connectivity matrices will be created for each participant, and connectivity features will be included in a sparse canonical correlation analysis (CCA). CCA enables the identification of patterns of functional connectivity that may be dissociable between different dimensions of adversity, reflected by the canonical variates (CVs). The significance of the CVs will be determined by repeating the procedure across 10,000 iterations of permuted data. The first N significant CVs will be retained and interpreted using methods examining the proportion of explained variance and ratio of non-zero loadings of threat compared to deprivation items within each CV. Multiple methods of feature and penalty selection will be performed and compared, replicating the methods of recent publications. **Hypotheses:** If adverse environmental experiences impact rsfMRI, the CVs will reflect a dissociation between threat- and deprivation-related profiles of functional connectivity. **Implications:** Hypothesized adversity-related alterations in rsfMRI profiles may reflect lasting changes in developing neural networks. Adversity is also a robust predictor of psychopathology. Together, this would raise interesting questions about the development of these networks and their role in individual differences in psychopathology.

3-P-248 Independent contributions of premature birth on executive function task performance and implicated brain structures and networks

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The relationship between prematurity and unfavorable outcomes has been well established. More specifically, premature birth is known to confer increased risk for learning disabilities, social difficulties,

and behavioral issues. The current study aims to understand the mechanisms underlying this delayed trajectory by investigating alterations in executive function-implicated brain regions and networks among children reported to have been born prematurely by parents. Data will be acquired from the Adolescent Brain and Cognitive Development Study(ABCD; Release 3.0). We will examine brain volume (a priori regions of interest: dlPFC, dmPFC, dACC, and vlPFC) and resting state functional connectivity (a priori networks of interest: FPN, COP, and DMN). Executive function will be indexed using List Sorting, Card Sort, and Flanker tasks from the NIH Toolbox. A general linear multilevel model will be used to account for family dependencies as well as to model volume and within- and between-network connectivity change over time. Several covariates will be included (maternal illness and drug use, birth complications, household income, gender, age) to identify the contribution of premature birth independent of potential confounding factors. We predict that greater prematurity will be significantly associated with smaller volumes in dlPFC, dmPFC, dACC, and vlPFC at baseline and year two follow-up. We also predict that greater prematurity will be related to decreased within-network connectivity and decreased between-network connectivity in our networks of interest. We expect that brain volume and connectivity at baseline will predict cognitive performance at year two follow-up. Additionally, we predict that household income will moderate the relationship between premature birth, structure/connectivity, and cognitive performance, such that the relationship between prematurity and unfavorable outcomes will be stronger for children from lower than higher income households.

3-P-249 Examining inhibitory control as a moderator between childhood resting state fronto-limbic connectivity and anxiety.

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Functional connections between amygdala and fronto-cortical regions are implicated in the regulation of emotions (Ochsner et al., 2012), and may contribute to the etiology of anxiety disorders (Cisler & Olatunji, 2012). Prior work has also noted levels of inhibitory control as a moderator in risk for anxiety disorders, although findings are mixed as to whether better inhibitory control exacerbates (i.e. Carlson & Wang, 2007; Thorell et al., 2004) or ameliorates (i.e. Ansari & Derakshan, 2011; Basten et al., 2011) risk. Here, in a sample of 55, healthy weight (body mass index for age % < 85), 7-8 year-old children (M = 7.99, SD = 0.59, 98.1% White, 56.4% female) from a longitudinal cohort study on the neural determinants of pediatric obesity (i.e., Food and Brain Study - DK110060), we will test the association between reported anxiety symptoms and resting state connectivity between amygdala and medial prefrontal cortex. We will also assess whether levels of inhibitory control moderate the relation between these connectivity patterns and level of anxiety. The Revised Children's Manifest Anxiety Scale is used as a metric of anxiety and inhibitory control is assessed via a stop signal task. Resting state MRI data will be preprocessed using fMRIprep and xcpEngine software (Ciric et al., 2018). The strength and directionality of connectivity will be assessed using GIMME (Gates & Molenaar, 2012). We hypothesize that there will be a positive relation between connectivity directionality and anxiety. Children with strong positive correlations between regions will report greater anxiety symptoms while negative correlations will relate to fewer reported anxiety symptoms. We also predict that levels of inhibitory control will moderate these associations, with high inhibitory control acting as a potential protective

factor. We expect that children with better performance on the stop signal task will have a weaker positive relation between connectivity and anxiety symptoms.

3-P-251 Developmental abnormalities in frontal-striatal functional connectivity as a biomarker for ADHD

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Introduction: Abnormalities in frontal-striatal circuitry have long been hypothesized to contribute to ADHD. Measures of frontal-striatal functional connectivity (F-SFC) using fMRI may serve as crucial biomarkers for ADHD; yet associations of these markers with ADHD and whether they differ across age are not well understood. We leveraged fMRI data from a large sample (n=395) of 8-14 year-old children with ADHD (n = 172 (49F/123M)) and typically developing children (TDC) (n = 223 (67F/156M) to investigate whether F-SFC is associated with age, sex, and ADHD. **Methods:** Bilateral caudate and putamen seeds were used to extract voxel-wise connectivity maps of the frontal cortex. FSL's randomize was used to test for significant two-way interactions for: Age*Sex, Age*Dx, Sex*Dx; main effects were tested when interactions were not significant (3000 permutations, Z threshold = 1.96, $p < 0.05$). **Results:** First, we did not observe an age*Dx interaction. The main effect of Dx when controlling for age revealed that children with ADHD showed significantly greater F-SFC than TDC in many frontal areas including the bilateral superior frontal gyrus and frontal pole. The main effect of age revealed a significant positive association of age with F-SFC in many of the same frontal regions. We also did not observe a sex*age interaction. The main effect of sex when controlling for age was significant, however, with males showing greater F-SFC compared to females in many of the same regions in which we observed significant Dx and age effects. Finally, we did not observe a Dx*Sex interaction, and neither of the main effects of Dx or Sex were significant. **Discussion:** We found an effect of Dx on F-SFC, but only when we controlled for age. Furthermore, we found main effects of age and sex in many of the same frontal regions, indicating that F-SFC patterns that distinguish children with ADHD from TDC overlap with those related to effects of sex and age.

3-P-252 Brain network organization and cognitive performance during childhood

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As the brain develops throughout childhood, brain networks become more segregated for functional specialization, while simultaneously becoming more integrated for efficient communication. The combination of increased segregation and increased integration has been linked to better cognitive performance. However, much of the work relating brain organization to cognitive performance has been focused on adults, leaving little understanding of this relationship in children. To explore this relationship, we collected resting state fMRI and neuropsychological data from typically developing children aged 8-10 years (N=23). We quantified three aspects of brain network organization: modularity (Q), participant coefficient (PC), and within-module degree (WMD). These measures quantify whole brain network segregation, internetwork connectivity, and intranetwork connectivity respectively. We assessed memory performance using the NEPSY-II Memory for Designs and Memory for Designs Delayed

subtests. We found a significant negative correlation between Q and both Memory for Designs and Memory for Designs Delayed. Additionally, when focusing on distinct networks, we found significant positive correlations between both visual network (VIS) PC and cingulo-opercular network (CO) WMD and these same two subtests. These results suggest that decreased segregation across the whole brain, in combination with increased internetwork connectivity of sensory networks (i.e., VIS) and increased intranetwork connectivity of higher-order networks (i.e., CO), is related to better memory. Notably, Memory for Designs Delayed had stronger correlations with all three of these network measures. This subtest is the more difficult of the two, which is consistent with other literature reporting stronger brain-behavior relationships on more difficult tasks. These results indicate that whole brain desegregation, with increased network-specific segregation and integration, underlies successful memory performance.

3-P-253 The application of covariance regression to identify functional brain networks related to age, ADHD, sex, and cognitive response control

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We utilized a whole-brain analysis approach to identify resting-state functional connectivity (rsFC) brain networks associated with attention-deficit/hyperactivity disorder (ADHD) and response control. Our approach combines a dimension reduction step (i.e., whole-brain group ICA) with a covariance regression step to improve statistical power over edgewise regression. Participants included 8-12 year-old children with ADHD (n=115, 29 girls) and typically developing controls (n=102, 35 girls) who completed an rsFC scan and a go/no-go task (GNG) outside the scanner. We modeled three sets of covariates: (1) ADHD diagnosis, sex, and their interaction; (2) model 1 plus GNG response variability (tau); and (3) model 1 plus GNG response inhibition (commission error rate), with GAI and age as confounding factors across models. Four networks were identified across all three models. The first network includes positive FC between cognitive-control (CC) and subcortical regions, as well as negative default mode (DMN)-subcortical FC and is positively related to age (ps<.001). The second consists of positive FC among CC-visual-somatomotor regions as well as negative CC-DMN FC and is positively associated with tau in boys with ADHD (p=.001). The third consists of positive DMN-visual FC as well as negative CC-DMN-visual FC and differs between boys with and without ADHD (p=.009) and between TD girls and boys (p=.026). The fourth consists of positive sensorimotor-visual FC and negative DMN-visual FC; FC within this network differs among girls and boys with ADHD (ps<.050) and is negatively associated with both tau (p<.001) and commission error rate (p=.015) in boys with ADHD. Unique networks were also identified in each of the three models suggesting some specificity to the covariates of interest. These findings demonstrate the utility of our novel covariance regression approach to studying functional brain networks relevant for development, behavior, and psychopathology.

3-P-254 Accounting for motion in fMRI: What part of the spectrum are we characterizing in autism and ADHD?

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Head motion can introduce spurious group differences in connectivity derived from functional Magnetic Resonance Imaging (fMRI) data. As post-acquisition cleaning procedures become increasingly stringent,

data retention decreases while the potential to limit study generalizability increases. Our goal was to examine whether fMRI experiments of children with autism spectrum disorder (ASD) and attention-deficit hyperactivity disorder (ADHD) are biased by head motion exclusion criteria. We aggregated data from 758 children (8- to 13-years old) who participated in resting state fMRI studies at Kennedy Krieger Institute between 2008-2013 (147 children with ASD, 273 with ADHD, and 338 typically developing [TD]). Phenotypic assessment included core ASD and ADHD symptomatology, intellectual ability, and basic motor control, as the children were, in effect, asked to complete a motor task by remaining as still as possible during the scan. Head motion was estimated using rigid body realignment and framewise displacement calculated from the realignment parameters. We considered three increasingly stringent levels of gross motion exclusion. Using Pearson's chi-squared tests, we found that the proportion of scans excluded differed by diagnosis for all three levels ($p<1e-05$ for all exclusion criteria). Children with ASD or ADHD were more likely to be excluded than TD children (all post hoc $p <.001$ corrected). Using generalized additive models (GAMs), we found that children with more severe social deficits, inattentive symptoms, hyperactive/impulsive symptoms, or poorer motor control were more likely to be excluded, while children with higher GAI were less likely to be excluded (all $p<.001$) for all exclusion criteria. In addition, these biases increased with the severity of the motion criteria used for exclusion. Our findings suggest that the generalizability of previous studies may be limited by selection bias, and future studies should adjust for these biases.

3-P-255 Brain connectomics in early adolescence predict suicidal ideation severity in later adolescence

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Suicidal ideation (SI) typically emerges during adolescence but is challenging to predict. Given the alarmingly high prevalence and significant adverse consequences of SI, it is important to identify neurobiological predictors of the severity of SI in adolescents in order to improve suicide prevention strategies. We used graph theoretical methods to examine whether, and which, local properties of functional brain topology in early adolescence predict the severity of SI in later adolescence. We recruited 101 participants (55 female) ages 9-13 years from the community with minimal psychiatric histories for this study. We assessed clinical characteristics and obtained resting-state fMRI data (baseline), for which we examined inter-regional functional connectedness across 250 brain regions by computing measures of nodal interconnectedness: local efficiency, eigenvector centrality, nodal degree, within-module z-score, and participation coefficient. We then used regularized LASSO regression and, subsequently, hold-out cross-validation, to identify the most important combination of clinical and brain-based predictors of self-reported severity of SI approximately 4 years later (ages 13-17 years). We identified 12 predictors of SI (R^2=.334). Within-module degree of the right substantia nigra was the most important predictor of SI severity, followed by 9 other brain-based predictors across frontal, temporal, cingulate, and subcortical structures, and two non-brain characteristics: objective severity of early life stress and severity of baseline depression. Our findings suggest that network properties of the developing brain in early adolescence are markers of vulnerability for SI occurring later in adolescence. Moreover, regional interconnectedness of the brain may forecast the emergence of SI before it is

evident clinically. Future research should validate the clinical utility of these markers as predictors of suicidal thoughts.

3-P-256 Pavlovian-to-instrumental transfer and outcome devaluation: A cross-validation study of tasks assessing the interplay between goal-directed and habitual responding in adolescents and young adults

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Habits refer to learned behaviors, actions, or thoughts that have become automatic over time, triggered by stimuli and often made without consideration of the outcome. While substantial work has examined habits in animal models and human adults, surprisingly little is known about habits from a developmental perspective. To address this gap, we present behavioral and fMRI data from two tasks aimed at characterizing the interplay between goal-directed and habitual behaviors in adolescents (n=7) and young adults (n=12): a Pavlovian-to-instrumental transfer (PIT) task and an outcome devaluation task. Pavlovian-to-instrumental transfer occurs when a stimulus that has been previously associated with rewarding or aversive stimuli affects later motivational salience and instrumentally learned behavior. We present data from an avoidance-based PIT task that involved pairing a conditioned stimulus with an aversive stimulus via negative reinforcement. Evidence for specific and general PIT will be discussed, and task-based neural correlates (e.g., striatum, insula) will be characterized for each group. In an outcome devaluation task, participants responded via button press to visual cues associated with food rewards. After training, participants underwent satiation of one food reward to devalue it. If task behavior remained goal-directed, then response rates for the devalued outcome would be reduced; if habitual, then response rates to food cues should remain stable. We will present task-based functional connectivity data during different phases of training, specifically connections between ventral and dorsolateral striatum and motor cortex, characterizing response patterns for each group. Overall, by using multiple paradigms, analytic techniques, and a broad conceptualization of habits, this work promises to yield new information for prevention and intervention efforts focused on sustaining or eliminating health-related habitual behavior (e.g., diet, substance use) in youth.

3-P-257 Age-related effects of racial and ethnic discrimination on striatal functional connectivity

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Racial/ethnic discrimination has negative effects on mental and physical health, but much of this work has focused on adults. Due to significant brain and social development that occurs during this period, adolescents may be at particular risk for the negative effects of discrimination. The effects of experiences of discrimination on brain function are not well understood, and little attention has been paid to how these effects may differ during the transition from adolescence to adulthood. Models of stress and social defeat posit that acute stressors (like discrimination) can lead to long-term alterations in striatal function and in function of connected regions (e.g., Novick et al., 2011). These effects may be particularly important in adolescence and early adulthood, as the functional organization of the brain matures. To determine whether experiences of racial/ethnic discrimination differentially impact striatal functional connectivity based on age, we analyzed resting state fMRI from 146 healthy adolescents and

young adults (23 reported discrimination based on skin color or ethnicity in the past year) using a graph theoretical metric of node strength (eigenvector centrality, EC) for striatal regions (e.g., caudate, putamen). EC allows us to index how the overall level of functional connection of these regions to other highly connected regions changes with age and following discrimination. There was no significant main effect of age on EC in striatal regions, but there was a significant age X discrimination cross-over interaction in the caudate. Among those reporting discrimination, there was a more negative association between age and caudate EC, suggesting that recent discrimination in adolescence is associated with increased striatal connectivity, but connectivity following discrimination decreases into adulthood. This provides preliminary evidence that experiencing race-based discrimination may differentially impact adolescent and adult brain function.

3-P-258 The impact of prenatal alcohol exposure on sensory processing in the PASS cohort

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It is well established that impaired learning and attention, emotional regulation, fine and gross motor skills, as well as hyperactivity and impulsivity are associated with fetal alcohol spectrum disorder (FASD). Additionally, there is a growing body of research that disrupted sensory processing, mediated centrally by the somatosensory cortex, underlies many of these cognitive and behavioral deficits. Here, we will investigate data on over 80 children from the PASS cohort in Cape Town, South Africa with prenatal alcohol exposure (PAE), based on the following aims and strategies: Aim 1: Associations between structural neural mechanisms of sensorimotor integration and measures of sensory processing and motor skills. Hypotheses: Based on human studies of retrospective assessments, we predict alterations in cortical thickness, reduced volume, reduced integrity in white matter microstructure, and disorganized connectivity of key brain regions associated with sensory and motor functions among PAE children compared to non-exposed children. We will measure differences using multimodal MRI techniques. Aim 2: Associations between functional neural mechanisms of sensorimotor integration and measures of sensory processing and motor skills. Hypotheses: Based on human studies of retrospective assessments of the functional connectivity between the corpus callosum and the default mode network in FASD, we predict altered functional connectivity of the primary motor network (PMN) associated with sensory and motor functions among PAE children when compared to non-exposed children. We expect independent and interactive (e.g. quantity by timing, etc.) effects on associations with diffusion tensor imaging analyses, sensory processing and motor skills. The research presented will illuminate the underling neural mechanisms associated with sensory processing differences often seen in children with PAE.

Q - Other

3-Q-259 Loss of control-eating in children is associated with altered cortical and subcortical grey matter volume

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Loss of control (LOC)-eating is the perceived inability to control how much is eaten, regardless of actual

amount consumed. Childhood LOC-eating is a risk factor for the development of binge-eating disorder (BED), but its neurobiological basis is poorly understood. Studies in adults with BED have shown both increased and decreased grey matter (GM) volume in reward-related regions (medial and orbital prefrontal cortex, ventral striatum) and lower GM volume in bilateral caudate relative to healthy controls. As binge-eating may result in structural changes, mixed findings may be due in part to differences in frequency and duration of binge-eating. To clarify these inconsistencies and identify potential neurobiological precursors of BED, we conducted secondary analysis of four prior studies that included child-reported LOC (semi-structured interview; LOC n=35, 26%) and T1 MPRAGE scans for 137, 7-11 year-old children (M=9.1 years, 69 boys, 19 with obesity-14%). Age, sex, and obesity status did not differ by LOC status (p's>.18). Due to poor scan quality (e.g., ringing, blurriness; 2 raters ICC>.80), 4 children were excluded. CAT toolbox in SPM12 was used to process MRI data and conduct a 1-way ANCOVA (whole brain FDR<.05, p<.005, k=674) adjusting for age, sex, and total intercranial volume. Children with LOC, relative to those without, had lower GM volume in bilateral caudate and left hippocampus and greater GM volume in right inferior frontal gyrus (IFG) and right precentral gyrus extending to supplemental motor area (SMA). Thus, children with LOC-eating showed altered GM volume in regions related to habitual and compulsive behaviors (caudate, hippocampus, and SMA), inhibitory control (caudate and IFG), and food cue reactivity (IFG and hippocampus). Future studies are needed to determine the extent to which alterations in neural circuits related to habitual behavior, inhibitory control, and food cue reactivity contribute to LOC-eating and the development of BED.

3-Q-260 Mechanisms of selective attention in reading

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Shifting and focusing attention is a key mechanism in the extraction of sensory information, to allow for adaptive behavior. Reading is a perfect example: spatial attention must shift precisely from one location to the next in order to select letters or words in sequence. The interplay between the development of attention and reading ability has yet to be measured in an ecologically valid paradigm. Here we evaluated the effect of visual spatial attention in a letter identification task. A string of 6 letters was presented for 250ms and participants were asked to report a post-cued letter from one of the six positions. Attention was manipulated by introducing two types of pre-cues: exogenous (50ms, peripheral, uninformative) and endogenous (150ms, central, informative). On valid trials, the pre-cue and post-cue sides match; on invalid trials they mismatch, and on neutral trials both sides of the fixation are pre-cued. Participants' accuracy showed a significant cue benefit for both exogenous (valid>invalid) and endogenous cues (valid>neutral). Notably, the cue benefit was significantly larger with endogenous than exogenous cues. To further understand the differential mechanisms of attention, we categorized errors as position swaps (when a letter in an incorrect position is confused with the target letter) and random errors. On neutral trials, observers were 2.4x more likely to make position swaps than random errors. Interestingly, we found that an endogenous (but not exogenous) cue decreases position swaps by 48%. Thus, endogenous visual spatial attention helps in correctly extracting the relative position of letters within a word. Our results demonstrate differential effects of covert attention subtypes on the processing of orthographic information. We hypothesize that the development of endogenous visual

spatial attention is key to the development of reading ability as children learn to efficiently prioritize relevant, and filter out irrelevant, visual information.

3-Q-261 Maternal mind-mindedness in infancy: Neuroanatomical outcomes in late childhood

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The concept of mind-mindedness (MM) refers to parents' tendency to comment verbally on their child's mental activities during parent-child interactions (Meins et al., 2002). MM has been positively associated with various developmental outcomes in children such as attachment security, language acquisition, behavioral regulation, executive functioning, and sleep consolidation (see McMahon & Bernier, 2017, for a review). Given that the effects of parenting on child adjustment are believed to transit through neural pathways (e.g., Belsky & de Haan, 2011), MM should be related to neural development. However, no study has yet examined the association between MM and the structure of the brain. Thus, the current study aimed to examine the prospective associations between maternal MM in infancy and children's grey matter volume (GMV) in late childhood. Maternal MM was assessed during a 20-min mother-infant free play among 65 infants (29 boys) when they were 12 months old (M = 12.60, SD = 1.32). This interaction was videotaped and later coded using the Meins et al. (2001) coding system for parental MM. A structural magnetic resonance imaging protocol was performed when children were 10 years of age (M = 10.45, SD = 0.44). Multiple regressions were used to predict whole-brain regional GMV from MM scores, controlling for child age, sex, total intracranial volume, and maternal education. The results indicate that higher maternal MM levels in infancy are associated with larger child GMV in the left superior temporal pole (MNI coordinates: x = −48, y = 6, z = −16; k = 629; T = 4.36) in late childhood, $p < .001$ uncorrected. This area of the brain is known to be involved in the processing of semantic and conceptual knowledge related to social information. The findings support the hypothesis that the quality of maternal behavior during infancy, namely MM, could induce structural changes in the developing brain.

3-Q-262 Pubertal timing and the development of self-evaluative behavior and neural processing

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Previous studies have shown that early pubertal timing, particularly in girls, is a risk factor for internalizing disorders in adolescence. The mechanisms behind this are unknown, but changes in self-perception are a candidate mechanism. The current study uses data from a longitudinal project of 174 girls to examine how pubertal timing is related to the development of self-evaluation both behaviorally and neurally. Participants were 10.0 to 13.0 years old at Time 1 and were followed up 18 months later. At each time point, participants completed a functional MRI paradigm in which they decided whether or not an adjective describes them, including positive and negative adjectives focused on social traits. They also completed the Pubertal Development Scale (PDS) and Tanner stage line drawings (LD) at both time points and reported on the date of menarche. Responses to the PDS and LD were converted into a composite Tanner stage measure and residualized on age to obtain a measure of pubertal timing. Self-reported subjective timing and age at menarche were also examined. Multilevel mixed effects models

showed that girls with earlier pubertal timing based on residualized Tanner stage as well as earlier subjective timing evaluated themselves less positively. Further, earlier timing based on residualized Tanner stage was associated with less temporal pole activation during self-evaluation. This differential activation in a region important for perspective taking could be a potential mechanism explaining less positive self-perceptions in girls who go through puberty early. This project is preregistered here: https://osf.io/g9zsb/.

3-Q-263 The association between perceived stress and sleep disturbances: The moderating role of stress mindset

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Over the last two decades, adolescents have been getting significantly less sleep. Although 8-10 hours a night is recommended for beneficial health outcomes, 87% of adolescents get less than this amount. Bioregulatory (e.g., changes in circadian rhythm) and social factors (e.g., school start time) contribute to poor sleep during adolescence. In addition, adolescents experience unique stressors involving school performance, peer relationships, and emerging adult responsibilities. Stress mindset, defined as the extent to which stress is perceived as beneficial or detrimental, can affect the association between perceived stress and health. Given the broad impact of sleep disturbances on health, we examined whether stress mindset moderates the association between perceived stress and sleep satisfaction in adolescents. We hypothesized that those with a more "stress-is-debilitating" mindset will have a stronger association between higher perceived stress and less sleep satisfaction than those with a relatively more "stress-is-enhancing" mindset. 52 adolescents (28 female; 13-18 years old) completed self-reports of stress mindset and perceived stress. Participants wore an actiwatch and completed a daily diary reporting on sleep satisfaction for 14 days. Self-reported sleep satisfaction and objective, actigraphy-assessed, sleep efficiency data are not typically correlated; thus, we will conduct an additional analysis examining whether stress mindset moderates the role between perceived stress and objectively-assessed sleep efficiency (the percentage of time spent asleep relative to time allocated for sleep). First, we will test the association between perceived stress and subjective sleep satisfaction controlling for pubertal status and sex. Then we will test the moderating role of stress mindset. Given that stress mindset can be changed, results from this study may inform interventions for improving sleep in adolescence. See https://osf.io/rzt4a/.