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CONFERENCE ABSTRACT

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REWARD PROCESSING UNDER UNCERTAINTY: EEG INDICES FROM YOUNG CHILDREN AND PARENTS DURING COOPERATIVE SOCIAL INTERACTION

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Our actions are often motivated by the expectation of certain outcomes. We investigated the effect of reward expectancy and its violation during social interactions. The cortical oscillatory correlates of collaborative actions of parents and their children were measured using high-density EEG. Parent-child dyads (mean child age: 4.6 years) played a turn taking game with high and low reward outcomes after every turn. After participants had learned the rules of the game, the reward contingency was randomly reversed in 20% of trials, thereby eliciting prediction errors. Independent component analysis (ICA) was used to determine and exclude non-brain components. Children and parents both exhibited strong P3a and P3b positivity in response to their own high vs. low reward outcomes. Interestingly, during parents' observation of their child's action, the P3a was effected by the parent's expectation of high or low reward, but not by the actual outcome. This event-related effect might be an indication of parents' increased attention to the consequences of their children's actions. The effect of expectancy violation on children's event-related potential varies highly between individuals. Finally, preliminary results suggest that parent-child dyads exhibit patterns more closely related to each other than to other participants of the same cohort.

BEHAVIORAL INHIBITION AND ANXIETY IN RELATION TO DELTA-BETA COUPLING: POTENTIAL EFFECTS OF AN ABM INTERVENTION

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Temperamental behavioral inhibition (BI) is linked to social reticence in adolescence (Fox et al., 2001) and development of Social Anxiety Disorder (Perez-Edgar & Fox, 2005). One mechanism by which BI may relate to anxiety is EEG delta-beta (δ-β) coupling, a physiological indicator of regulation processes. However, findings are equivocal regarding the relationship between δ-β coupling, BI, and anxiety (Putman 2011). The present study included children (N = 179; 87 boys), ages 9 through 12 (M = 9.93; SD = 0.98) identified as BI (n = 71) and non-BI (n = 108) using the BIQ (Bishop et al., 2003). Children completed a baseline Social Dyad and resting state EEG. BI children were randomized into an Attention Bias Modification intervention and returned to complete an outcome visit identical to baseline. At baseline, the temperament groups had significant δ-β coupling, with coupling for the non-BI group (r=.60) (non-significantly) stronger than the BI group (r = .49). Similarly, anxious children showed weaker coupling (r=.50) compared to non-anxious children (r = .65, p = .05). BI interacted with anxiety to predict δ-β coupling, such that BI children who were also anxious showed significantly weaker coupling (r=.35) compared to BI and non-BI children low in anxiety (r =.69, .64, p = .03). Post intervention, coupling for the placebo group virtually remained the same (r = .60 vs. .66). Coupling for the ABM group nearly doubled in strength from baseline (r = .32) to outcome (r = .59). Finally, ongoing coding of Social Dyads suggests that BI children show significant higher discomfort, lower voice arousal, and lower display of happiness compared to their counterparts, validating BIQ results.

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MILD MATERNAL HYPERTHERMIA DURING MID-GESTATION CAUSES BOTH FETAL AND JUVENILE BEHAVIORAL DEFICITS IN GUINEA PIGS

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Elevation of maternal body temperature by only a few degrees results in damage to the fetal nervous system. The cells that are primarily effected are those that are actively dividing during exposure. However, extreme exposures are likely to cause maternal stress which is itself a teratogen. In order to avoid this confound, we combine a mild maternal

exposure to hyperthermia with acclimation techniques using a warm water bath. Female IAF Hairless guinea pigs were acclimated before pregnancy to handling and all procedures. Fetal movement and state organization were observed by ultrasound visualization from weeks 4–9 of a 10-week gestation. On gestational day 30 (peak proliferation in the striatum), pregnant females were assigned to either the mild hyperthermia bath (45 °C) or control group (40 °C). During the manipulation, pregnant females were lightly held in the bath with the bottom half of their body submerged for 15 min. After birth, offspring were tested for differences in social interaction and temperature preference in order to determine long term effects and correlation to fetal behavioral deficits. Data analysis indicated that mild exposure to maternal hyperthermia produced deficits in fetal Interlimb Movement Synchrony, a measure of interlimb coordination. Postnatal observations revealed selective hyperactivity/reactivity and deficits in social interaction for maternal hyperthermia exposed pups, suggesting that the damage from prenatal exposure was persistent. Due to the sensitivity in detecting behavioral deficits after such mild exposures, this model may prove useful in the study of developmental disabilities of unknown or idiopathic origin.

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ADOLESCENT'S FAMILY ASSISTANCE AND DIURNAL CORTISOL

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A body of research has shown that long-term caregiving is associated with psychological and biological stress among adult caregivers. Indeed, caregivers show deviations from the typical diurnal rhythm of cortisol when compared to non-caregivers. Although both adolescents and adults may provide family care, little research has examined the relationship between high levels of family assistance (a form of caregiving) and alterations in diurnal cortisol rhythms in adolescence. Thus, in the present study we assess the biological associations of time spent helping the family during the teenage years. 414 adolescents from an ethnically diverse sample (57% female, average age 15) completed nightly diary checklists over 14 days in which they reported the amount of time spent helping the family in a variety of ways, including cooking, cleaning, and sibling care. Participants also provided four saliva samples for four consecutive days to assess diurnal cortisol rhythms. We are currently investigating the relationship between high levels of family assistance and diurnal cortisol rhythms among this unique population. We expect that adolescents providing high levels of family care will exhibit deviations from the diurnal rhythm of cortisol, particularly upon waking and early in the morning. Results will be discussed in terms of their implications for adolescent development and health outcomes.

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DEVELOPMENT OF SPONTANEOUS EYE BLINKING FROM INFANCY TO EARLY CHILDHOOD

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Infants blink spontaneously (SB) only a few times each minute but show wide individual differences in blinking rate. Cross-sectional data suggests that SB rate increases gradually from infancy to adulthood, yet no longitudinal studies cover this period. Further, mechanisms of SB rate in primates include regulation by central dopamine (DA) system. The aims of the present analyses were to describe developmental change in SB rate (10 to 48 mos) and also to investigate whether SB rate related to the type of cognitive activity and to task performance.

Participants (N = 12, F = 6) were observed at 10, 24 and 48 mos. Each participated in a variety of cognitive and temperament tasks. Tasks varied by age. The order of tasks was as follows: baseline, working memory, attention regulation, episodic memory. SB rate was scored by trained coders (reliability estimates>90%).

Our current analyses showed wide variability in SB rate but no substantial increase in SB rate from 10 to 48 mos. At 48mos, SB rate varied by the type of task, but no differences in SB rate were observed at 24 mos. Although we are not yet able to perform tests to answer questions about individual differences, preliminary data suggest that we might find a positive correlation between SB rate and working memory performance. Our work may help identify contributions of DA to cognitive development and may have potential to provide new information about the developmental differentiation of cognitive function.

[NICHD HD049878 to MAB]

PRENATAL ALCOHOL EXPOSURE: EFFECTS OF OXYTOCIN ADMINISTRATION ON NEUROGENIC, ENDOCRINE, AND BEHAVIORAL OUTCOMES

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Fetal alcohol spectrum disorders encompasses a range of deficits following prenatal alcohol exposure (PAE). Of particular relevance, PAE leads to alterations in hypothalamic-pituitary-adrenal (HPA) (stress system) activity and changes in emotional regulation. The hippocampus (HPC), a brain region involved in stress and emotional regulation, exhibits decreased neurogenesis levels following PAE. It has been shown that neurogenesis may be necessary for mounting an appropriate stress response. Thus, decreased HPC neurogenesis may be one mechanism underlying stress and emotional deficits following

PAE. Oxytocin (OT) stimulates HPC neurogenesis and dampens HPA activity in male rats; it is not known whether these effects occur in females or following PAE. Thus, we examined whether OT could modulate the effects of PAE on neurogenic, stress, and behavioral outcomes. Adult male and female offspring from PAE, pair-fed, and control dams were treated with OT or vehicle for 10 days. We measured: corticosterone levels before and after acute stress, anxiety-like and locomotor behavior in the novelty suppressed feeding (NSF) task, and HPC doublecortin expression. PAE males exhibited altered responses to stress and an inability to return to basal levels. Further, PAE males demonstrated shorter latency to feed in the NSF task, indicating less anxiety or more motivation for food intake. OT decreased locomotor activity in both sexes, which may have greater implications for PAE animals that display hyperactivity. Similar to endocrine and behavioral data, preliminary analyses suggest neurogenesis is affected. Overall, our data reveal altered neurobehavioral outcomes following PAE and a role of OT in decreasing PAE-induced hyperactivity.

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EFFECTS OF CHRONIC ORAL CORTICOSTERONE EXPOSURE ON FOOD AND WATER INTAKE IN ADOLESCENT AND ADULT MALE AND FEMALE MICE

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Corticosterone (CORT) is a potent modulator of metabolic and behavioral function and a major adrenal hormone released following activation of the hypothalamic-pituitary-adrenal (HPA) axis. Disruption of the HPA axis and chronically elevated levels of CORT are noted in many physiological and neurobehavioral dysfunctions, including obesity. Moreover, the age and sex of the individual can further modify the effects of a dysregulated HPA axis. Previous studies have reported that chronic oral CORT treatment of adult male mice leads to a phenotype resembling the metabolic syndrome, including weight gain, increased adiposity and leptin, and glucose dysregulation. In the current study, we exposed adolescent (30d) and adult (70d) male and female C57BL/6 mice to 4wks of oral CORT exposure (100mg/ml) in their water and assessed their body weight and food and fluid consumption. We found greater weight gain in the adult-treated males and females compared to the adolescent-treated animals. Moreover, though CORT affected food and fluid intake in all groups, the effect of CORT on food intake was greatest in the adolescent- and adult-treated males, while fluid intake was most affected in the adolescent-treated males and females. Together, these data indicate age- and sex-dependent effects of chronic CORT-induced metabolic and behavioral changes. We are currently examining the brains of these animals to quantify potential changes in neuropeptides, such as orexin, proopiomelanocortin, and neuropeptide Y, known to affect metabolism and ingestive behaviors. These data will help elucidate the mechanisms through which HPA disruption leads to neurobehavioral dysfunctions, such as the metabolic syndrome and obesity.

THE COMMUNICATIVE FUNCTION OF NEONATAL IMITATION IN CHIMPANZEES (PAN TROGLODYTES)

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Species differences in imitative capacity may be evident in the imitative performance of newborn primates. Neonatal imitation is the developmentally earliest form of imitation in humans. It may be less cognitively complex than later imitation, as it occurs in early interactions with social partners, and does not involve additional skills, such as would be required in imitation of tool-use, for example. This study assessed imitative capacity in five neonatal chimpanzees, when they were 7 to 15 days of age. Infant responses to three modelled actions, mouth opening, tongue protrusion, and tongue clicks were assessed with two different test paradigms. One paradigm used a time-based test structure, and the other was an interactive communicative test. In the communicative paradigm, significant agreement was found between infant actions and the three demonstrated actions. Additionally, chimpanzees matched the sequence of three actions of the tongue click model, often substituting mouth opening for the clicks. Overall, newborn chimpanzees were found to imitate more in the communicative than the structured paradigm. The results support a conclusion that imitative capacity is not unique to the human species. Additional data from a study of the development of communicative skills in young chimpanzees found responsive open-mouth smiles occurred in the first weeks of life, suggesting that neonatal imitation may serve a socio-communicative function. Socialization practices interact with these innate competencies to influence the level of imitative performances later in life.

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ORCHIDS AND DANDELIONS: BDNF AS A MODERATOR OF ACCELERATED NEUROBEHAVIORAL DEVELOPMENT FOLLOWING EARLY LIFE STRESS

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Childhood exposure to adverse experiences increases the lifelong risk of developing pathology, including increased risk for anxiety,

depression and PTSD. Recent work has indicated that common genetic polymorphisms may confer individual differences in risk for these forms of pathology. The mechanisms underlying increased risk for pathology development, as well as those that confer individual differences in risk remain unknown. Using a mouse model of early life stress (ELS), in the form of limited maternal bedding from P4 to P11, we have found that ELS is associated with increased risk for cognitive and emotional disturbance later in life. These effects that are associated with precocious maturation of limbic brain centers, and developmental shift in the timed expression of trophic factors associated with regional maturation. Here we test the hypothesis that ELS induced elevations in BDNF expression, support stress-induced acceleration in regional and behavioral maturation. We further test in a mouse model, whether a common human variant in the BDNF gene (BDNF Val66Met) moderates the effects of ELS on the timing of regional and behavioral maturation. To test this hypothesis, we collected tissue from the hippocampus of mice across early development and assessed the effects of ELS on neurotrophin expression, markers of cellular and synaptic maturity, and behavioral development in a contextassociated threat conditioning paradigm. We find that ELS was associated with an earlier developmental rise in BDNF, precocious synaptic and interneuron maturation, and an earlier emergence of the latent period in contextual fear suppression. In BDNF Val66Met mutant mice, we find a significantly blunted response to ELS, with a failure of mice to show shifts in neurobehavioral development. The current data provide support for the hypothesis that accelerated maturation following ELS is in part supported by developmental and ELS-associated changes in BDNF expression, and that common variants in the BDNF gene can alter the neural and behavioral response to ELS.

NEURAL CORRELATES OF ATTENTION TRAINING IN YOUTH WITH ANXIETY DISORDERS

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Computer-based Attention Bias Modification Training (ABMT) reduces anxiety in youth, but little is known about its influence on neural indicators of attention. Past event-related potential (ERP) work suggests P2 as a biomarker of threat-related attention and has shown stronger P1, N170 and P3 components in high-anxiety adults and youth; no studies have investigated neural correlates of ABMT in youth. Thirty youth (*M* age = 11.97, SD 2.89) with primary DSM-IV-TR anxiety disorders (placebo group *N* = 16) completed a modified dot probe task during ERP measurement before, after, and eight weeks after (8WFU) ABMT in a randomized trial. Repeated measures ANCOVAs on P1, N170, P2, and P3 mean amplitude (POz, Oz) were conducted, with stimulus type (Neutral-Threat [NT] trials, Neutral-Neutral [NN] trials) as within-subjects factor and condition as between-subjects factor, at post-treatment and 8WFU. There were significant stimulus-type-by-condition interaction effects for P1 ($F(1,23) = 6.954$, $p = .015$), and P3 ($F(1,23) = 4.527$, $p = .044$) at post-treatment (POz): in the treatment group, P1 was significantly greater during NN trials than in the placebo group ($p = .03$), and the treatment group showed higher, but not significant, P3s during NN than during NT trials ($p = .193$). At 8WFU, a significant main effect of stimulus type for N170 ($F(1,21) = 6.092$, $p = .022$) revealed both groups showed stronger N170 responses for NN than for NT trials. Overall, ABMT led to increased neural processing of neutral stimuli; these findings may indicate biomarkers of ABMT's effects in youth and provide insights into possible mechanisms through which ABMT may reduce anxiety.

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BINGE EATING IN ADOLESCENT AND ADULT RATS: RISK FACTORS, CO-MORBIDITY AND BIOLOGICAL MECHANISMS

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Binge eating (BE) comprises repeated, intermittent over-consumption of palatable food in a short period of time, not necessarily motivated by hunger or metabolic demand. BE and drug seeking share similar features such as loss of control over consummatory behavior, withdrawal-like symptoms when the food or the drugs are not available and even craving. The aims of this study were to examine risks factors for BE and co-morbidity to drug addiction and to advance the understanding of neurobiological mechanisms. Using two animal model approaches to BE (representing trait and state BE) we found that adolescent rats are more prone than adults to BE episodes and that obese rats are also at high risk for BE (BE prone; BEP), compared to controls (more BE resistant; BER). In addition, BEP rats showed high motivation to obtain a large amount of preferred diet even when this predictably was followed by abdominal discomfort caused by lactose ingestion. This indicates pathological motivation for food. Furthermore, we found that the degree of BE predicted the pattern of craving for self-administered cocaine after it ceased to be available. Finally, mRNA expression of TH and DAT in the VTA and hypothalamic arcuate nucleus were correlated with levels of BE. Our findings in rats suggest that adolescents and in particular obese adolescents are at risk for BE. Furthermore, restricted access to an attractive diet was found to be correlated to heightened cocaine craving, particularly in BEP, and that the dopamine systems plays an important role in the control over BE.

MOTHER-CHILD FRONTAL EEG SYNCHRONY DURING INTERACTION TASKS

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Physiological synchrony is the process by which interaction partners coordinate with one another's physiological responses. Physiological synchrony has important implications for the mother-child relationship, in particular, because this relationship is considered critical in children's developing self-regulation of emotion, behavior, and overall well-being (Feldman, 2012). Specifically, mothers are thought to assist children in the modulation of arousal and attenuation of physical and psychological distress (Field, 2012; Uchino, 2004). We observed dyadic recordings of frontal EEG asymmetries of mothers and their 3-year old children to see if we could capture synchrony of this particular physiological response. We focused on frontal EEG asymmetry because this measure is conceptually and empirically meaningful in the emotion regulation research literature. Thirty-two typically developing 3-year-old children (21 girls, 11 boys) and their mothers visited the research lab for simultaneous EEG recordings during puzzle and building block tasks. We assessed frontal mother and child EEG asymmetry scores on a second by second basis to determine if there were linear patterns of physiological synchrony. The physiological linkage effect was statistically significant and stronger for mother-girl dyads, extending to a lag of 2 seconds. The effect was also statistically significant for mother-boy dyads, but weaker and extending only to a lag of one second. These findings suggest that mothers have different physiological synchrony with girls and boys. Implications for differences in interaction patterns between mothers with their daughters and sons will be discussed.

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EFFECTS OF ELEVATED PRENATAL TESTOSTERONE ON POSTNATAL AUDITORY LEARNING IN BOBWHITE QUAIL CHICKS

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Elevated yolk progesterone in bobwhite quail eggs has been shown to impair *prenatal* auditory learning, but facilitate *postnatal* auditory learning in quail chicks. In contrast, elevated yolk testosterone has been found to facilitate *prenatal* auditory learning, but its effects on *postnatal* auditory learning are unknown. This study assessed whether elevated prenatal levels of testosterone, within the naturally occurring range, would impair or facilitate postnatal auditory learning in quail chicks. Testosterone suspended in corn oil (T, n = 26) or corn oil vehicle alone (V, n = 39) was injected into the yolk of bobwhite quail eggs prior to incubation. Control eggs (C, n = 40) received no injection. Following hatching, chicks were exposed to an individual bobwhite maternal call (CALL A or CALL B) for 10 min every hour for 24 hr. Chicks were then tested for their preference for the familiarized vs. a novel maternal call (A or B) at 48 hr following hatching. Results revealed that chicks in the T, V, and C groups showed no preference for either the familiarized or novel maternal call, indicating that elevated levels of testosterone did not facilitate postnatal auditory learning. This finding shows differential effects of elevated testosterone on *prenatal* vs. *postnatal* auditory learning, as was previously reported for elevated levels of progesterone; however, the nature of the influence on prenatal vs. postnatal learning (interfere or facilitate) differed between the steroid hormones. Future research will address the possible mechanisms involved in this striking difference.

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MATERNALLY REGULATED PRENATAL LIGHT EXPOSURE EFFECTS SOCIAL MOTIVATION OF BOBWHITE QUAIL CHICKS

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Maternal influences on offspring occur not only during egg formation, but also during prenatal development in both birds and mammals. Previous work with precocial birds indicates prenatal maternal stimulation can influence postnatal perceptual and social preferences. Here, we examined the influence of one maternally regulated factor, prenatal light exposure, on the development of social motivation/responsiveness in bobwhite quail. During incubation, quail hens leave the nest intermittently during the day to find food and water; these bouts expose the developing embryo to intermittent prenatal light. The study's primary aim was to assess if the quantity or distribution of prenatal light exposure would influence neonatal social motivation. Quail embryos were incubated under one of four daily light exposure conditions: dark, intermittent light exposure, low-intensity light for 12-hours, or high-intensity light for 12-hours. After hatching, chicks from each light exposure condition were tested individually at 48, 72, or 96 hr of age. Chicks were video recorded during two testing sessions; one with four familiar broodmates present and one with broodmates absent. Total time near broodmates and the frequency of distress calls when broodmates were absent were analyzed. Results revealed chicks prenatally exposed to intermittent light bursts (mimicking natural hen behavior) showed higher social motivation in the presence of other hatchlings and more distress calls in their absence when compared to the low and high intensity light conditions, but not to the dark condition. Findings point to the role of maternal behavior during incubation on chick's early social development.

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THE ROLE OF DIVERSITY IN CHILDREN'S RECOGNITION OF NEWLY LEARNED BLACK, LATINO, AND WHITE CHILD FACES

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The other-race effect demonstrates that individuals typically have better memory for newly learned faces of their own race vs. newly learned faces of another race (e.g., Kelly, et al, 2008; Meissner & Brigham, 2001). The phenomenon is largely thought to stem from greater experience of facial characteristics in one's own racial group, explained by face space models that are norm-based (e.g. Valentine, 1991) or input-based (e.g., Nelson, 2001). The current study tested children's ability to recognize unfamiliar faces from the CAFE set of children's faces (LoBue, 2014; LoBue & Thrasher, 2015), across 3 different races (i.e., Black, Latino, White) that varied on distinctiveness. We familiarized 5- to 7-year-old children to faces one by one then tested recognition memory after a brief delay without any indication of the upcoming test because incidental or implicit recognition is a more naturalistic process since it eliminates differential use of individual memorization strategies during familiarization. Data were analyzed by hit vs. false alarm rates in which d prime results showed that children with more daily diversity (i.e., regular interactions with other-race neighbors, relatives, caregivers, and peers) recognized significantly more faces than children with less daily diversity. Children with more diversity showed equal memory for own and other race faces, suggesting routine experiences with diversity can counteract the traditional other-race effect. Furthermore, greater memory for other-race faces was more pronounced if other-race faces were rated as more distinctive or unusual as opposed to more typical or average-looking, again going against the traditional other-race effect phenomenon.

EARLY CAREGIVING INTERVENTION PROTECTS CHILDREN FROM THE DELETERIOUS IMPACT OF POVERTY AND MALTREATMENT EXPOSURE ON THE DEVELOPING BRAIN

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Children exposed to early life poverty experience an absence of normative input needed for typical brain development, which may explain risk for a broad number of neurocognitive delays. There is a need to identify protective factors that mitigate the influence of poverty, especially during this formative period of brain development. In a prospective longitudinal study, we examined whether poverty status and quality of home and caregiving environment predicted electrophysiological functional patterns of brain activity in middle childhood. Family SES and observations of home environment and caregiving quality were assessed during infancy and toddlerhood. Follow up assessments took place once children reached 8 years of age, and resting EEG was recorded for 6 min during an Eyes Open/Eyes Closed paradigm. Absolute and relative spectral power at theta, alpha, beta, and gamma band was computed from raw EEG data for analyses. Data from 87 children indicated that severity of poverty exposure was associated with more immature patterns of functional brain activity (relatively lower levels of alpha activity and higher levels of theta activity) in both absolute and relative frequency bands. Quality of early caregiving and home stimulating appeared to buffer children from the negative impact of poverty exposure on functional brain activity. Children who experienced higher levels of early life cognitive stimulation and caregiver responsiveness showed more normative patterns of resting EEG in middle childhood. Findings have critical implications for prevention and intervention targeting vulnerable children and families.

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ELUCIDATING THE MECHANISMS OF FEAR EXTINCTION IN DEVELOPING ANIMALS: A SPECIAL CASE OF NMDAR-INDEPENDENT EXTINCTION IN ADOLESCENT RATS

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NMDARs have been found to be critical for the consolidation of fear extinction in rodents across the lifespan with only one exception, infancy. In the current study, a possible second instance of NMDAR-independent extinction across development was tested. Although adolescents typically exhibit impaired extinction retention, some recent work has shown that rats that are conditioned as juveniles and then given extinction training as adolescents (JuvCond-AdolesExt) have good retention of extinction (indicating successful extinction consolidation). However, this good extinction retention is observed in the absence of an upregulation of the synaptic plasticity marker phosphorylated mitogen activated protein kinase (pMAPK) in the medial prefrontal cortex, a region considered critical for extinction consolidation. In the current study, rats received either the non-competitive NMDAR antagonist MK801 (0.1 mg/kg, s.c.) or saline 10 min prior to extinction training. Although juvenile rats exhibited impaired extinction retention after MK801 compared to saline, this effect was not observed in JuvCond-AdolesExt rats ($ns = 11–12$). Further experiments ruled out a number of alternative accounts for the lack of an effect of NMDAR antagonism on extinction retention in JuvCond-AdolesExt rats (e.g., that the animals were adolescents or had a delay between conditioning and extinction). These results provide evidence for yet another circumstance in which NMDARs are not required for successful extinction retention – that is, when rats learn fear as juveniles and undergo extinction as adolescents. Furthermore, our findings highlight the complexity of fear inhibition across development, particularly in adolescence.

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GUINEA PIG PUP ACCEPTANCE OF A NOVEL FOOD AFTER PRENATAL EXPOSURE TO MATERNAL HYPERTHERMIA

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Guinea pigs (*Cavia porcellus*) are naturally cautious when it comes to novel food items as many plant based foods can be toxic. Pilot testing suggests that adult animals take at least a week to acclimate to a novel food. However, we hypothesized that pups would learn to accept a novel food item faster though social learning. We also hypothesized that animals exposed to maternal hyperthermia (MHT) would acquire food preferences over a different time frame than control animals. Maternal hyperthermia is a potent prenatal teratogen that causes damage to proliferating cells in the fetal brain. We targeted the striatum of the basal ganglia by subjecting pregnant guinea pigs to a mild hyperthermia during mid-gestation. We have previously demonstrated in rats and mice that exposure to an antiproliferative during striatal development produces behavioral deficits in offspring consistent with developmental disability. After birth, 1–2 week old guinea pig pups were placed in a social enrichment pen and offered a novel food to which their mothers were already familiar. MHT animals acclimated to the novel food item faster than either the control animals or adults from previous studies, with the MHT animals spending 50–75% of their time in the novel food zone by day 3 of testing. Controls continued to be hesitant until day 5 of testing. These findings suggest social learning may play a role in guinea pig acclimation to novel foods. Further, impulsivity in the MHT animals may have implications for future research of food preference in children with developmental disabilities.

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TWO-HIT MODEL OF PRENATAL ALCOHOL EXPOSURE AND EARLY-LIFE ADVERSITY: IMPACT ON IMMUNE FUNCTION

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Prenatal alcohol exposure (PAE) has a significant impact on immune function, resulting in an increased risk of infections, alterations in immune organ development, and alterations in immune cell populations. Importantly, altered immune function can impact both physical and mental health. Specifically, the neuroimmune system is involved in brain development, with perturbations linked to cognitive deficits and mental health disorders. In addition, children exposed to PAE are more likely to encounter stressful and/or abusive environments during early-life, which can also impact immune function and brain development. Using a two-hit model, interactive effects of PAE and early-life adversity were explored, with outcome measures focused on immune/neuroimmune function. Our results indicate that the two-hit model has differential effects on males and females. In males, the combination of PAE and early-life adversity led to impairments in immune cell responses to challenge, whereas in females, immune cells were unaffected. Males also showed blunted cytokine responses to immune challenge both with PAE alone and in combination with early-life adversity, with only subtle dampening of cytokine levels in female rats. Taken together, these results suggest that males may be more vulnerable to immunosuppressive effects of PAE combined with early-life adversity, with females showing signs of resilience. Ongoing work aims to determine whether this pattern of vulnerability vs. resiliency also extends to neuroimmune parameters. Importantly, alterations in immune function have implications for a range of health-related outcomes and as such, further insight into immune alterations associated with PAE may lead to immune-based, and perhaps sex specific, intervention strategies.

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THE DEVELOPMENT OF FEEDBACK PROCESSING IN ADOLESCENCE: AN ELECTROPHYSIOLOGICAL STUDY

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The ability to process external feedback processing and adjust behavior to reach a goal is a core feature of human cognition. It is important to understand how feedback processing develops throughout adolescence because this developmental period is marked by maladaptive behaviors and poor decision-making. Traditionally, the Feedback-Related Negativity (FRN), a negative event-related potential (ERP) occurring approximately 250–350 ms after negative feedback, has been used as an index of feedback processing. However, literature utilizing the FRN to investigate development of feedback processing in adolescence is mixed. Given that the FRN reflects a time-domain signal composed of underlying theta and delta frequency band activity, conflicting results may be due to the contribution of both theta and delta frequencies in the FRN. In adults, feedback-related theta has been associated with the saliency of feedback, while feedback-related delta activity has been associated with processing secondary feedback features including outcome magnitude. Here, fifty-three 9 −15 year

olds completed a gambling task while EEG was recorded. We show that separately examining feedback-related theta and delta activity may provide more information as to the development of feedback processing than traditional FRN analyses. Correct and error FRN mean amplitude was not related to age. On the other hand, theta response to correct feedback decreased with age, while theta response to error feedback was not associated with age. Moreover, delta band activity during the time-range of the FRN was unrelated to age. These results demonstrate correct feedback is more salient to younger children, an effect that diminishes with age.

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ALTERNATED HINDLIMB STEPPING BEHAVIOR DEVELOPMENT AND SEROTONIN RECEPTOR PLASTICITY IN THE INTACT AND ISOLATED SPINAL CORD

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Examining stepping behavior in spinal transected rats can provide insights into the spinal and supraspinal mechanisms that regulate locomotion. This project examined changes in hindlimb stepping behavior in intact and spinal rat pups, as well as changes in serotonin receptor density in the lumbar spinal cord. Neonatal rats received a low-thoracic spinal transection or sham operation on postnatal day 1 or 5 (P1 or P5). Behavioral testing occurred on P5 or P10. On day of testing, subjects received an intraperitoneal injection of 3.0 mg/kg quipazine (a serotonin receptor agonist) or saline. Next, subjects were euthanized and spinal cords were extracted for immunohistochemistry. Serotonin receptor density in the lumbar spinal cord was analyzed using confocal microscopy. Quipazine-treated subjects showed significantly more alternated hindlimb steps than saline-treated subjects. Compared to shams, spinal subjects injected with quipazine showed significantly more hindlimb steps. For P10 quipazine-treated spinal subjects, significantly more stepping occurred in pups that received spinal surgery on P1 compared to on P5. For subjects that received spinal surgery on P1, significantly more stepping occurred on P10 than on P5. Upregulation of serotonin receptors in the ventral horn of lumbar spinal sections was observed in spinal subjects compared to shams. Findings suggest that stepping behavior evoked by quipazine in immature rats is influenced by age at spinal injury, age at testing, and serotonin receptor density in the lumbar cord. Thus, alterations in descending pathways cause changes in spinal circuitry that affects motor function and depends on developmental age.

MATERNAL CONTRIBUTIONS TO MOTHER-CHILD PHYSIOLOGICAL ATTUNEMENT IN LOW-INCOME LATINO/A DYADS

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Recent research indicates that physiological attunement between a mother and her child contributes to the organization of the child's stress response and regulatory processes early in a child's life. However, the influence of moderating factors, such as situational and behavioral variables, on dyadic attunement is not well understood, as some studies have reported discrepant findings. The current analysis extends the investigation of mother-child physiological attunement in a sample (N = 267) of primarily low-income Latino/a mothers and their 0-4-year-old children. Saliva was collected by mothers and their children at three time points across two consecutive days in their homes and assayed for the stress-related hormones cortisol (CORT) and alpha amylase (AA). Parallel growth curve modeling was used to predict child's CORT and AA from their mother's CORT and AA to assess attunement of a dyad's trajectories (slopes) and levels (intercepts) of physiological activity. Results revealed that dyads had significantly attuned CORT levels and that this relationship was moderated by maternal behavior. Specifically, mothers who displayed higher levels of harsh parenting during a semi-structured parent-child interaction had CORT levels that were more attuned to their child's compared to mothers who displayed lower levels of harsh behaviors. No attunement was observed within dyads for CORT and AA trajectories or AA levels. These results highlight the contribution of maternal behavior in moderating the physiological attunement of mother-child dyads and provide insight into understanding the dynamics of physiological co-regulation.

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CAN CHILDREN WITH SELECTIVE MUTISM EFFICIENTLY IDENTIFY EMOTIONS?: AN EYETRACKING STUDY UTILIZING NIMSTIMS

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Selective Mutism (SM) is a rare form of childhood social anxiety. Children with SM are characterized by a lack of verbal interaction in social settings (Viana, Beidel & Rabian, 2009). Research has suggested that in general, individuals with social anxiety disorders tend to show an attentional bias towards negative social cues such as faces representing negative and threatening emotions (Mueller, Hofmann, Santesso, Meuret, Bitran, & Pizzagalli, 2009). The goal of the current study is to examine baseline preference of children with SM to faces exhibiting positive, negative, and neutral emotions, as well as their processing efficiency for mapping emotion words onto the correct referent. The baseline preference of children with SM for faces exhibiting emotions could potentially lead to further understanding of

the attentional biases of children with social anxiety disorders. The concept of processing efficiency for emotion words builds upon the information processing research with dot probe tasks that finds socially anxious individuals exhibit a bias for negative affects. Eyetracking will allow for further understanding on how quickly SM children can process emotion words and identify the matching stimuli. 30 children, ages 4–10 with selective mutism were recruited from the *Brave Bunch Summer Program for Children with Selective Mutism* to participate in a battery of cognitive assessments as well as an eyetracking procedure employing an intermodal preferential looking paradigm utilizing NimStims. Based on previous research, we predict that they will show biased baseline preferences for negative affects and map negative emotion words quicker than trials testing positive emotion words.

BEHAVIORAL EFFECTS OF COMBINED ALCOHOL AND CANNABINOID EXPOSURE DURING A MODEL OF LATE GESTATION IN RATS

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Cannabis is the most commonly used illicit drug among pregnant women, and over half of pregnant women who report cannabis use also consume alcohol. However, the consequences of combined alcohol and cannabis exposure on fetal development are not well understood. The current study examined the effects of ethanol, CP-55,940 (a cannabinoid agonist; CP), or the combination on behavioral development. From postnatal days (PD) 4–9, a period of brain development equivalent to the third trimester, Sprague-Dawley rat pups received ethanol (5.25 g/kg/day) or sham intubation, as well as CP (0.4 mg/kg/day, i.p.) or vehicle. Behaviors were examined throughout development, beginning on PD 12. Motor development was delayed by ethanol, but advanced by CP; performance of subjects exposed to the combination was intermediate and did not differ from controls. In contrast, ethanol, but not CP, induced long-lasting changes in motor performance, leading to impairments that were more severe when combined with CP. Separately, both ethanol and CP increased open field activity, whereas the combination of ethanol and CP specifically impaired habituation. Finally, only ethanol impaired spatial learning, but both ethanol and CP separately increased thigmotaxis. Thus, developmental exposure to ethanol or CP disrupted behavioral development in unique ways and the combination produced the most severe effects within specific measures. Importantly, the combination increased mortality, possibly masking additional interactive effects. Nevertheless, these data suggest that prenatal cannabis exposure disrupts development and that effects may be more severe when combined with alcohol, which has important implications for public health policy.

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THREAT-BASED STRESS, BLUNTED CORTISOL RESPONSE, AND EXTERNALIZING BEHAVIOR IN ADOLESCENTS

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Stress and cortisol reactivity are consistently linked to adolescent externalizing behavior. Studies, however, typically fail to distinguish between types of experiences and assume different stressors influence development via the same mechanisms. Recent research indicates stressors may have differential associations with externalizing problems, and implicates cortisol reactivity as a moderator of these associations. The effects of higher cumulative stress on poorer mental health may be the result of specific experience of events related to interpersonal violence (i.e., threat exposure). This study examined associations between threat-based stress and externalizing behavior, and examined whether associations were moderated by cortisol reactivity among 162 adolescents referred to treatment for conduct disorder, delinquency, or exhibiting behavioral problems at home or school (M_{age} = 15.35). Threat- and non-threat based lifetime stress and urban hassles were assessed using the Life Events Scale and Urban Hassles Index, respectively. Externalizing behaviors were assessed using the Externalizing Problems subscale of the Child Behavior Checklist, and the area under the curve formula for cortisol awakening response (CAR_{AUC}) was used to assess cortisol reactivity. Age, ethnicity, and socioeconomic status were entered as control variables. Regression analyses indicated that threat-based lifetime events were significantly associated with externalizing symptoms, while non-threat based lifetime events were not. Both threat-based and nonthreat-based urban hassles were positively related to externalizing problems, and the association between threat-based urban hassles and externalizing problems depended on the youth's biological stress levels. Specifically, higher levels of threat-based urban hassles were associated with more externalizing behavior only among adolescents with blunted cortisol reactivity.

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THE INFLUENCE OF DONALD O. HEBB ON THE FOUNDERS OF THE ISDP

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Donald O. Hebb was a major contributer to many of the concepts in developmental psychobiology (Fentress, 1987, Dev. Psychobiol., 20, 103–109). Many of these ideas were presented in his book, The Organization of Behaviour (1949), but he continued to contribute ideas to developmental psychobiology throughout his career. Hebb's

concept that intelligence had two components, neurological and environmental, led him to conduct the first experiment on the effects of enriched environmental experience on learning and memory in rats in 1947. Hebb also showed that perceptual experience was necessary for proper visual development. His earlier studies investigated the effects of neural damage at different ages on cognitive functions. A critical reading of Hebb's papers indicates that he was ahead of his time in understanding the importance of a developmental psychobiological approach to the study of brain and behaviour (Brown & Milner 2003 Nat. Rev. Neurosci, 4, 1013–9). Many of the founders of the ISDP were interested in early experience and thus had a strong connection to Hebb's research. Many of the founders also used Hebb's theories in The Organization of Behaviour as explanations for their data, presenting possible mechanisms by which behaviour was regulated at a neurophysiological level. Some of the founders of the ISDP most closely related to Hebb's research were Victor H. Denenberg, John L. Fuller, John P. Scott, John A. King, Mark Rosenzweig and William A. Mason. This presentation examines how the work of each of the founders of the ISDP was related to Hebb's ideas.

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EEG ALPHA ACTIVITY MODULATED BY ACTION EXPERIENCE DURING EARLY CHILDHOOD

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Research with infants and adults has demonstrated that the electroencephalogram (EEG) mu rhythm, measured within the alpha frequency range over central sites, exhibits greater activation during the perception of actions with which the observer has first-hand motor experience (Cannon et al., 2014; Gerson et al., 2015). This modulation of mu activity suggests that the underlying neural mirroring system (NMS) may serve as a mechanism of action understanding by which representations of previous motor experience are activated during the perception of similar actions. However, associations between the mu rhythm and action experience during early childhood have not yet been studied. In the present study, we used an at-home training paradigm (Gerson et al., 2015) to manipulate children's (3–6 years; $N = 14$) and adults' ($N = 6$) active and observational experience with two tools. We then examined EEG mu rhythm (child: 7–10 Hz; adult: 8–13 Hz) desynchronization during the observation and execution of tool-use actions. A repeated-measures MANOVA revealed a significant Region × Experience interaction ($p = .02$), with greater desynchronization during perception of the active training task at occipital sites, $t(13) = 2.24$, $p = .03$, but not at frontal, central, or parietal sites ($ps > .10$). Preliminary analyses with adults, however, failed to indicate differential EEG activity as a function of action experience ($ps > .10$). Adult data collection is ongoing and future analyses will consider additional indices of NMS activity (e.g., frontal-parietal coherence, beta rhythm). We hypothesize that, during early childhood, active and observational experience differentially influence visual attention, which modulates occipital alpha rhythm desynchronization.

EMOTIONALLY GAZE-CUED OBJECT PROCESSING IN TYPICALLY AND ATYPICALLY DEVELOPING CHILDREN

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Social learning is dependent upon the ability to process emotional facial expressions. Research using ERP has shown that differentially processing negative emotional facial expressions can impact gaze following and processing of objects that have been gaze cued (Hoehl et al., 2008). The current study utilizes eye tracking to investigate this process in infants who are typically developing (TD, N = 67) and young children who have Autism Spectrum Disorder (ASD) and fragile X syndrome (FXS, N = 22). Both atypically developing populations present clinically with social impairments, but the link between social behaviors and emotional processing may be different in the two populations. In the current study a neutral or fearful face, with an object on each side, was presented on an eye tracker for one second. Next, the eyes on the face stimulus shifted gaze towards one object (target) for 5 seconds. Lastly, the objects were shown alone for 5 seconds. Children with FXS ($t(21) = 2.96$, $p = .008$) and TD ($t(66) = 7.31$, $p < .001$) visually prefer the target object on neutral but not fearful trials, while the ASD group's object processing did not differ by emotion or from chance levels. These findings suggest that the presence of a negative emotion may disrupt gaze following and object processing in TD and FXS groups, but not in children with ASD, who may not interpret the social cue at all. Future analyses will explore looking to the face during cueing to investigate the role that emotional face processing may play in the current findings.

THE ERROR-RELATED NEGATIVITY MEDIATES LONGITUDINAL RELATIONS BETWEEN BEHAVIORAL INHIBITION AND OBSERVED SOCIAL ANXIETY

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Behavioral inhibition (BI) is an early childhood temperament, characterized by negative reactivity and avoidance of novelty. This temperament is predictive of social reticence in childhood and increased risk of developing social anxiety in adolescence. Moreover, relations between BI and social anxiety are influenced

by the error-related negativity (ERN), a neural measure of performance monitoring sensitive to error salience. However, much of the research linking ERN to anxiety has been limited to survey-based anxiety assessments that may lack ecological validity; limited research has demonstrated a link between ERN and observed social anxiety in naturalistic social interactions. In the present study, children were assessed for behavioral inhibition at ages 2 and 3. At age 12, adolescents returned to the laboratory and performed a flanker task under two conditions: once while believing they were under peer evaluation, and once while not being observed. This methodology isolated social changes in error monitoring (social-effect-ERN). At age 12, adolescents also completed standard survey-based social anxiety assessments and were observed during a social interaction with unfamiliar peers. BI and social-effect-ERN both predicted greater observed social anxiety during the social interaction; observed social anxiety was also positivity related to parent and child reports of social anxiety. Critically, social-effect-ERN was found to mediate relations between BI and observed social anxiety. Collectively, these results are consistent with the notion that BI predicts later social reticence and anxiety. Moreover, the results identify a mechanism underlying this relation and provide the first evidence of a link between error-monitoring and observed social anxiety.

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BRAIN CORRELATES OF DOMINANT BACTERIA ACROSS DEVELOPMENT: A PROOF OF CONCEPT STUDY IN TYPICALLY DEVELOPING AND ADVERSITY EXPOSED CHILDREN

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We performed a proof-of-concept study in humans to establish the existence of brain-microbiome associations in youth, and examine their influence by early stress exposure. Community composition of the gastrointestinal microbiome and brain activity during an emotional faces task (performed in a magnetic resonance imaging MRI scanner) were examined in mid childhood-early adolescence. We examined two antagonistic bacteria in the gut (Bacteroides and Prevotella), and observed that they predicted opposing patterns of activity in the brain (particularly in the prefrontal cortex). Functional connectivity analyses of these prefrontal clusters revealed different connectivity patterns with the whole brain that had implications for anxiety

THREAT LEARNING VIA EMOTIONAL EAVESDROPPING IN THE TODDLER PERIOD

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Observational learning about threat is a common means of learning about danger in the environment. The current study examined whether observational threat learning occurred as early as the toddler period and whether this learning endured over a 2-week period. Toddlers were exposed to two novel toys (CS+ and CS-). For the CS+, toddlers witnessed a confederate scolding an adult when she played with the CS+ toy. For the CS-, toddlers witnessed a neutral reaction from the confederate. Following this observation, toddlers were placed in one of three conditions (immediate, surrogate, or delay). In the immediate condition, toddlers were given a chance to play with either toy (CS+ vs CS-), and they were significantly more likely to choose the CS- to play with. In the surrogate condition, toddlers were given the chance to decide for the adult which toy she should play with; toddlers who chose the CS+ spent more time looking at the adult as she played the toy than when the CS- was selected. In the delay condition, toddlers were again given the chance to play with either toy (CS+ vs. CS-) but after a 2-week delay. Toddlers showed evidence of memory retention over the 2-week period, again choosing the CS- more often than the CS+. These findings indicate that toddlers can learn about a social threat through observation and can apply this learning to agents even when it is not themselves. Moreover, observational learning can be maintained at least over a 2-week period during toddlerhood.

THE ROLE OF MICROGLIA IN COMORBIDITY BETWEEN ADOLESCENT ASTHMA AND ANXIETY

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Adolescent developmental is sensitive to perturbations affecting adult neuronal and behavioral processes associated with internalizing disorders. Asthma, a common chronic health challenge, affects 9% of U.S. adolescents, and often occurs with anxiety and depression. Little is known about neurobehavioral impacts of chronic adolescent asthma. Microglia, the brain's resident immune cells, activate after peripheral insult; over-activation is implicated in neuropsychiatric disorder development. The mechanism underlying asthma and internalizing disorder comorbidity, and microglia involvement in this relationship, has not been established. Our lab has developed a mouse model for chronic adolescent asthma, individually manipulating two components of

allergic asthma: airway inflammation (via repeated exposure to house dust mite extract, HDM) and labored breathing (via repeated exposure to methacholine, MCH). Our previously published results demonstrate that mice exposed to adolescent MCH had higher adult anxiety-related neurobiological and behavioral symptoms than unexposed mice. The present study tested acute effects of airway inflammation and labored breathing on microglia activation, immune marker expression, and corticosterone production in juveniles (postnatal day [P] 21) and near-adults (P56) at 0, 1, 2, 4, 8, or 24 hr after final asthma treatment. Classic pro-inflammatory cytokines (*IL-6*, *TNF-α*, *IL-1β*) were measured in lung, spleen, and hippocampus. Microglia markers (*Cd11b*, *Iba-1*) were examined in hippocampus. Corticosteroids were measured from serum and feces. Preliminary evidence indicates that weekly MCH exposure led to elevated *Cd11b* expression (indicative of increased microglial activity) compared to controls. Study results suggest that microglia may be involved in one specific pathway that leads to increased internalizing symptoms with asthma.

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EPIGENETIC EFFECTS OF PRENATAL MATERNAL EXPOSURES AND MODERATION THROUGH POSTNATAL MOTHER-INFANT INTERACTIONS

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The developing fetal brain is sensitive to *in utero* disruption in response to adverse maternal exposures. We have been exploring the epigenetic impact of prenatal exposures in animal models and humans to build a translational framework. In the first series of studies, we exposed pregnant mice to bisphenol A (BPA) and examined behavior, brain gene expression, and epigenetic outcomes. We then conducted epigenetic analyses on cord blood samples from a human cohort in which there was prenatal BPA assessment. In a second series of studies, we assessed prenatal psychosocial stress in mothers during pregnancy and conducted epigenetic analyses of human placentas. We then examined gene expression in rodent placentas after chronic stress during pregnancy. We determined that: 1) in mice, prenatal BPA leads to increased epigenetic silencing of the brain-derived neurotrophic factor gene (*Bdnf*) and impaired memory in male offspring; 2) elevated gestational BPA exposure is associated with epigenetic silencing of *Bdnf* in human cord blood samples (in males only); 3) maternal stress during pregnancy is associated with increased epigenetic silencing of 11β-hydroxysteroid dehydrogenase 2 (*Hsd-11β2*) in human placentas and 4) in prenatally stressed rodents, placental expression of *Hsd-11β2* is decreased. We also find evidence that both BPA and maternal stress alter the frequency of postnatal mother-infant interactions and that these postnatal experiences can serve to moderate the neurobiological and behavioral impact of prenatal adversity. The integration of cross-species approaches strengthens the causal inferences that can be made when predicting the impact of experience on long-term outcomes.

EFFECT OF AUTISM SEVERITY ON NEURAL SUBSTRATES OF LANGUAGE APTITUDE

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Previous studies have examined sex differences in brain volume of ASD (Bloss and Courchesne 2007). However, little research has been conducted on autism severity. Here, we assess whether autism severity is associated with cortical thickness underlying language aptitude. USC, UCLA, Seattle Children's Institute, Harvard, and Yale were involved in data collection. The sample comprised of 48 ASD girls and 54 ASD boys, ages 7 to 17. Diagnosis was based on the Autism Diagnostic Interview-Revised. Language aptitude was defined as ability to formulate sentences, evaluated by the Clinical Evaluation of Language Fundamentals. Freesurfer was used to determine cortical thickness for 146 regions obtained from the Destrieux atlas. MANOVA analyses were performed on all cortical regions, with ASD severity and formulated sentence score as independent variables. MRI scanner type, pubertal status, and handedness served as covariates. Multiple comparisons were taken into account by using a stringent $p < .01$. An ASD severity by language score interaction existed in the right occipital pole (p=.002) and left inferior precentral sulcus (p=.001) of ASD girls. For ASD boys, the interaction existed in the right postcentral gyrus ($p = .001$), right postcentral sulcus (p=.005), right parieto-occipital sulcus ($p = .006$), right intraparietal sulcus and transverse parietal sulci (p=.005), and left superior temporal sulcus ($p = .008$). Our results suggest that ASD boys' brains are far more dependent on the relationship between ASD severity and language ability than girls. They also display greater right hemispheric cortical thickness laterality for language tasks than ASD girls, instead of the left hemisphere usually seen in typically developing children.

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DIMENSIONS OF ADVERSITY IN RESTING STATE FUNCTIONAL CONNECTIVITY OF THE AMYGDALA AND HIPPOCAMPUS

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In neurodevelopmental studies, adversity has largely been defined by utilizing composite scores collapsing across multiple domains. This

approach potentially obscures unique mechanistic effects of multiple, frequently co-occurring dimensions of adversity, such as abuse and neglect. This project aims to characterize differences in resting state functional connectivity (rs-fcMRI) associated with abuse and neglect across community and high-risk (children with involvement in the child welfare system) samples of adolescents aged 11–18 years (current N = 103). A robust literature implicates early adversity in altering the structure, function, and connectivity of the amygdala and hippocampus. We examined rs-fcMRI correlations between BOLD signal in four seed regions (bilateral amygdala and hippocampus) and a whole-brain parcellation (Gordon et al., 2014). Next, we evaluated which of the following four regression models best explained variation in correlations between each parcel and seed region using likelihood statistics and AIC: 1) a null model, 2) a neglect only model, 3) a model with neglect and abuse as main effects, or 4) a model also incorporating an interaction term for neglect and abuse. Considering connections best explained by models 2–4 only, preliminary findings suggest that the neglect only model explained the most variation in connectivity strength between our connections of interest. However, for the left amygdala, the interaction model best explained variation in connectivity strength, particularly for regions of the dorsal attention and visual networks. Overall; this suggests that rs-fcMRI studies of adversity may benefit from separate considerations of neglect and abuse.

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ATTENTION SHIFTING IN YOUNG CHILDREN WITH FRAGILE X SYNDROME

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Fragile X syndrome (FXS) is a genetic disorder caused by a trinucleotide CGG expansion within the *FMR1* gene located on the X chromosome. Infants with FXS are impaired in dynamic visual attention processing, which relies on processes of attention shifting that require disengagement of attention from the first stimulus to fixate on a second. The present study investigated attention shifting and orienting in 21 young children with FXS and 21 mental age matched typically developing (TD) children using infrared eye tracking. Attention shifting was assessed using a modified gap-overlap task. On gap trials, the central stimulus disappeared before the peripheral target appeared, and on overlap trials, the central stimulus remained present when the peripheral target appeared. A gap effect emerges when latencies to shift to the peripheral target are longer in overlap conditions, reflecting the recruitment of cortical disengagement mechanisms. Visual latencies to saccade to the peripheral target were measured. Preliminary results show the expected gap effect in the TD group: participants are slower to orient to peripheral targets on overlap trials than on gap trials (t (20) = −2.9, p = 0.008). There was no significant gap effect in the FXS group indicating that children with FXS are shift attention to the peripheral target at the same speed regardless of the presence or absence of a central stimulus (t (19) = −0.96, p = 0.34). These finding suggest atypical attentional disengagement patterns in FXS that may be underlying impairments in attention shifting, and suggest potential targets for attention training in this population.

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SCIENCE COMMUNICATION IN THE 21ST CENTURY

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Throughout history, the media has played a powerful role in dictating the facts. As communications become increasingly fast-paced, does the race to publish pose a threat to the truth? What lessons can research take from journalism when it comes to promoting evidence-based knowledge? Both academic and mainstream publishing is facing a paradigm shift, as we move increasingly into online formats and away from print. How will researchers and publishers adapt to this changing landscape? Dr. Lisa Chong will share her invaluable insights into why science communication is more important in the 21st century than ever before – and what she sees for the future of research dissemination. She will also discuss her career journey from researcher to editor; including the challenges she faced along the way.

TRAINING EFFECTS OF ATTENTION BIAS MODIFICATION ON ERROR-RELATED NEGATIVITY IN YOUTH WITH ANXIETY

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Attention to threat bias in individuals with anxiety may be trained via Attention Bias Modification Training (ABMT) as a potential treatment for anxiety. However, little is understood about ABMT's influence on underlying neural correlates associated with anxiety, such as the error-related negativity (ERN). One session of ABMT decreases ERN amplitude but this has yet to be shown for individuals with anxiety who typically receive additional sessions. The current study examined the ERN during the Erickson Flanker task in youth diagnosed with anxiety who either received eight ABMT (EXP, N = 10, 13.2 years) or eight placebo (CON, N = 11, 10.18 years) sessions. Post-error slowing and ERN amplitude at frontal-central sites were assessed before (PRE), immediately after (POST), and 2 months after (2 MO) treatment. No differences between EXP and CON groups on post-error slowing were found. However, both groups showed a decrease in post-error slowing between PRE and POST assessments (t(20) = 2.065, p = .052). The

immediate (PRE to POST) and sustained (PRE to 2 MO) effects on ERN amplitude were examined. Changes in ERN amplitudes from PRE to POST did not differ between EXP and CON. However, there was a marginally significant group x time interaction effect ($F(1,20) = 3.25$, $p = 0.090$) from PRE to 2 MO, demonstrating that there was a decrease between PRE and 2 MO ERN only within EXP and not CON. These preliminary results suggest that ABMT may not have immediate effects on underlying neural correlates of anxiety but that these effects may be delayed trained effects which manifest months after treatment has ended.

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MATURATIONAL EFFECTS ON SLEEP/WAKE PATTERNS IN INFANTS RECEIVING AN INFANT FORMULA WITH A PREBIOTIC BLEND

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Sleep/wake patterns undergo rapid nocturnal sleep consolidation and maturation of wake rhythm during the first 6 months of age. The effects of diet on sleep-wake entrainment, and gut-brain axis connections require further study. This pilot study tracked longitudinal development of 24-h sleep/wake organization in healthy term infants randomized to one of two formulas from baseline (14–35 days of age) up to 112 days of age: routine cow's milk-based infant formula without added prebiotics (Control; n = 82) or with a prebiotic blend (polydextrose [PDX] and galactooligosaccharides [GOS]; 4 g/L, 1:1 ratio) (PDX/GOS; n = 79). Infants wore actigraph devices at three study timepoints (consecutive 72-h periods); 24-h sleep-wake variables were averaged from collected motor activity data (baseline, n = 157; Day 70, n = 133; Day 112, n = 129) and analyzed by repeated measures ANOVA. A total of 131 infants completed the study; complete actigraphy data (all study timepoints) was available for 124 participants. Significant age-related changes ($p \leq 0.018$) were demonstrated by study end: total nocturnal time awake and duration of wake episodes (mean) decreased; total diurnal wake time increased and number/duration of naps decreased. In addition, the PDX/GOS group demonstrated significantly longer latency (minutes) to first and second nap ($p \leq 0.028$) since wake-up time relative to Control at Day 112; this suggests improved consolidation of waking states in infants receiving prebiotics. Results provide further support for home-based actigraphy to assess sleep/wake patterns throughout the first months of life. Moreover, the effect of the prebiotic blend on wake organization is consistent with an influence on the gut-brain axis.

[The study was funded by Mead Johnson Nutrition (MJN; Evansville, IN)]

SOCIAL BUFFERING REDUCES PLASMA CORTICOSTERONE LEVELS AND AMYGDALA ACTIVITY FOLLOWING STRESS EXPOSURE IN JUVENILE RATS

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Stress exposure results in elevated plasma corticosterone (CORT) in 17-day-old pre-weanling rats. Rats who receive social support (social buffering) by being returned to their cage mates and mother following the stress exposure have significantly lower levels of CORT relative to rats who are deprived of social support (e.g. maternal separation) by being placed in a novel environment following stress exposure (Gallimore et al., 2015). Because the amygdala plays a crucial role in the stress response as well as social buffering of stress, the present study examined activation of amygdala in response to a stress exposure (repeated periorbital shock to the left side of the face) followed by either social support or social isolation. Activation in the central nucleus of amygdala, a key region for fear responses, was measured using immunohistochemical analysis of brain tissue for production of the immediate early gene, zif-268. Rats placed in isolation following stress exposure showed significantly higher activation of both the left and right amygdala relative to home cage controls, though activation on the right was considerably less. Social buffering immediately after the stress exposure resulted in significantly lower amygdala activation on the left side compared to isolated animals. Both left and right amygdala activation following social buffering was not significantly different than that of home cage controls. These data contribute to the literature on social buffering as a powerful psychological and physiological method of reducing stress in young mammals.

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EVOLUTION OF ODOR MIXTURE PERCEPTION FROM BIRTH TO WEANING IN THE RABBIT

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Extracting relevant information from highly complex environments is mandatory to survival. In olfaction, young organisms already have to deal with surroundings (e.g., mother's body, nest, social group) composed of a huge diversity of molecules (odorants). These odorants are usually not perceived alone but within complex mixtures. In the rabbit, newborns have been shown to perceive binary odor mixtures either in the elemental way (i.e., as independent elements carrying their own odor qualities) or weak configural way (i.e., as a novel and specific quality in addition to those of the elements). Here, using a selection of three odor mixtures known for

their mode of perception in rabbit neonates (AB: configural, A'B' and AC: elemental), we compared, for the first time in a mammal, the evolution of perception from the neonatal period (PND 2) to the second postnatal week (PND 9) and preweaning period (PND 24). To that goal, pups were conditioned to a mixture or to one of its elements during a nursing episode (i.e., during the unique daily contact with the mother) and tested for their oral responsiveness to the single odorants and mixtures. Results showed that: 1) the perception of the AB mixture became more configural between PND 2 and 9; 2) this change was not observed for A'B' and AC; however 3) the perception of A'B' became weak configural at PND 24. Thus, this study suggests that, based on chemical composition and biological significance, the perception of certain odor mixtures changes over early development in the rabbit.

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SOCIAL ANXIETY AND NEURAL RESPONSES TO SOCIAL FEEDBACK AND EXCLUSION IN ADOLESCENCE

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Social cues from peers take on heightened significance during adolescence. This developmental period is particularly challenging for youth with elevated sensitivity to negative social cues. Examining individual differences in responses to social cues during adolescence may yield insights into which youth are at risk for developing social anxiety disorder. We report results from an electroencephalography study of youth ages 12 to 17 (current $n = 49$; data collection ongoing) who completed two social paradigms. Using an adaptation of the Social Judgment Task, participants are told that their picture was rated as being "liked" or "disliked" by unfamiliar peers. Participants then view pictures of unfamiliar peers and, after rating whether they expect to have been liked by that peer, they receive explicit acceptance or rejection feedback. Preliminary analyses reveal that unexpected vs. expected rejection elicited larger P3 ($t_{36} = 3.1$, $p = .02$) and frontal negative slow wave ($t_{36} = -2.8$, $p = .04$) amplitudes. In the second paradigm, the Cyberball task, participants toss a ball with two other players who at first play fairly but subsequently exclude the participant from the game. We have shown that a frontal negative slow wave to exclusion events in this task is associated with subjective ostracism-related distress (Crowley et al., 2010). This presentation will explore how youths' neural responses to peer rejection and social exclusion across these two tasks relate to their social anxiety symptoms (brief Fear of Negative Evaluation Scale, Social Phobia and Anxiety Inventory for Children).

[Mind & Life Institute 1440 Foundation to MJC; NIH T32 MH18268 to MJC and CJW]

EMERGING SENSORIMOTOR NEURAL RHYTHMS IN 6- TO 9-WEEK-OLD INFANTS

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A central problem of social cognition is, *how does the brain encode others' actions and how do these systems develop?* Part of the answer is hypothesized to lie in the brain's "neural mirroring" properties found in the electroencephalogram (EEG) mu rhythm. The mu rhythm is suppressed when executing an action and when observing others perform the same action. It is unknown *when* human infants first exhibit mu rhythm desynchronization (MRD; suppression of EEG activity). Newborn rhesus macaque monkeys suppress 5–6 Hz EEG activity when observing and executing facial gestures (Ferrari et al., 2012). In the present study, we examined emerging sensorimotor EEG activity in 6- to 9-week-old infants engaged in a series of tongue protrusion, mouth opening, and neutral face (baseline) observation and execution trials (Ferrari et al., 2012; Meltzoff & Moore, 1992). Analyses focused on 2.5–4.5 Hz MRD based on prehension execution MRD findings in 3-month-olds (Berchicci et al., 2011). One-sample *t*-tests determined whether MRD was significantly less than zero (i.e., a significant decrease in mu rhythm power from baseline). Preliminary analyses, based on usable data from 13 infants, revealed significant MRD at central sites during the observation of both gestures, but not in response non-biological motion (i.e., spinning disc). Similar to findings with older infants, concurrent analyses of MRD at occipital sites were non-significant. Future analyses will determine whether this frequency band exhibits mirroring properties by including a larger sample with sufficient artifact-free execution trials. Potential implications for the "Like-Me" (Meltzoff, 2007) developmental psychological framework will be discussed.

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ROLE OF DOPAMINE 1 AND DOPAMINE 2 RECEPTORS ACROSS ADOLESCENCE IN ADDICTION-RELATED BEHAVIOURS

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Adolescent abuse of methamphetamine (meth) is a significant public health concern worldwide, and a growing problem in Australia; however, few studies have investigated addiction in adolescence. Drugs of abuse active dopamine receptors in brain regions implicated in reward processing. We firstly aim to investigate the developmental trajectory of dopamine receptor 1 (D1R) and 2 (D2R) expressing neurons in the striatum, prefrontal cortex and insula cortex across adolescence. Secondly, we aim to examine potential age differences in meth conditioned place preference (CPP) in adolescent and adult mice

and investigate the involvement of D1R and D2R expressing cells in these behaviours. We hypothesise that adolescents form stronger meth CPP compared to adults, which is associated with age differences in D1R- and/or D2R-expressing cells in discrete neural regions. Preliminary stereology data showed male dorsal striatum volume and D1R cell population and density do not change across adolescence (p's>0.05). Our meth CPP study observed that mice, irrespective of age, acquired meth CPP at doses of 0.1 and 0.3 mg/kg (p's<0.001), but not 1 and 3 mg/kg (p's>0.05). At the 3 mg/kg dose, there was a weak trend for an adolescent propensity to form a preference versus aversion (p = 0.1). Seven sessions of extinction reduced the meth CPP in adult compared to adolescent mice at 0.1 mg/kg dose (p < 0.05), but not with 3 mg/kg meth (p > 0.05). Taken together, results suggest male dorsal striatum volume and D1R cell population and density are similar across development and therefore unlikely to explain differences in meth CPP behaviours in adolescent compared to adult mice.

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AN ANALYSIS OF THE TIME-FREQUENCY AND TOPOGRAPHIC PROFILES OF INFANT EEG SENSORIMOTOR MU RHYTHM

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The mu rhythm is believed to reflect human mirror system activation in adults and infants. However, this notion has recently been challenged, partly because of difficulties in separating sensorimotor mu rhythm activity from occipital alpha activity. To address this issue, the present study employed time-frequency analyses along with a current source density (CSD) transformation to infant EEG. CSD transformation removes cortical activation due to volume conduction, and time-frequency analysis reveals the temporal profile of cortical activity throughout a task. EEG was recorded while 37 9-month-old infants executed grasping actions and observed an experimenter grasping. Analyses focused on the 6–9 Hz frequency range, which captures alpha/mu activity in infants. As expected, there was significant mu suppression throughout the time course of the execution trials that was strongest in the motor region (C3/C4). Moreover, even after removing volume condition via CSD transformation, significant mu suppression was evident over sensorimotor regions (C3/C4, P3/P4) in the observation condition, consistent with mirror system activation. Independent alpha suppression over visual cortex was also present. Critically, mu suppression during the observation condition was significant about 800 ms (t_{36} = −4.420, p < .001) before onset of the experimenter's movement and remained significant through 400 ms post-movement onset. The pre-movement mu suppression might be related to the action prediction. Collectively, the results confirm the utility of mu suppression as an index of infant mirror activity and suggest that unique insight into dynamics of the infant mirror system can be gleaned from accounting for the temporal profile of these effects.

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CORTISOL MODERATES THE ASSOCIATION BETWEEN CUMULATIVE EXPOSURE TO POVERTY AND ADJUSTMENT PROBLEMS IN PRESCHOOL

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Children growing up in poverty are at increased risk for socioemotional and adjustment problems that can persist throughout the lifespan. A growing literature suggests that altered levels of stress hormones, and their effects on brain structure and function, may be one pathway through which poverty adversely affects socioemotional development. Using data from the Family Life Project (N = 1,292), a prospective longitudinal sample of children in predominately low-income and rural communities, this study explored the extent to which stress physiology (as indicated by child cortisol levels adjusted for time of day) operates independently and interactively with years spent below the poverty line to predict anxiety and internalizing symptoms in preschool (M age = 3.5, SD = .5). Main effects analyses indicated that cumulative time in poverty as well covariates including early temperament (distress to novelty) and maternal depression were each uniquely associated with preschool anxiety and internalizing as rated by mothers. There were no statistically significant main effects between cortisol levels and anxiety or internalizing symptoms. Time spent in poverty statistically interacted with cortisol such that children experiencing more years below the poverty line in combination with higher levels of baseline cortisol displayed significantly more internalizing and anxiety problems in preschool. The results highlight how early adversity, specifically cumulative exposure to poverty, gets under the skin to alter physiological functioning in ways that may lead to a heightened risk for child psychopathology.

[NICHD grant # R01 HD051502 to CBB]

MEASURING STRESS REACTIVITY IN THE FIELD: DEVELOPING A HOME-BASED TSST AMONG A HIGH POVERTY SAMPLE OF ADOLESCENTS

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Stressor paradigms are essential tools for studies investigating neurobiological mechanisms linking stress reactivity with mental and physical health outcomes, especially among youth growing up in high-stress contexts such as poverty. The Trier Social Stress Test – Child

(TSST-C) is a widely used laboratory stressor that has been shown to induce arousal across multiple biological systems. This task has previously been used in lab-based settings leaving harder to reach populations underrepresented in the literature. The present study developed and tested a home-based TSST among a high poverty sample of adolescents (M age = 12.72) participating in the Family Life Project (N = 1292). Home visitors were trained to administer an adapted version of the TSST-C using a pre-recorded adolescent sham panel matched on participant gender and race. Measures of the stress response included cortisol and alpha amylase (sAA) from saliva, blood pressure, and heart rate assessed at baseline, 5 min post, 20 min post, and 40 min post. Analysis of data from the first 100 participants indicated that youth experience a sympathetic response characterized by increasing sAA and diastolic blood pressure but do not exhibit a cortisol response. Over 70% of children believed the sham panel was live and over 85% of children felt both the speech and math tasks were 'somewhat' or 'very' stressful. Preliminary analyses suggest that the TSST-C home version may serve as a promising adaptation for high-risk hard to reach populations.

[NIH grant # R01 HD081252 to CBB]

MYOCLONIC TWITCHES DURING ACTIVE SLEEP DRIVE COORDINATED ACTIVITY IN THE NEWBORN RAT CORTICO-HIPPOCAMPAL NETWORK

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Active sleep (AS, or REM sleep), which is most abundant during the perinatal period, has long been considered an important contributor to early brain development. Using infant rats, we recently showed that AS facilitates the expression of functional connectivity in the network that comprises the hippocampus and the red nucleus, a brainstem sensorimotor structure (Del Rio-Bermudez, *Current Biology*, 2017). Specifically, when continuous neural oscillatory activity in the local field potentials (LFPs) emerged by the end of the second postnatal week, coupled oscillations in the theta-frequency band (4-7 Hz) in both structures were only evident during AS. Critically, before emergence of continuous oscillatory activity, brief bursts of neural activity in the hippocampus and associated networks—including the red nucleus and somatosensory cortex—were observed in close temporal association with AS-related myoclonic twitches. It was not clear from that study, however, whether twitches are necessary for the earlier expression of coordinated activity within hippocampal-dependent networks. Here we test the hypothesis that twitches drive functional connectivity between hippocampal CA1 and the barrel field of somatosensory cortex (S1BF). Using unanesthetized 8-day-old rats, we recorded from both structures to characterize twitch- and state-dependent spontaneous activity. Preliminary findings are indicating that spontaneous multiunit activity (MUA) and oscillatory events in the LFPs of both S1BF and CA1 are significantly higher during periods of twitching. In addition, when whisker twitches occur, they trigger more coherent neural activity between S1BF and CA1. Therefore, our results are supporting the hypothesis that AS-related twitching helps to synchronize activity between the somatosensory cortex and hippocampus before continuous oscillations emerge.

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EPIGENETIC MECHANISMS OF SPINAL PLASTICITY IN EARLY DEVELOPMENT

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While the role of epigenetic mechanisms in central nervous system (CNS) development has been rapidly gaining attention in recent years, research has largely focused on the brain. Data from studies of epigenetic modifications in the spinal cord are currently limited to mechanisms of injury outcomes or pain and are generally conducted outside of developmental windows. To our knowledge, no studies have been done to investigate epigenetic trajectories in the developing spinal cord and if those trajectories dovetail with the dynamic manner in which this region of the CNS responds to environmental perturbations. Given that spinal cord plasticity is greater during early development and is somewhat preserved by transection, and that epigenetic alterations have been heavily implicated in brain plasticity and are highly responsive to experience, these alterations are promising candidates for molecular substrates of spinal plasticity. Here we investigate epigenetic modifications of the *brain-derived neurotrophic factor* (*Bdnf*) gene, a neurotrophin heavily involved in both development and plasticity, in the spinal cord of infant rats following early spinal cord transection. Male Sprague-Dawley rats received a low thoracic spinal cord transection or sham surgery on postnatal day (PD) 1 and were then allowed to mature to either PD5 or PD10 at which point lumbar spinal cord tissue was harvested for nucleic acid extraction and methylation analyses. Data indicate significant group differences in *Bdnf* expression accompanied by differential methylation of a specific locus (exon IV) of this gene. Results will be discussed in the framework of mechanisms underlying spinal cord development and plasticity.

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PHARMACOLOGICAL INHIBITION OF STRESS-INDUCED EPIGENETIC TRACES

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Early, adverse experiences confer vulnerability to aberrant brain development and behavioral outcomes, particularly when these

experiences occur within the caregiving relationship. The mechanisms by which these aberrant trajectories occur have yet to be elucidated, though some promising candidates have been identified. One of these candidates is DNA methylation, an epigenetic mechanism that is highly responsive to experience and associated with several stress-induced behavioral abnormalities. Using the scarcity-adversity model of low nesting resources, our lab has previously reported increased methylation of *Bdnf* exon IX in the prefrontal cortex of maltreated infant rats. The aim of the current work is to determine if administration of epigenome-modifying drugs concurrent with maltreatment is sufficient to prevent this altered state of methylation. Infant male and female Long Evans rats were subjected to either nurturing care (from their biological mother or a foster dam) or maltreatment from a foster dam for 30 min daily from postnatal days (PN) 1 to 7. Various doses of either HDAC or DNMT inhibitors were administered daily to each group prior to caregiving manipulations. Brains and plasma were extracted 24-hours after the last manipulation (PN8) for methylation assays. Data indicate that inhibition of both HDACs and DNMTs prevent methylation alterations associated with caregiver maltreatment. Given that previous work from our lab has uncovered maltreatment-specific behavioral abnormalities in adult rats, the current work is viewed as an initial step in understanding the relationship between changes in the epigenome and behavior induced by our model of early stress.

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DIFFERENCES IN STATE-DEPENDENT RESPONSES TO SENSORY FEEDBACK BETWEEN SOMATOSENSORY AND MOTOR CORTEX IN DEVELOPING RATS

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In the developing rat, myoclonic twitches occur in skeletal muscles across the entire body during active sleep (AS, or REM sleep). The sensory feedback from these twitches strongly drive neural activity throughout the sensorimotor system. Further, early in development, the motor function of primary motor cortex (M1) has not yet developed, and thus neural activity in M1 is primarily related to sensory input. We have recently shown that in the region within M1 that represents the forelimb, reafference from forelimb twitches results in substantially more neural activity than reafference from wake movements. This raised the following question: Is this state-dependent difference in the magnitude of reafferent responses unique to M1, or is it a more general feature across sensorimotor cortex. To answer this question, using 9- to 11-day-old rats, we recorded from neurons in the regions of M1 and primary somatosensory cortex (S1) that are responsive to forelimb movements. We then examined the neural activity in the period immediately after forelimb twitches and wake movements. Consistent with previous findings, we found that both S1 and M1 show strong responses to forelimb twitches. However, unlike M1, S1 shows equally strong responses to wake movements. This finding indicates that M1 and S1 process wake-related movements differently and highlights the unique ability of AS-related twitches to activate the entire somatomotor neuraxis. Combined with our previous work showing state-dependent gating of reafference in the medullary external cuneate nucleus, this result suggests a segregation of the sensory pathways providing reafference to S1 and M1 in the developing rat. Determining the mechanisms and pathways involved in this segregation is one focus of current work.

[NIH grant R37 HD081168-02 to MSB]

TESTING THE PUBERTAL RECALIBRATION HYPOTHESIS: DOES PUBERTY ALTER CORTISOL REACTIVITY TO SOCIAL STRESS AS A FUNCTION OF CURRENT LIFE STRESS AND HISTORY OF ADVERSITY?

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Individuals who experienced severe early life adversity have twice the risk for emotional problems during adolescence as individuals without adversity. Puberty may be a time when emotional problems surface or worsen. Pubertal changes in the hypothalamic-pituitary-adrenal (HPA) axis may underlie these problems, as altered patterns of HPA activity have been associated with psychopathology. For individuals experiencing changes in environmental risk, puberty may induce a "recalibration" of neurobiological systems to match the current environment and subsequently affect risk for psychopathology. Our work examines whether the HPA axis recalibrates across puberty to match current stress levels and whether adaptation differs by history of institutional deprivation. To test this hypothesis, children and adolescents (7–15 years) with and without a history of institutional deprivation were interviewed about current life stress, underwent a nurse's exam for Tanner staging, and completed the Trier Social Stress Test to measure cortisol reactivity. Results support the hypothesis that puberty is a time of HPA reorganization based on current stress. However, puberty appears to be a more salient time for reorganization for those who experienced early deprivation. Post-institutionalized adolescents currently in low-stress environments appear less stress-reactive *later* in puberty than *earlier* (possible recalibration to a low-stress environment). Post-institutionalized adolescents in high-stress environments earlier in puberty demonstrate *blunted* cortisol reactivity while those in later puberty show *heightened* reactivity (potentially sensitizing to a stressful environment). The results may challenge hypotheses on the direction of stress effects on HPA activity across

puberty. Longitudinal data, which are forthcoming, will allow for more definitive conclusions.

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UTILIZATION OF SALIVARY EPIGENOMICS TO DEFINE MECHANISTIC PATHWAYS LEADING TO LASTING ALTERATIONS IN HPA FUNCTION FOLLOWING EARLY SEVERE SOCIAL DEPRIVATION

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Leveraging data from the Bucharest Early Intervention Project (BEIP), the only randomized trial of foster care compared to continued institutional rearing, salivary epigenomics were collected during the Trier Social Stressor Test at age 12. A stepwise analytic approach examined whether epigenetic changes were correlated with gene expression and cortisol. Matched whole genome methylation arrays (Agilent) and gene expression arrays (Illumina) were obtained from 20 individuals enrolled in the BEIP, 8 care as usual (CAUG), 6 foster care (FCG) and six never institutionalized controls (NIG). Expression arrays were run on saliva samples obtained from baseline and expected peak cortisol reactivity in the TSST and hybridized to detect only genes that demonstrated significant changes in gene expression. 367 differentially methylated regions were detected between the CAUG and the NIG: 355 hypomethylated regions, 12 hypermethylated ($p < .00001$). The most significantly differentially methylated gene in each region was selected and tested for correlation with expression data. 24 genes were significantly correlated between methylation and change in gene expression. One methylation site in JAK1 (cg15997411) and two sites in CALD1 cg15709214 and cg15709214 were significantly associated with gene expression and cortisol. These results indicate that methylation predicted fold change in gene expression and cortisol response to the TSST. Given the established evidence that cortisol levels differed as a result in institutional rearing this data provides the first mechanistic evidence that methylation differences in JAK1 and CALD1 are correlated with early caregiving group, predict gene expression levels and are associated with concurrently obtained cortisol.

THE INTERACTION OF RESPONSE INHIBITION AND VICTIMIZATION IN THE EMERGENCE OF AGGRESSIVE BEHAVIORS DURING ADOLESCENCE

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The ability to inhibit prepotent and goal inappropriate responses (i.e., response inhibition) is a key executive function for self-regulation of behaviors. Adolescents with poor inhibitory control have more difficulties in self-regulation and tend to act more impulsive, inappropriate, or/and aggressive during social interactions with peers. They are also more likely to attract hostility from peers. In the present study, we examined the mediating effect of peer victimization in the relationship between response inhibition and development of aggressive behaviors in a multilevel framework. 3826 Grade 7 adolescents (12.8 years old ±0.4, 49.2% girls) from 31 secondary schools in the greater Montreal, Canada were followed for four years. Results indicated that overall liability towards low inhibitory control and the added effect of reduced inhibitory control in a given year were associated with higher aggressive behaviors toward peers over a 4-year period. Multilevel mediation analysis revealed that victimization was implicated in aggressive behaviors in three ways: general liability, concurrent added effect and long-term added effects. Victimization was also shown to mediate the relationship between overall level and concurrent level of response inhibition on aggressive behaviors. We argue that the aggressive behavior of disinhibited adolescents may be the result of exposure to peer victimization and may be following an 'ecophenotype specialization' process, whereby the environment will shape a neurocognitive profile. Using a smaller high-risk subsample of this study, we also investigated the neurocognitive correlates of poor response inhibition, victimization and the interaction between these risk factors.

SOMATIC COMPLAINTS IN YOUNG CHILDREN: RELATIONSHIPS WITH CORTISOL, INTERNALIZING PROBLEMS, AND MATERNAL ANXIETY DISORDERS

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Somatic complaints refer to physical symptoms (i.e. headache, abdominal pain) with no identifiable organic cause. These symptoms are particularly concerning early in life and have been associated with a maladaptive developmental trajectory. The current study followed a sample of 185 children from preschool (2.5 to 5 years) to school-age (5 to 11 years) to examine the development of child somatic complaints and their relationships with maternal anxiety disorders, child internalizing symptoms, and cortisol reactivity. Mothers' lifetime history of DSM-IV anxiety disorders (SCID) and children's cortisol reactivity were assessed at preschool, and children's somatic complaints and anxiety/depression symptoms were assessed at preschool and school age using maternal and alternate caregiver CBCL reports. Results reveal that maternal anxiety significantly moderates the relationship between preschool and school age somatic complaints, as well as between cortisol reactivity and child somatic complaints. Specifically, preschool somatic complaints significantly predict school age somatic complaints, but only in cases where the mother has a history of anxiety disorders. Similarly cortisol reactivity

was significantly lower in children with somatic complaints, but only in cases where the mother also had a history of anxiety disorders. In all cases, regardless of maternal anxiety disorder history, preschool age somatic complaints predicted school age internalizing problems, above and beyond the effects of preschool internalizing problems. This study provides evidence of associations between child somatic complaints, cortisol reactivity, and maternal anxiety disorder history. Future work should continue to consider maternal psychopathology and child physiological factors when examining the development of somatic complaints in childhood.

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SALIVARY ALPHA-AMYLASE AND SALIVARY CORTISOL PREDICT WORKING MEMORY PERFORMANCE IN TODDLERS RESIDING IN LOW-INCOME URBAN COMMUNITIES

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Research in developmental psychobiology suggests the importance of taking a multisystem approach to understanding relations between stress-response physiology and behavioral and cognitive outcomes in children. Cross-system coordination of the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system (SNS) has been of particular interest given research indicating the importance of these systems for higher-order cognitive processes. Despite this knowledge, less is known about cross-system coordination and higher-order cognition during childhood in contexts characterized by high sociodemographic risk. Data come from 59 families residing in some of New York City's highest-poverty neighborhoods who were seen at home visits occurring at 24 months of child age. Three saliva samples were collected from children around an emotional stressor (pre-stressor, 5 and 20 min post-stressor). Saliva was assayed for salivary cortisol (CORT) and salivary alpha-amylase (sAA), a surrogate biomarker of norepinephrine. Children were administered the "three boxes" working memory task. Self-report psychosocial and sociodemographic risk data were collected from caregivers. We observed an interaction between CORT reactivity and sAA reactivity to the emotional stressor (pre-stressor to 5-minutes post-stressor) in predicting working memory performance. Toddlers evidencing high CORT reactivity/low sAA reactivity to stress or low CORT reactivity/high sAA reactivity had higher working memory scores, on average, than toddlers evidencing low CORT/low sAA or high CORT/high sAA. Reactivity from pre-stressor to 20 min post-stressor was not significantly associated with working memory. Findings provide further evidence of multisystem influences on children's cognitive processes and will be discussed in terms of relations to contextual sociodemographic risks.

PERINATAL ANTIBIOTIC EXPOSURE: IMPLICATIONS FOR NEUROBEHAVIORAL DEVELOPMENT IN PRETERM INFANTS

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Approximately 40–70% of preterm deliveries are associated with intrauterine infection resulting in high rates of prenatal and postnatal antibiotics. We sought to determine whether maternal antibiotic use during pregnancy and/or postnatal infant antibiotic exposure is associated with developmental outcomes among 150 preterm infants. We found that maternal and infant antibiotic use increased electroencephalographic activity at ~34 and ~40 weeks gestational age. Further, we report that maternal and infant antibiotic use altered attention, cognition, language, and autism risk at 18 months. Importantly, our data demonstrate an interaction effect of maternal/infant antibiotic use and infant exposure to a high-nurture intervention during NICU hospitalization.

CAREGIVER SEPARATION AND CHILDHOOD DEPRESSION: PREDICTORS OF CHILD GUT BACTERIA

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This study sought to expand on rodent models of adversity on gut-behavior relationships by measuring a non-laboratory based index of caregiver separation in relation to child depression and the gut microbiota. In phase I of the study, we assessed children 4–7 years old from a broad socioeconomic status range (N = 84) and observed a significant positive correlation between number of caregiver separation events and child depression. In phase II (N = 40), we observed that both increased number of caregiver separation events and increased childhood depression predicted decreased relative abundance of protagonist bacteria in the gut (Bifidobacterium) an average of 8 months later.

CURVLINEAR ASSOCIATIONS BETWEEN SOCIAL FEAR AT AGE 3 AND HAIR CORTISOL AT AGE FIVE

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Fearful temperament in childhood has been linearly and curvilinearly related to greater cortisol reactivity (e.g., Talge, Donzella, & Gunnar,

2008; Zimmermann & Stansbury, 2004), yet its relation to cumulative cortisol exposure, as assessed by hair cortisol (HCC), is less understood. Furthermore, differential associations of social fear and non-social fear with HCC have not been explored, though this distinction is important in identifying risk and protective factors for elevated physiological stress in childhood. The present study investigated the relation of social and non-social fear at age 3 to HCC at age 5 in 149 children from the Boston University Twin Project. Social fear and non-social fear were assessed via parent reports on the Child Behavior Questionnaire shyness scale and fear scales. Quadratic models run separately for social and non-social fear were nested to account for non-independence in our twin sample. Non-social fear did not predict HCC (overall model $F = .73$, $p = .48$). Social fear at age 3 both linearly and curvilinearly predicted HCC at age 5 (overall model $F = 3.22$, $p = .045$), with the curvilinear (inverted U function) effect explaining the majority of the social fear variance in HCC. Though directions of effect cannot be established, the results hint at adaptive social functioning (i.e., neither very high nor very low social fear) as a potential protective factor against later elevated cumulative physiological stress.

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EFFECT OF PARENTAL SMOKING BEHAVIOR ON PRE-ADOLESCENTS' ATTENTIONAL BIAS TO SMOKING-RELATED CUES

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Children who have a parent who smokes are more likely to begin smoking than their peers who do not have a family history of smoking behavior. Previous research in our laboratory with young adults suggests that this relationship may be mediated by the development of enhanced attentional biases toward smoking-related stimuli. Attentional biases are thought to be implicit, suggesting that despite efforts to ignore smoking-related cues, attention is implicitly drawn to these emotionally-valanced stimuli. Attentional biases are likely to influence downstream cognitive processes, potentially contributing to the development of evaluation and memory biases for addictive stimuli. The goal of the present study was to compare attentional biases in 8–12 year – old children of smokers ($n = 64$) and nonsmokers ($n = 72$). Children engaged in a dot-probe task consisting of 40 trials in which a picture of a smoking-related object was presented alongside a visually-matched picture of a nonsmoking object. Children who had a parent who smoked showed an attentional bias *away* from the smoking stimuli ($M = -24.4$, $SE = 7.4$), whereas those who had nonsmoking parents showed no attentional bias ($M = 0.1$, $SE = 7.0$). These findings suggest that attentional biases to smoking-related stimuli may change throughout development.

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BLUNTED DIURNAL CORTISOL AND AGGRESSIVE BEHAVIOR IN INFANCY

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It is well-established that externalizing behavior problems in children (e.g., defiance, aggression) are associated with disruptions in stress system functioning, often manifested as a blunted pattern of diurnal cortisol (Alink et al., 2008). Past research has shown that externalizing problems can be detected in infants as young as 8 months old, however no studies to date have examined how cortisol relates to externalizing behavior at this young age. Instead, studies have focused on the impact of parenting quality (e.g., sensitivity) and environmental risk (e.g., poverty) on the early development of externalizing problems (Lorber & Egeland, 2011; Conradt et al., 2013). In this study, we examined the effect of diurnal cortisol slope on aggressive behavior among infants while controlling for the effects of parenting and environmental risk. Seventy-four mothers of 12–18 month-old infants completed questionnaires, took part in a videotaped free play assessment, and sampled their infant's saliva throughout the day over three days. Diurnal cortisol slope was calculated as the simple difference score between the bedtime and morning saliva samples, averaged across the three days. Infant aggression was measured with the Infant Externalizing Questionnaire (Lorber et al., 2014). Maternal sensitivity was coded form the video-taped play assessment. Results from OLS regression revealed that a blunted cortisol slope (i.e., less decrease from morning to evening) predicted more aggressive behavior in infants, while controlling for maternal sensitivity, sex, and a composite risk score (B=.23, $p < .05$). These results suggest that diurnal cortisol may be an important predictor of aggressive behavior during infancy.

DYSREGULATED FEAR TEMPERAMENT PROFILE IS LINKED TO ELEVATED CORTISOL REACTIVITY: THE IMPACT OF MATERNAL PERSONALITY AND SOCIAL WITHDRAWAL

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Dysregulated fear (DF), a temperament profile characterized by high fear in low-threat context, predicts social withdrawal (SW) during kindergarten (Buss et al., 2013). Risks for SW in temperamentally fearful children may be manifested both behaviorally and through neuroendocrine (e.g. cortisol) responses (Buss & Kiel, 2013). Contextual factors, such as maternal personality, may influence the

developmental continuity of fearful temperament (Degnan et al, 2008). The current study examines the joint impact of early child temperament and maternal personality on the development of SW, and how SW subsequently predicts cortisol reactivity in a peer context. Participants were 138 children drawn from a 2-cohort study. At age 2, children were categorized into three temperament profiles: normative, high fear to high threat, and DF. Mothers reported on their own levels of positive affectivity and approach tendency. During kindergarten, saliva samples were collected from children in a laboratory visit involving interaction with unfamiliar age- and sex-matched peers. Mothers reported children's SW. Early temperament profile did not predict later SW. However, this link was marginally moderated by maternal personality ($b = -.16$, $\beta = -.24$, $t = -1.81$, $p=.07$). That is, relative to high-fear-to-high-threat toddlers, DF toddlers with mothers characterized with high approach personality displayed heightened SW in the kindergarten year ($b=.52$, $\beta=.74$, $t = 2.2$, $p=.03$). Holding the temperament categorization constant, high SW in turn predicted high cortisol production during peer interaction ($b = 3.18$, $\beta = .23$, $t = 2.79$, $p = .006$). We provide preliminary evidence that early DF profile predicted elevated cortisol activity in a peer context, but only in children with mothers who had high approach personality.

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EARLY LIFE STRESS ALTERS SEXUAL DEVELOPMENT AND EXPRESSION OF PROINFLAMMATORY CYTOKINES

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Experiences of early life stress significantly increase lifetime risk for pathology development. Significant sex disparities exist in risk for stress-associated pathology, however, the biological basis of these sex disparities are unknown. Recent work has linked activation of the immune system with both the sculpting of neural development as well as sexual differentiation of a subset of brain structures. Exposure to stress has also been associated with enhanced innate immune responses, including an upregulation proinflammatory cytokines. We hypothesize that ELS alters immune development, contributing to alterations in the timing of neural developmental events and the sexual differentiation of the brain. Here, we use a mouse model of ELS in the form of limited maternal bedding from P4-P11. Previous work by our lab and others has shown that Limited Bedding Stress (LBS) induces a fragmentation in maternal care and results in stress in the developing pup. To test our hypothesis, we assessed the effects of ELS on measures of sexual maturation, gonadal hormone development, and innate immune expression. Here, we find that ELS results in delayed vaginal openings (p28-35), but earlier emergence of rapid estrous cycling in young adult animals. Using RT qPCR, we find that ELS is associated with a delayed peak in estrogen receptor alpha and estrogen receptor beta expression in the hippocampus. In ongoing experiments, we are assessing the developmental effects of ELS on innate immune activation, including peripheral lymphocytes and proinflammatory cytokines including IL-1 and IL-6.

FAMILY ALLOSTASIS: WITHIN- AND BETWEEN-FAMILY DIFFERENCES IN CORTISOL

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We examine allostatic physiology as an important component of family dynamics. 101 first-year undergraduate students (37 male, 64 female, 17.9 ± 0.45 YO) and their two parents participated in a videotaped family task (building a house of cards). Four saliva samples were taken from each participant at 20 min intervals, and cortisol assessed via ELISA. Family type was coded using the Family Structure and Process (FSAP) coding system. ANOVA revealed elevated cortisol at sample 1 and 2 vs. samples 3 and 4 ($F(3,217) = 5.09$, $p \leq 0.01$), and elevated cortisol in emerging adult (EA) children vs. mothers and fathers ($F(2,219) = 4.23$, $p \leq 0.05$). Interactions revealed that EA children had elevated cortisol at samples 1 and 2 relative to their parents ($F(3,218) = 4.26$, $p \leq 0.01$), and that cortisol values were higher at samples 1 and 3 in distant families versus cohesive families ($F(3,217) = 2.99$, $p \leq 0.05$). ANOVA revealed that cortisol response is similar among family members, as indicated by a significant interaction between cortisol sample and family identification number, indicating that cortisol response patterns differ depending on family membership ($F(99,194) = 1.63$, $p \leq 0.01$). Cortisol response patterns are similar among family members in cohesive families and differ among family members in distant families (interaction between cortisol sample and family ID among distant families: $F(38,75) = 1.49$, $p = 0.07$ and cohesive families: $F(37,73) = 1.76$, $p \leq 0.05$). Results will be discussed in terms of developmental perspectives on family functioning during transition periods.

LATERAL LEMNISCUS DEVELOPMENT AND ITS RELATION TO RECEPTIVE VOCABULARY

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The lateral lemniscus (LL) is a bilateral fiber pathway comprised of the axonal projections from the superior olivary complex to the inferior colliculus (Naidich et al., 2009). It is thus the major conduit for the transmission of auditory perceptual information in the brainstem. Although the pathway is an important component of this early auditory system, its development has not been investigated using modern diffusion-weighted imaging (DWI) techniques. Our study aims to be the first, to our knowledge, to track the LL in vivo and to explore potential behavioral associations in a sample of typically developing individuals. In this study, we examined the LL in 129 participants

(70 females, age = 0–18 years, M = 8.67 years) using DWI. Bilateral ROIs where manually drawn in the midbrain using the superior cerebral peduncle as an anatomical landmark. Tracking was successful in 94 participants. Fractional anisotropy (FA) increased linearly in the LL from infancy to late adolescence, which is consistent with extended development of the auditory system more broadly (Litovsky, 2015; $t(90) = 7.21$, $p < .001$; controlling for age, whole brain FA, and gender). We also assessed the LL's relation to vocabulary development. We found that axial diffusivity (AD) of the LL is associated with improved PPVT scores ($t(77) = 2.21$, $p < .05$, controlling for age, gender, and wholebrain AD). This study provides preliminary evidence of the development and behavioral associations of the LL. Successful tracking of this pathway is potentially important in the clinical treatment of auditory disorders in children.

EXPERIMENTAL MANIPULATION OF PREFRONTAL CORTEX DIFFERENTIALLY AFFECTS AMYGDALA REACTIVITY FOLLOWING PARENTAL DEPRIVATION

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Early-life adversity can have profound and lasting effects on affective development and behavior. Humans rely on their caregivers longer than any other species, making parental deprivation one of the most potent stressors for an infant. Prior studies suggest that parental deprivation alters the development of frontoamygdala circuitry and related anxiety. However, the functional nature of these abnormalities is unknown. Here we manipulated prefrontal engagement via cognitive load to experimentally test its effects on subsequent amygdala reactivity during development in children who experienced parental deprivation via previous institutionalization (PI) during infancy and typically developing comparison youth (8–11 years old). At baseline (low cognitive load), there were no group differences in prefrontal engagement, but PI children showed heightened amygdala reactivity to subsequently presented faces. During high cognitive load, comparison children increased prefrontal engagement and had subsequent increases in amygdala reactivity. By contrast, PI children showed lower prefrontal activation and did not show subsequent changes in amygdala reactivity. The results suggest that early-life adversity alters later frontoamygdala development, with heightened amygdala reactivity as a baseline state and weaker prefrontal recruitment during cognitively demanding conditions. Thus, the nature of amygdala-PFC interactions differs qualitatively between comparison and PI youth. The present findings indicate that early-life adversity alters normative development of the neural circuitry supporting emotion regulation with lasting effects on emotional behavior. Amygdala-PFC phenotypes following parental deprivation may be ontogenetic adaptations that the developing system makes to meet the demands of an adverse environment, which are likely to have long-term consequences on behavior.

THE RELATION BETWEEN INFANT SUPINE HEAD ORIENTATION PREFERENCE AND ASYMMETRIES OF SELF-TOUCHING ACTIONS

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Previous research found that infants with a right supine head orientation preference (SHOP) preferred to use their right hand for a visually guided reaching task when they were 19 weeks of age (Goodwin & Michel, 1981). To examine the antecedent conditions which may contribute to hand preferences, we focus on the relation between SHOP and self-touching actions. Ten infants were observed for SHOP at 3, 6, and 9 weeks of age. Only those infants with a right head orientation preference (HOP) were included in the study. HOP was determined by first calculating the percentage of right orientations (%R) using the formula (R/(R + L))*100, where R indicated the frequency of right orientations, and L indicated left turns. We then used a 1.9 confidence interval to classify each infant's HOP. Infants were considered to have a right HOP if their %R − CI was greater than 50%. Following the SHOP procedure, infants were recorded for ten minutes while sitting in a semi-upright position. These videos were analyzed for the frequency of arm movements, grasps, and self-touches. Finally, a one sample t-test was conducted to test whether the sample mean of infants with a right HOP differed significantly on the number of right arm movements, grasps, and self-touches compared to the number performed on the left. Results indicated that infants performed significantly more right movements than left movements. This study supports Michel's modified progressive lateralization theory which states that early asymmetries of hand-use can cascade via self-generated experiences into expanded hand-use preferences across a variety of manual skills.

THE ROLE OF EARLY MATURING PATHWAYS IN SOCIO-COGNITIVE COMPETENCE: THE CASE OF NEONATAL BRAINSTEM DYSFUNCTION

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The canonical triune brain model suggests a role for early developing neural pathways that involve the brainstem. Recent research using the auditory brainstem evoked response, points to long-term developmental psychobiological aftermath of transient and persistent neonatal

brainstem dysfunction (NBD). A prospective double-blind 8-year-long study with infants born preterm who were diagnosed with a transient NBD suggests gaze engagement deficits during the neonatal period. Later, at one year of age, children born with NBD showed increased risk for behavioral inhibition and increased dependence; and deficits initiating activity, such as joint attention become evident during the preschool ages. Social attention deficits, along with increased alerting and social withdrawal emerge at 8 years of age in children with NBD. These later symptoms become evident using gaze tracking during triadic interaction tasks and electroencephalographic changes in the alpha and theta power density ranges. Results with persistent brainstem pathology seem to be more prevalent in children with autism who show pervasive socio-communicative deficits. Taken together, these recent findings suggest a developmental neurobiological pathway for social attention dysfunction in NBD that may contribute to our theoretical models of social neural networks and contribute to the characterization of the developmental psychobiological phenotype of NBD. Pending replication and future study, this line of work may suggest NBD as a new clinical phenotype and extend our understanding of role of early emerging pathways in our socio-emotional competence.

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THE NEUROPHYSIOLOGICAL BASIS FOR SLEEP: A DECADE LONG PROSPECTIVE STUDY OF CHILDREN FROM BIRTH

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Sleep is vital for physical, cognitive and psychological well-being. Little however is known about the brain mechanisms controlling sleep in human children, and the relationship between these early maturing neural networks and the characteristics of sleep at childhood. Brainstem structures regulate and modulate sleep and arousal. Structural brainstem damage results in sleep-wake organization deficits; though, such damages are often fatal and highly challenging to study. Nevertheless, recent studies point to functional deficits in the brainstem, particularly relevant in preterm neonates for whom brainstem susceptibility is fairly common. Therefore, the current research studies the relation between neonatal brainstem integrity and sleep.

We explored these relations between neonatal brainstem dysfunction and sleep difficulties in childhood, using a prospective decade-long follow-up design. The primary aim was to predict sleep characteristics in childhood using neonatal brainstem functions. The brainstem functions of infants born preterm were evaluated at birth using auditory brainstem evoked responses (ABR). At ten years of age (mean = 10.31 ± 0.88) twenty seven children underwent sleep evaluations using 48–72 consecutive hours of actigraphy recordings, along with parental diaries and slept questionnaires. Results of a regression analysis which included neonatal risk parameters, ABR functioning, and gestation-familial factors, importantly twinhood showed that gestation age, neonatal ABR transmission times ($\beta = -.370$, $p < .05$) and twinhood ($\beta = .475$, $p < .05$) predict sleep duration at 10 years of age ($R^2 = .358$, $p < .05$). That is, normal ABR and having a twin were related to longer sleep at 10 years of age. This human's study shows that neonatal neurophysiological brainstem integrity and twinship influence sleep throughout childhood.

EXPLORING BIO-MARKERS OF EMOTION REGULATION IN PEER SUPPORT WITHIN SELF INJURING ADOLESCENTS

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The development of self-inflicted injury (SII) typically emerges during adolescence. Often associated with several negative health outcomes, SII is a prevalent public health issue. Despite adolescence being a developmental period associated with strengthened peer relationships, little research has been conducted to understand the role of these relationships in the development of emotional regulation and overall mental health outcomes. The current study uses a multi-method approach and within-subjects design to investigate the effects of peer support on emotion regulation. To examine friendship dyads in detail, ten female peer dyads composed of SII adolescents and typical controls between ages 13–17 engaged in an interaction task where target adolescents discussed an emotionally distressing situation with their peer. Psychophysiological data (respiratory sinus arrhythmia; RSA) was acquired during the interaction and used to assess parasympathetic activity. Baseline physiological results indicated that adolescents in the SII group demonstrated lower resting RSA than adolescents in the control group, which is indicative of emotional regulation difficulties and physiological inflexibility. Furthermore, individual responses to peer support reveal patterns of positive change in RSA and support regardless of group status. Further examination of the role of peer support and associations with emotional regulation may improve preventative measures and treatments for adolescents with SII and other high risk populations.

REGULATING RESPONSES TO SOCIAL AND APPETITIVE REWARDS ACROSS DEVELOPMENT

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Learning how to regulate one's responses towards rewarding stimuli is key to successful development. Prior work has found that adolescence

is a time when individuals are particularly prone to risky and impulsive behavior, but are all reward environments created equal? This research examines the behavioral and neural correlates of appetitive regulation in development both across different forms of regulation (i.e. impulse control and reappraisal) and different reward environments (i.e. social and health). We collected both behavioral and fMRI data from participants across a wide developmental age range (6–25), who completed two regulatory tasks: 1) social impulse control (as assessed via the affective go/no-go), and 2) appetitive reappraisal. We found that both successful performance in both tasks increased with age, but that the success in one regulatory domain was not predictive of success in the other. The brain data supported this dissociation account, finding that while both tasks involved down-regulation of the ventral striatum, individuals were more likely to recruit vlPFC—a region involved in working-memory and task switching during impulse control, and dlPFC—a region involved in abstract reasoning and executive control, during reappraisal. Taken together, these results suggest that while regulating responses towards different sources of reward gets better as individuals get older, self-control in one domain does not necessarily predict success in the other, and that individuals rely on distinct cognitive circuitry in order to accomplish these different regulatory goals.

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STATE-DEPENDENT OSCILLATORY ACTIVITY IN THE PONTINE GREY OF NEONATAL RATS

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Oscillatory neuronal activity is thought to contribute to the development of neuronal networks by promoting connectivity between distant but functionally related brain structures. In infant rats, we have provided evidence of state-dependent neural activity—including oscillatory activity–in such sensorimotor structures as primary motor cortex and cerebellum. The pons is an intermediary brainstem structure that facilitates communication between the motor cortex and cerebellum, and also receives input from the sensory periphery. We hypothesized that the pons, as a sensorimotor hub, would also exhibit state-dependent activity in early development. To test this hypothesis, we recorded extracellularly in the pontine grey of 11- to 12-day-old rats as they cycled freely between sleep and wake. Whereas unit activity in the pontine grey was sparse, we observed oscillatory activity in the form of local field potentials (LFPs) at this age. Specifically, preliminary data indicate the presence of theta oscillations (4–6 Hz) and beta oscillations (15–35 Hz) that were continuously expressed during sleep. Both rhythms are indicative of long-range functional connectivity, and beta rhythms in particular have been implicated in communication between primary motor cortex and cerebellum. Ongoing experiments will examine the sources of these oscillations and their emergence at earlier ages.

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IMPROVED FINE MOTOR SKILLS AND SCHOOL READINESS IN PRE-KINDERGARTENERS AFTER SUMMER TREATMENT PROGRAM

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Prior research suggests early motor skills have a cascading effect on academic achievement. To understand the effect early intervention may have on fine motor skills and school readiness, data was collected during a 7-week summer treatment program focused on improving academic and behavioral skills in pre-kindergarteners (N = 22, 4–5 years old) from low-income backgrounds. The Learning Accomplishment Profile-Diagnostic Edition (LAP-D) fine motor writing (FW) and fine motor manipulation (FM) subscales were used to assess fine motor skills pre-/post-intervention. School readiness was measured pre-/post-intervention using the Bracken School Readiness Assessment (BSRA-3). Overall, FW scores increased from pre- (M = 16.59, SE = 1.16) to post-intervention (M = 18.82, SE = 1.23; d = .397, p = .013), as did FM scores (pre: M = 20.73, SE = .55; post: M = 22.36, SE = .62; d = .591 p = .005). BSRA-3 scores increased from pre- (M = 86.5, SE = 4.04) to post-intervention (M = 92.91, SE = 3.97; d = .538, p = .002). To test differential gains in school readiness based on fine motor skills before intervention, high/low scoring FW and FM groups based on pre-intervention scores were created and compared on pre-/post-intervention BSRA-3 scores. The high-FM and low-FM groups increased on BSRA-3 scores from pre- (high-FM: M = 89.77, SE = 5.23; low-FM: M = 81.78, SE = 6.36) to post-intervention (high-FM: M = 96.15, SE = 5.06; d=.336, p=.034; low-FM: M = 88.22, SE = 6.41; d = .344, p = .038). BRSA-3 scores also increased for the high-FW group from pre- (M = 92, SE = 4.26) to post-intervention (M = 97.88, SE = 3.80; d = .388, p=.024).The low-FW group marginally increased BSRA-3 scores from pre- (M = 76.88, SE = 7.40) to post-intervention (M = 84.25, SE = 8.15; d = .335, p = .063). Preliminary results indicate that a short intervention targeting academic and behavioral skills can improve fine motor skills and school readiness before kindergarten. Data collection is ongoing.

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CAN HIGH QUALITY MATERNAL CARE AMELIORATE THE EFFECT OF PRENATAL MATERNAL DISTRESS?

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Antenatal maternal psychological health is associated with a broad range of child development outcomes (Bergman et al., 2007; Van den Bergh et al., 2004). Very little is known about postnatal effects that may mitigate the impairments induced by prenatal maternal distress. Animal studies find that postnatal care can reverse the long-term impairments induced by prenatal maternal distress (Maccari et al., 1995; Wakshlak et al., 1990); however, only a few studies have tested this question within humans (Bergman et al., 2008; Grant et al., 2010). This study evaluated whether high quality maternal care could mitigate cognitive impairments associated with prenatal maternal distress. Maternal distress was assessed via self-reports of depression, state anxiety, and perceived stress for 145 individuals at 15, 19, 25, 31 and 36 gestational weeks and 2 years. Quality of maternal care was evaluated at one year using a standardized laboratory observational measure. The Bayley Scales (BSID-II) Mental Developmental Index was administered to assess cognitive development at two years. Maternal intelligence was assessed via the WAIS and socioeconomic factors were collected. Elevated maternal distress during pregnancy predicted poor child cognitive performance at two years of age ($r(145) = -4.610$, $p = .005$). Notably, there was a significant interaction between prenatal distress and postnatal sensitivity ($r(145) = 1.865$, $p = .028$), indicating high quality care postnatally mitigated the effects of prenatal distress. This association remained after considering maternal postnatal distress, sociodemographic covariates, as well as maternal intelligence. These findings suggest that maternal sensitivity may ameliorate adverse cognitive outcomes associated with prenatal maternal distress exposure.

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FRAGMENTED MATERNAL SENSORY SIGNALS PREDICT LOW EFFORTFUL CONTROL IN CHILDHOOD

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Maternal behavior is an important source of environmental sensory signal to the developing brain and a key predictor of child functioning (Bernier et al., 2010; Malmberg et al., 2016; Sethna et al., 2016). However, the characteristics of maternal signals that shape child outcome remain unknown. Recent literature in rodent models suggests that fragmented and unpredictable maternal sensory signals predict offspring emotional functioning (Molet et al., 2016). The current study examines the effect of fragmented maternal sensory signals during infancy on effortful control in human children. Effortful control, an index of self-regulation, predicts externalizing problems and academic and interpersonal success at young ages. This prospective, longitudinal study followed 98 children from infancy through childhood. Maternal behavior was observed during a 10-minute interaction with her child at 12 months. Maternal sensory signals were assessed using real time, moment-to-moment coding of maternal visual, auditory, and tactile signals to her infant. A transition matrix was created and entropy rate was computed as an index of predictability of transitions between sensory signals. When children were 5–7 years of age, Effortful Control (EC), an index of self-regulation of emotional/behavioral reactivity, was assessed via maternal report on the Children's Behavior Questionnaire (CBQ). Unpredictable maternal sensory signals at 12 months of age predicted lower child EC scores at 5–7 years of age ($r(98) = -.206$, $p = .042$). This suggests that exposure to fragmented maternal signals during early postnatal life may play a role in the development of executive attention abilities in offspring and have lasting consequences for self-regulation into childhood.

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FREQUENT FALLS DO NOT DETER INFANTS FROM WALKING

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Previous work shows that infants fall a lot—on average, 17 times/hour at home, in a playroom, and while holding caregivers' hands. However, previous work reports only the frequency of infant falls. We asked whether falling incurs penalties beyond loss of balance, and if not, why not. We scored videos of 76 walking infants (43 girls, age = 12.69–19.53 months, walking experience = 0.07–9.01 months) during free play on flat ground in a laboratory playroom. Each infant contributed 1–15 falls to analyses. Most falls involved multiple segments in a sequence of impacts that disseminate potentially injurious forces: 28.9% of falls involved only a single impact (falling onto hands, onto buttocks, etc.); the remainder involved multiple impacts (falling first onto hands, then onto legs), occasionally in a long string (legs, hands, arms, torso, head). They nearly always fell onto padded body parts. Head (4.9%) and trunk (10.6%) impact were rare, and always occurred after first falling onto a more padded body part. Infants caught themselves with their hands within $M = 0.1$ s of impact. After falling, infants rarely cried (1.6% of falls), caregivers rarely showed concern (9.3% of falls), and infants picked themselves up and went back to play within $M = 2.94$ s. We conclude that falling is frequent, but not particularly salient for infants or caregivers. We propose that skills requiring vast amounts of experience, such as walking and talking, incur low penalty for errors, so as not to deter infants from practicing to the point of mastery.

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EARLIER AND ATYPICAL STRUCTURAL CONNECTIVITY FOLLOWING EARLY CAREGIVER DEPRIVATION

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Early parental deprivation has been associated with both neurological and behavioral differences across development. For example, children with a history of previous institutional care (PI) followed by international adoption are at heightened risk for developing internalizing problems such as depression and anxiety disorders. Functional magnetic resonance imaging studies have suggested that these behavioral differences are attributable to accelerated development in neural circuits. The current study used diffusion tensor imaging (DTI) to examine the development of structural connectivity, providing an index of white matter integrity, which animal studies suggest marks the relative maturity of functional connections. DTI was collected in children and adolescents (6–16 years old) with or without a history of PI followed by international adoption. Results indicate a main effect of age and of early caregiving on whole brain fractional anisotropy (FA) values, but only a main effect of early caregiving on radial diffusivity (RD). Specifically, FA, but not RD, increased linearly with age across both caregiving groups, whereas both FA and RD values were elevated in the PI youth. Taken together, these patterns suggest that FA and RD are affected in different ways by early adversity. Moreover, higher global FA in the PI group was more associated with greater anxiety. These results suggest that early life parental deprivation is associated with earlier white matter integrity, although this might be indicative of compromises to the associated myelination. These findings are discussed with respect to trade-offs accompanying accelerated neural development.

MODULATION OF SOCIAL AND EMOTIONAL PHENOTYPES BY AMBIENT TEMPERATURE IN OXYTOCIN 'KNOCKOUT' MICE

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Ambient temperatures typical of laboratories and vivaria (~22–24 °C) can represent a significant cold challenge for mice. Importantly, no research to date has examined the effects of ambient temperature on standard tests of social-emotional behavior in mice. We examined this question in oxytocin 'knockout' (OTKO) and wildtype (WT; B6;129S) mice tested under one of two ambient temperature conditions (22°C or 28°C) in Sociability-Social Memory (SSM), Elevated Plus Maze (EPM), and Open Field (OF) tests. Given that OTKO mice have an impaired capacity for brown adipose tissue thermogenesis, we predicted that their behavior would be modulated more by ambient temperature than that of WT mice. Mixed-effects models, controlling for litter size and litter-of-origin as random factors, revealed significant genotype x thermal condition interaction for activity levels in females but not males in both EPM and OF tests. Similarly, we found significant genotype x thermal condition interaction for the ratio of time spent in the center versus edge of the OF for female but not male mice ($t = 2.71$, $p < .007$). In addition, there was a significant main effect of thermal condition ($t = 3.71$, $p < .0003$) and interaction between genotype and thermal condition ($t = 2.09$, $p < .04$) for female but not male mice for latency of approach to an unfamiliar social partner during the social memory portion of the SSM. Our results indicate that the effect of the presence of endogenous oxytocin on social-emotional behavior in female mice is significantly modulated by ambient temperature during testing.

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BIRTH SEASONS IMPACT WHEN INFANT START CRAWLING AND WALKING

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Motor activities, especially self-controlled activity, have been the centrality in theories of psychological development and the potential for psychological functioning in children whose disabilities limit their activity. Some of the best evidence comes from research on the psychological revolution that occurs shortly after infants start to crawl, involving dramatic changes in perceptual, perceptual-motor, spatial-cognitive, and social-emotional skills (e.g., Anderson et al., 2013; Campos et al., 2000). The acquisition of self-controlled activity such as crawling and walking has traditionally been accounted for by maturational factors (e.g. muscular, neurological development). Meanwhile a few studies put forward non-biological factors such as cultural practices on norms of motor development (Karasik et al, 2010; Dong, Zhang, & Tao, 1999). Our study interviewed 131 U.S. infants in the Bay area and 118 Chinese infants in Shanghai, China and revealed seasonal effects on the onset of crawling and walking. Consistent with cross-cultural studies, our findings include that (1) there was no gender difference in crawling or walking onset in either sample, (2) Chinese infants were on average 5.7 weeks late in crawling and 6.3 weeks late in walking than the U.S. infants, (3) winter-born infants (Dec-Feb) started crawling and walking earlier than summer-born (Jun-August) infants in both samples, (4) seasonal effects were bigger for crawling than walking onset in both samples, especially with Chinese infants. This study underscores motor development is multifactorial. Taken

together, an epigenetic approach is called for and speculation of how nature and nurture interplays will be discussed.

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IMITATION OF FACIAL GESTURES AT BIRTH – NOW WE SEE IT, NOW WE DON'T

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The observation that neonates seem to imitate facial gestures has led to a heated debate among scientists. Is what we observe really imitation or can the observations be explained elsewise? While those in favor of the phenomenon might evoke a mechanism based on mirror neurons as an explanation, those opposed to the idea of an early imitative capacity have suggested that what looks like an imitative response is better explained as arousal, an innate releasing mechanism, a coincidental match or plainly as an artifact. These issues will be addressed anew based on observations of 33 newborn human children (mean age: 47 hr) observed for imitation of tongue protrusion and mouth opening. The stimuli were presented dynamically, in three 20s long gesture modeling periods, interwoven with three 20 s long response periods in which the presenter kept a still face. Imitation of tongue protrusion was evident immediately, whereas mouth opening showed a protracted response. Individual analysis showed that only four children consistently failed to imitate any of the gestures. Children were as likely to imitate when the stimuli were presented dynamically as they were during the still face. The study provides renewed support for neonatal imitation, but also complicates the picture. Imitation depends partly on the time window used in the analysis and also on the gesture presented. Infants reacted faster to a presentation of tongue protrusion than to mouth opening. Finally, our findings underscore the importance of considering individual differences, demonstrating that neonates differ in their proneness to display imitation-like responses.

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EARLY BRAIN CONNECTIVITY IN INFANTS AT FAMILIAL RISK FOR DEPRESSION

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Altered resting state functional connectivity has been identified in infants exposed to maternal prenatal depression, highlighting a potential neural mechanism by which risk for depression may be transmitted across generations. The present study examines whether such alterations are present within the first few weeks of postnatal life and associated with infant neurobehavior. Twenty-two neonates completed a neurobehavioral assessment (the *Neonatal Behavior Assessment Scale*) as well as structural and resting state functional magnetic resonance imaging within 6 weeks postpartum (M = 22 days, SD = 12). Mothers were assessed for depression 1–3 times during pregnancy and once by 6 weeks postpartum. Women who met lifetime criteria for a Major Depressive episode (using the *Structured Clinical Interview for DSM-IV*) were included in the depressed group (n = 11) and women without history of any mood disorders were included in the control group. Independent component analysis and graph theory were used to compare global resting state networks and network topology in these neonates. Similar resting state networks were identified in both groups, but neonates at familial risk for depression exhibited stronger connectivity in the rolandic operculum (p = 0.0046), putamen (p = 0.0033), and insula (p = 0.0072), increased diversity in the pallidum (p = 0.0033), and decreased diversity in the inferior frontal gyrus (p = 0.0003). Functional connectivity strength in the putamen was positively associated with abnormal infant reflexes (p < 0.01). Pallidum connectivity strength and diversity negatively correlated with infant ability to self-regulate (p's < 0.01). These preliminary findings suggest that neural correlates of clinical risk may be identified shortly after birth and are associated with early neonatal behavior.

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MATERNAL ABUSE FROM CHILDHOOD INTERACTS WITH POST TRAUMATIC STRESS DISORDER TO PREDICT CORTISOL ATTUNEMENT

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The intra-dyadic attunement of hypothalamic-pituitary-adrenal (HPA) axis functioning in mothers and their children is rapidly becoming a well-replicated phenomenon. However, severe or prolonged stressors, such as experiencing child abuse, may disrupt this attunement, particularly in the context of comorbid psychopathology. The present study used Hierarchical Linear Modeling to examine HPA axis attunement between mothers and their infants in a high-risk clinical cohort of 173 mothers. Cortisol was measured from four saliva samples provided by mothers and their infants during a lab visit that included infant stressor tasks at 6 months postpartum. Maternal exposure to childhood sexual and physical abuse were assessed using the Childhood Trauma Questionnaire. Maternal lifetime Post Traumatic Stress Disorder (PTSD) diagnosis was assessed using the Structured Clinical Interview for DSM-IV.

Maternal and infant cortisol were positively correlated across the 4 time points, suggesting attunement (b = 0.16, t(171) = 2.76, $p < 0.01$). Attunement was not predicted by maternal PTSD (b = 0.30, t(169) = 1.55, $p = 0.12$), childhood physical abuse (b = 0.25, t(171) = 1.38, $p = 0.17$) or childhood sexual abuse (b = −0.04, t(171) = −0.23, $p = 0.82$). There was a significant interaction between PTSD diagnosis and childhood sexual (b = 0.94, t(169) = 2.40, $p = 0.02$), but not physical abuse (b = 0.51, t(169) = 0.78, $p = 0.44$). PTSD predicted *stronger* mother-infant cortisol attunement among women who experienced childhood sexual abuse (b = 0.82, t(46) = 2.83, $p < 0.01$), but was unrelated to attunement among mothers without childhood sexual abuse (b = −0.01, t(133) = −0.06, $p = 0.95$). These results suggest that mother-infant dyads in which the mother was sexually abused early in life and later developed PTSD may be hypervigilant to each other's cortisol changes in the context of stress.

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CONTEXT AND CONTEXTUAL FEAR MEMORY FORMATION DIFFERENTIALLY INDUCE EXPRESSION OF c-Fos, Arc, Egr-1, c-Jun, AND Npas4 IN THE MEDIAL PREFRONTAL CORTEX OF ADOLESCENT RATS

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The context preexposure facilitation effect (CPFE) is a contextual fear conditioning paradigm in which context preexposure, context-immediate-shock training, and retrieving contextual fear occur across three phases. Our lab has shown that the preexposure and training days of the CPFE induce expression of the inducible transcription factor, *Egr-1*, in the medial prefrontal cortex (mPFC) in developing rats, but this does not explain the ontogenetic emergence of conditioned freezing during the CPFE (Robinson-Drummer et al., *submitted*). The current study extended these findings by examining other inducible synaptic plasticity genes driven by context preexposure and immediate-shock training in adolescent (P31) rats. Expression of *c-Fos*, *Arc*, *Egr-1*, *c-Jun*, and *Npas4* in the mPFC was analyzed 30 min following context preexposure or training using qPCR. Preexposure to the training context (Pre group) induced expression of all five genes in the mPFC significantly above that of home-cage (HC) controls. Immediate-shock training followed by a post-shock freezing test induced expression of the five genes in the Pre group above the HC group, but the same increase occurred in non-associative controls preexposed to an alternate context (Alt-Pre). Removal of the post-shock freezing test in subsequent studies revealed learning-related increases (i.e., Pre above Alt-Pre controls) in mPFC *c-Fos*, *Arc*, *Egr-1* and *Npas4*, but not *c-Jun* expression. These results indicate that context exposure in a post-shock freezing test re-engages novelty-driven IEG expression that may obscure associatively based expression. These studies also identify additional plasticity-related molecules in mPFC that may be tested for their role in the ontogeny of the CPFE.

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FLEXIBILITY IN ACTION: HOW INFANTS AND ADULTS NAVIGATE UNDER A BARRIER

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Behavioral flexibility—the ability to tailor motor actions to changing body-environment relations—is critical for adaptive, functional motor action. Navigating the everyday environment requires selecting the appropriate action for the current situation. This project assessed flexibility of motor actions for navigating under barriers normalized to standing-height (overhead, shoulder-, chest-, thigh-, and knee-heights, presented in random order with multiple trials per height). Participants could walk normally at the overhead barrier height, but they needed to duck or squat for the shoulder- and chest-height barriers, crawl for thigh-height, and belly crawl at knee height. We observed adults ($N = 14$), 17-month-old experienced walkers ($N = 20$), 12-month-old novice walkers ($N = 12$), and 12-month-old experienced crawlers ($N = 15$). We examined the adaptability, accuracy, and efficiency of strategies for each barrier height. Adults displayed tremendous flexibility: They chose an adaptive strategy at the right moment and executed it seamlessly without errors or superfluous effort. Infants, however, did not display flexibility to the same extent. Although infants found an adequate posture to navigate under the barrier on most trials, their methods were inefficient and inaccurate. They did not select an alternative strategy until arriving at the barrier, tested multiple postures prior to selecting an adequate strategy (standing, sitting, squatting, crawling, etc.), frequently chose actions that required unnecessary effort (crawling when walking was possible), and bumped their heads on most trials. With increased locomotor experience and age, infants showed greater evidence of behavioral flexibility.

VARIETY MATTERS: WHAT CAN WE LEARN ABOUT INFANT WALKING FROM SOCCER-PLAYING ROBOTS

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Traditionally, developmental researchers have studied infant walking using standard gait—a simplified walking task that requires infants to

take continuous steps along a straight, forward path. However, during natural locomotor activity, infants' walking is immensely variable. They take forward, backward, and sideways steps with many starts and stops. If straight line walking is the gold standard, then is the sporadic and omnidirectional quality of spontaneous infant walking a feature or a bug? Movement variability during walking may be a byproduct of deficits such as poor strength or balance control. Alternatively, the natural variability of infant walking may be beneficial to the process of learning to walk. Here, we address this issue by training soccer-playing robots on the walking paths generated by 115 infants during free play. This conceptually novel approach enables a unique empirical examination of infants' spontaneous walking patterns during the complex motoric challenge of playing soccer. First, we trained a team of robots on variable paths (defined by infants). Other teams were trained on non-variable paths such as straight-lines, squares, and circles. A soccer competition between the teams revealed that training robots on infants' variable walking paths leads to enhanced performance relative to non-variable paths. Furthermore, we find that robots trained on more variable infant walking paths (curvier bouts, omnidirectional steps, many starts and stops, and larger areas covered) outperformed all other training teams. We propose that variability plays a crucial functional role in learning to walk and can inform more efficient translational research.

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EARLY-LIFE ADVERSITY AND PRENATAL ALCOHOL EXPOSURE ALTER ADOLESCENT SOCIAL BEHAVIOR DEVELOPMENT AND OXYTOCIN RECEPTOR BINDING

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Social behavior deficits associated with prenatal alcohol exposure (PAE) emerge early and persist across the lifespan. Early-life adversity (ELA) can also dramatically shape social behavior development, and individuals with PAE are more likely to experience ELA. The central oxytocinergic (OT) system is as a key regulator of social behavior, and its disruption may underlie social deficits following PAE and/or ELA. Here, we use rat models of PAE and ELA to investigate adolescent social behavior and central OT binding. Dams were assigned to: 1) PAE: access to liquid ethanol diet *ad libitum*; 2) Pair-Fed: access to liquid control diet yoked to consumption of a PAE partner; or 3) Control: access to a pelleted control diet ad libitum. From P8-12, half the dams were provided with insufficient nest bedding, which increased abusive-like maternal behaviors. Offspring were evaluated at postnatal day (P) 30 or P45 using a test of social discrimination, and brains were assayed using OT receptor binding and c-fos mRNA (PFC, lateral septum, amygdala, hypothalamus). Preliminary analyses indicate sexually dimorphic effects of PAE and ELA: social discrimination at P30 was impaired by PAE in males regardless of rearing conditions, and by ELA in PAE and control females. ELA decreased OT receptor binding in the lateral part of central amygdala in control but not PAE males, with no differences observed in females. These results suggest PAE and ELA alter social behavior development in sexually dimorphic ways, and these behavioral changes are associated with altered development of the OT system during adolescence.

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MATERNAL SEPARATION AND PRECOCIAL MATURATION: SEX-SPECIFIC CHANGES IN LIMBIC-DERIVED AXONAL INNERVATION OF THE PREFRONTAL CORTEX

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Early life experiences significantly shape the behavioral and neural trajectory of an organism across development. Therefore, disruptions during early developmental periods likely set the course for aberrant brain maturation. Indeed, children who have experienced early adversity often exhibit deleterious effects that manifest as maladaptive behaviors, cognitive impairment, and/or increased susceptibility to mental illness. Increasing evidence in humans with a history of adversity points to a role of atypical corticolimbic circuit development, leading to changes in functional connectivity between the basolateral amygdala (BLA) and prefrontal cortex (PFC). In rodent models of early adversity via maternal separation (MS) during the postnatal period, comparable neural and behavioral phenotypes are observed, including loss of PFC inhibitory tone and increased anxiety-like behaviors. The neural mechanisms underlying these findings following MS remain unknown, though it is likely that dysfunction is in part driven by precocial BLA innervation of the PFC. To determine the impact of sex and MS on this circuitry, targeted anterograde tracer microinjections into the BLA were performed at key developmental milestones spanning juvenility and adulthood. Labeled axonal fibers from BLA-PFC projecting neurons were quantified within the PFC. We present novel data indicating that MS drives increased BLA innervation of the PFC in a sex- and age-dependent manner, such that juvenile MS female innervation patterns resemble that of their adult control counterparts. This suggests a critical role for early experiences on corticolimbic development and provides putative mechanistic insight into the underlying etiology of adversity-induced vulnerability and resilience.

EFFECTS OF EARLY LIFE STRESS AND PARENTING ON METHYLATION PATTERNS: A RANDOMIZED CLINICAL TRIAL OF ATTACHMENT AND BIOBEHAVIORAL CATCH-UP

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Children who experience early adversity often experience psychosocial and biological dysregulation. Attachment and Biobehavioral Catch-up (ABC) is an early intervention for children who have experienced adversity. ABC has demonstrated more normalized cortisol production and improved emotion regulation in children who received the intervention compared to children who received a control intervention. However, little is known about how these changes occur. DNA methylation is a potential mechanism through which early environment can alter an individual's biological functioning and behavior. The current study used saliva to investigate DNA methylation differences among infants at risk for neglect and a low-risk comparison group. Children in the at-risk group were recruited through the Department of Family Services (DFS) and were randomly assigned to receive ABC or a control intervention. Saliva samples for the at-risk group were collected pre-intervention and 1 month after the last intervention session, while samples for the low-risk children were collected at matched time points.

At baseline, analyses revealed 23,326 differentially methylated sites between at-risk and low-risk children. This set of sites was used to further understand intervention effects on the epigenome. Analysis of variance revealed that 979 CG sites had differential rates of change between the ABC and DEF group. In both hypermethylated and hypomethylated sites, the ABC group had a smaller change in methylation scores than the DEF group. These findings indicate that environmental stressors in early childhood alter DNA methylation patterns. This study also suggests that early intervention and subsequent changes in parenting may further change DNA methylation patterns.

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CENTRALLY ADMINISTERED OXYTOCIN REDUCES PLASMA CORTISOL ELEVATIONS IN ISOLATED GUINEA PIG PUPS

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In several species, the presence of close social companions, especially an infant's attachment figure or a pair-bonded adult's partner, reduces (i.e., buffers) hypothalamic-pituitary-adrenal (HPA) responses to stressors such as novelty exposure or restraint. Oxytocin is released in response to social interaction and can inhibit CRH neurons in the hypothalamic paraventricular nucleus, and so is a potential mediator of social buffering. Indeed oxytocin has been shown to underlie the ability of the adult male prairie vole to buffer the HPA response of its partner following restraint. Whether oxytocin plays a similar role in the buffering of infants' by mothers is not known. To begin to address this question, preweaning guinea pigs were infused with either oxytocin (0.5 or 1.0 μg) or artificial cerebrospinal fluid vehicle into the cerebral ventricles through a surgically implanted indwelling cannula prior to 1 hr of isolation in a novel cage. Blood samples were obtained from ear vessels at 30 and 60 min and behavior was observed. The 0.5 but not 1 μg dose significantly reduced plasma cortisol levels at both time points. In addition both doses increased the number of 1-min intervals that pups exhibited a characteristic crouched stance, particularly in females at the higher dose. These results show that central oxytocin can reduce the cortisol elevations of guinea pig pups under conditions (exposure to a novel cage) in which maternal buffering has been observed, and so support the possibility that oxytocin mediates the social buffering in infants of this species.

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EMBRYONIC ETHANOL EXPOSURE IMPAIRS PAVLOVIAN CONDITIONING IN THE ZEBRAFISH IN A TIME-DEPENDENT MANNER

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Individuals exposed to alcohol in utero can exhibit substantial deficits in some, but not all, types of learning and memory. This is especially true in tasks that require the hippocampus, such as spatial memory, declarative memory, and explicit recall of previously learned information. We have previously shown that rats exposed to ethanol during the third-trimester-equivalent (postnatal days 4–9) later exhibit impairments in a hippocampus-dependent trace fear conditioning task, but show normal performance in the hippocampus-independent delay conditioning procedure. Building upon this rodent research, the current project tested the effects of embryonic ethanol exposure in zebrafish (*Danio rerio*) on later trace and delay conditioning. Embryos were exposed to 0.5 or 1% ethanol for a 24h period beginning at various times post-fertilization. As adults, fish were trained in either Delay or Trace conditioning procedures using visual cues as the CS and US. The measure of learning was conditioned approach to the CS. Our preliminary findings indicate that ethanol has differential effects on delay and trace conditioning depending on the timing of exposure. Exposure during a period just before hatching (48–72 hpf) results in deficient learning of both tasks, whereas ethanol exposure occurring after hatching (72–96 hpf) selectively impairs trace conditioning. These data support the differential brain toxicity of ethanol depending on the timing of exposure, and add to the growing body of evidence supporting the zebrafish as a complementary model system for studying fetal alcohol exposure.

EEG CORRELATES OF PROPRIOCEPTIVE–VISUAL ASYNCHRONY PERCEPTION IN CHILDREN WITH AUTISM SPECTRUM DISORDER

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Proprioceptive–visual intermodal perception is posited to underlie self-recognition, self-other differentiation, and embodiment. For example, ownership of a fake hand can be induced through synchronized movements between the fake and an occluded real hand (Rubber Hand Illusion, RHI). Moreover, proprioceptive–visual integration is arguably the sensory basis for mapping others' movements onto one's own body, such as in imitation. Thus, a disturbance in proprioceptive–visual intermodal perception can presumably affect social awareness. In line with this notion, studies show that adults with ASD report less robust effects of the RHI, and children with ASD show a delayed onset of the RHI relative to typically developing children. More recent evidence indicates that the temporal binding of visual–haptic sensory input is altered in ASD relative to typical development. Currently, little is known about the neural differences during proprioceptive–visual intermodal perception in ASD. In this study, we recorded electroencephalographic (EEG) activity in children with ASD and in typically developing children in the following four different conditions: (1) passive observation of a series of reach-to-grasp movements, (2) performance of reach-to-grasp movements while the movements were occluded by a cloth partition but viewed on a monitor providing visual feedback, (3) same as two but with feedback delayed by 30 frames, and (4) at rest. Alpha and beta band EEG coherence and desynchronization were computed across primary motor, somatosensory, temporal, and occipital sensor sites. Group and individual differences in EEG coherence, desynchronization, and their interrelations with measures of social cognition and symptomatology were observed.

[Marino Autism Research Institute]

EFFECTS OF SUBDIAPHRAGMATIC VAGOTOMY ON MATERNALLY POTENTIATED VOCALIZATIONS IN RAT PUPS

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Accumulating evidence suggests that the maternal potentiation of ultrasound vocalization (USV) paradigm might serve as a translational model for the effects of maternal-offspring separation in the NICU. Very few studies have investigated the biological underpinnings of disrupted co-regulation and emotional connection that can follow maternal-offspring separation. Here we aimed to further investigate the role of the vagus nerve in the maternal-offspring connection using a rat model, where separation stress is assessed by USV potentiation. We also tested a new, less invasive, surgical technique for subdiaphragmatic vagotomy. On postnatal day (PND) 6–8, 70 rat pups were randomly assigned to one of three surgical groups of vagotomies, each with its own sham control: traditional vagotomy or two variations of a novel surgery, which involved tying a slipknot around the vagus such that it can be severed before testing. The slipknot was either pulled the night before testing, or thirty minutes before. USV testing took place on PND 11–13 using a 2 min isolation- 2 min reunion with dam- 2 min re-isolation (potentiation) paradigm. Pairwise comparisons of the change scores failed to show significance between many pairs which were expected to be different. Potentiation was not abolished after any of the vagotomies; in fact, in all groups, approximately half of pups showed an USV potentiation to maternal separation. Given the high variability in USV rates to maternal separation within each group and our vagotomy results, our findings indicate that potentiation could be regulated by several context-dependent mechanisms, which do not always involve the vagus.

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DEHYDROEPIANDROSTERONE LEVELS AT BIRTH: RELATIONS TO PREGNANCY AND DELIVERY CHARACTERISTICS

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Enhanced production of dehydroepiandrosterone (DHEA) by the fetal hypothalamic-pituitary-adrenal (HPA) axis enables maturational events critical for labor progression and neonatal adaptation. Despite knowledge of the interconnected nature of maternal and fetal physiology and dramatic changes in DHEA production after birth, few studies have examined DHEA in neonates. Understanding normative patterns of early DHEA activity is needed to accurately assess functioning of the biological stress system with relevance for health and development. This study examines DHEA concentrations over the first day of life and its associations with pregnancy, delivery, and demographic factors. Participants were 98 newborns (51% female) from a larger study of prenatal stress and newborn outcomes. Three saliva samples collected prior to and 20- and 40-mins following a medical stressor were quantified via immunoassay and used to determine baseline and stress reactive DHEA levels. Clinical data were obtained from medical records. Basal and reactive DHEA levels were significantly and positively associated with administration of labor-inducing and pain medications, as well as adolescent maternal age. DHEA levels significantly dropped in response to the stressor. DHEA reactivity, but not pre-stress levels, varied by time since birth and delivery method, with a more pronounced drop observed within 12 hr after birth and following vaginal delivery. By capturing DHEA levels immediately after birth, this study provides a window into prenatal functioning of the HPA system and reference levels in neonates. This knowledge of basic adrenal physiology provides a

foundation that can be expanded upon to help reduce long-term effects of early life exposures.

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THE RELATION BETWEEN EXECUTIVE FUNCTIONING AND LETHALITY OF SUICIDE ATTEMPTS AMONG ADOLESCENTS

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Suicide is the second leading cause of death among adolescents in the United States. The selection of higher lethality suicide methods, such as gunshot or hanging/suffocation, often results in higher likelihood of death. Importantly, it remains unclear precisely how and why people select more lethal means. This is in part driven by the environment and the physical accessibility to lethal means, but research also points to potential psychological mechanisms underlying suicide lethality as well. Among adults, it has been shown that those who select more lethal means are characterized by greater deficits in executive functioning. This has never been tested among youth. The current study aims to address this research gap by examining the association between executive functioning and lethality of suicide attempts among community-based adolescents (n = 52). We measure executive functioning using the Stroop task, and assess history of suicidal behaviors, lethality, and psychiatric diagnoses. The sample consists of adolescents with no prior history of suicidal ideation (SI) or attempt (SA), those with SI history, and those with SA history. We will continue to collect data, especially to increase the number of adolescents with SA history. Analyses will ultimately focus on comparing these three groups, with additional analyses focusing on attempters-only and examining them according to whether they selected low, medium or high lethality attempts. Univariate and multivariate analyses controlling for psychiatric symptoms (e.g., depression) will be conducted. Findings from this study are expected to inform prevention efforts by identifying a psychological mechanism underlying suicide lethality in youth.

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THE ASSOCIATION BETWEEN PARENT AND CHILDREN'S CHRONIC PHYSIOLOGICAL STRESS: THE MODERATING ROLE OF EMOTION REGULATION

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Emotion regulation (ER) is related to better ability to cope with everyday stress (Lengua, 2002) and may contribute to the interplay of environmental and biological stress. No work has been done to examine the links between chronic physiological stress and ER in preschoolers. The current study (N = 49, 28 females, M = 43.54 years) investigated the association between parent and child chronic physiological stress, and examined ER and household chaos as potential moderators of this relationship. We collected hair cortisol concentration (HCC), a biomarker of chronic hypothalamic-pituitary-adrenocorticol activity from both parents and children. We measured ER and household chaos through the *Emotion Regulation Checklist* and *Confusion, Hubbub, and Order Scale*. Lower ER (r(49) = −.361, p = .012) and higher parent HCC (r(50) = .60, p < .001) were related to higher levels of child HCC. Higher household chaos was associated with poorer ER (r(70) = −.32, p = .008). A conditional process model (F(5, 43) = 7.89, p = <.001) yielded a significant parent HCC x ER interaction (B = −.14, CI = −1.57, −.22), revealing a conditional effect of parent HCC on child HCC (B = 3.31, CI = .34,6.23), while household chaos was not a significant moderator. Thus, the relationship between parent and child HCC varies depending on children's ER but not on levels of chaos in the home. For children with high levels of ER, there was no relationship between parent and child HCC, but at lower levels of ER, there was a positive association. Findings suggest that children's own capacity of ER buffers the transgenerational effects of chronic physiological stress.

HIDDEN AFFORDANCES IN PLAIN SIGHT: DISCOVERING POSSIBILITIES FOR ACTION WITH DUPLO BRICKS

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All objects offer "overt affordances," where information about possible actions with the object is easily accessible to perception. For example, it is easy to see that a water bottle can be grasped, banged, and shaken. But how would a neophyte infant or child discover that the lid must be twisted to the left to open? Such "hidden affordances" characterize most everyday artifacts, which are designed for particular actions—most of which are not easily accessible to perception. Here, we examined how young children discover hidden affordances during free play with Duplo bricks, a toy with both salient overt (swiping, banging, etc.) and hidden affordances (interlocking the bricks). The studs and holes are visually apparent and fun to touch, but the possibility of interlocking studs with holes must be discovered. Results from 48 children (12 to 60 months) show a developmental trajectory, from actions geared to exploiting overt and hidden affordances. Most 12-month-olds (83%) displayed simple actions on overt affordances (swiping, banging, etc.). Although a subset of infants (33%) also explored the studs and holes by fingering and looking, they did not realize that the bricks could be interlocked. By 24 months of age, all infants displayed successful interlocking of bricks, but they only stacked bricks on top of each other. Not until 42 months of age did children (75%) fully exploit the hidden affordances of Duplos by

recognizing that bricks can be interlocked into creative and irregular structures.

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SOCIOECONOMIC AND ENVIRONMENTAL CORRELATES OF INFANT HAIR CORTISOL

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Chronic biological stress is linked to poor health outcomes, but the factors that shape biological stress are not well understood. The current study investigated the association of socioeconomic and environmental context with infant hair cortisol concentrations (HCC), a reliable measure of chronic biological stress. We collected hair cortisol samples from 76 infants (37 males, $M = 12.22$ months, $SD = .77$). Mothers filled out a sociodemographic form. Chaotic context of household and neighborhood were evaluated by Confusion, Hubbub, and Order Scale (Matheny et al., 1995), and Neighborhood Organization and Affiliation Scale (Coulton et al., 1996), respectively. Higher infant HCC was correlated with higher neighborhood chaos ($r(75) = .33$, $p = .004$), but was unrelated to household chaos, $r(75) = .17$, ns. Parental occupational prestige was negatively correlated with infant HCC, $r(75) = -.27$, $p = .02$. Infants whose families had lower income had higher HCC, $r(72) = -.29$, $p = .01$. Maternal education level was unrelated to infant HCC, $t(74) = 1.08$, ns. However, a nonsignificant trend was observed such that infants of less educated fathers tended to have higher HCC, $t(73) = 1.78$, $p = .08$. Results demonstrate the sensitivity of infant cortisol to multiple aspects of socioeconomic status, suggesting one pathway through which socioeconomic status may contribute to allostatic load from very early in life. It is striking that HCC is related to neighborhood chaos as early as infancy, and may reflect an indirect pathway in which neighborhood chaos shapes the stress levels and responsivity of the parents.

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SEX DIFFERENCES IN PUP CAREGIVING IN A RODENT MODEL OF SCARCITY-ADVERSITY WITH MALTREATMENT

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Quality of maternal care received early in life has life-long implications for brain and behavioral outcomes. Our lab employs a rodent model of caregiver resource deprivation. This manipulation results in caregiver maltreatment toward pups. Using this model, we have identified a number of sex-specific outcomes of experiencing this form of early adversity. For example, male rodents exposed to this manipulation demonstrate altered fear behavior, while females exhibit alterations in depressive-like behavior. One potential explanation for these sex-specific outcomes could be that male and female offspring are receiving a different quality of maternal behavior. It is well-documented that males are licked and groomed more often than their female littermates, however, it is unknown if there are differences in adverse maternal behaviors performed toward male and female pups particularly during times of adversity (i.e. resource deprivation). To test this hypothesis, we subjected male and female pups to our scarcity-adversity model of low nesting resources for 30 min per day for the first postnatal week of life and tracked the maternal behavior performed toward individual pups. Preliminary data indicate that dams perform more adverse maternal behaviors toward female as compared to male pups. The relationship between DNA methylation, an epigenetic mechanism which alters the way that genes are expressed; and receiving adverse maternal care will be presented.

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DEVELOPMENTAL CONSEQUENCES OF COMMON BIRTH INTERVENTIONS IN PRAIRIE VOLES

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Oxytocin is one of several hormones that help coordinate the remarkable adaptations that must occur in the fetal brain at birth. In the Unites States currently, 32% of births are delivered via Cesarean-section, while it is estimated approximately half of all births experience the addition of exogenous oxytocin. Thus, there is great variation in birth experience with the potential for similar variation in oxytocin signaling. In the course of our recent experiments, we have explored the developmental consequences of variation in birth experience in terms of offspring social behavior. Preliminary evidence suggests that prairie voles born to oxytocin-treated dams display a more gregarious phenotype across several domains of behavior in later life. These effects were subsequently replicated in a follow-up study that made use of cross-fostering to disentangle potential confounds of changes in maternal behavior. The observed behavioral differences may relate to changes in epigenetic regulation of the oxytocin receptor and differential expression patterns thereof. These findings have significant public health relevance given the widespread nature of labor induction / augmentation with exogenous oxytocin in contemporary obstetric practice.

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SHYNESS, CORTISOL, AND QUALITY OF LIFE AMONG ADULTS WITH SCHIZOPHRENIA

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Individual differences in temperament develop early in life and remain stable throughout adulthood. Those who are temperamentally shy are susceptible to impairments in several domains including poor social functioning, reduced quality of life (QoL), and higher rates of psychiatric disorders. Although shyness is known to be associated with reduced QoL in adults with schizophrenia, this is not always the case, suggesting moderating influences may affect this relation. One biological influence linking temperament and QoL in healthy controls is cortisol. Individuals with schizophrenia display dysregulated cortisol activity, which may influence the relation between temperament and QoL; however, this has not been examined in schizophrenia. In this study, we investigated whether baseline cortisol levels moderated the relation between shyness and QoL in 34 stable outpatient adults with schizophrenia. Participants completed the Heinrichs Quality of Life and Cheek & Buss scales to assess QoL and shyness, respectively. Regression analyses revealed that cortisol modified the relation between shyness and QoL ($ß = 1.092$, $p = 0.004$) such that individuals with low baseline cortisol and high shyness displayed the lowest QoL. Individuals with high baseline cortisol reported similar QoL scores irrespective of shyness status. These results suggest that low cortisol may be helpful to understanding the relation between temperament and QoL in schizophrenia. These findings are consistent with extant studies implicating developmental changes from high to low cortisol levels in people who are shy and the negative downstream effects resulting from HPA axis dysregulation, extending those studies to people who have schizophrenia and are shy.

WHEN GIVING BECOMES RECEIVING: BENEFITS OF SCIENCE COMMUNICATION

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Communicating your research across a range of audiences not only allows you to experience the joy that comes from sharing your passion, but it can offer great benefits for your academic career. Dr. Jee Hyun Kim shares her personal experiences in public engagement, which have led to unique opportunities for collaborations, presentations, grant funding, and promotion. From what started as a way to give to the community and her colleagues in science communication, Dr Kim's outreach efforts has grown her academic standing internationally. Her science communication has directly facilitated her research in ways ranging from easy recruitment of human participants for her studies to being invited as a paid expert consultant in various organisations, leading to innovative collaborations. How we consume information is changing world-wide, so do not miss out on the future of disseminating your science!

DISTRACTOR SUPPRESSION AND MEMORY PERFORMANCE IN SCHOOL AGE CHILDREN

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Previous literature has shown that declining selective attention skills during aging results in poorer distractor suppression, allowing older adults to benefit from distracting information to enhance memory. Young children also show poor distractor suppression due to the protracted development of selective attention. This study examines whether young children's memory can similarly benefit from distracting information. Children ages 4–8 years completed a combined memory-attention task consisting of three phases: encoding, visual search, and retrieval. Children viewed multiple objects during encoding. Next, children searched for a target amongst 0, 5, 10, or 15 distractors. Half of the objects from encoding were included as "relevant" distractors. The remaining half ("irrelevant" distractors) were not re-presented during the search phase. During retrieval children saw all objects from encoding and an equal number of novel objects and indicated whether they were old or new. Preliminary analyses examined memory and attention separately. Visual search response time (RT) slowed with increasing number of distractors, indicating an RT cost associated with distractor suppression. Older children showed better memory overall. Primary analyses examined relationships between distractor suppression, age, and memory for relevant vs. irrelevant distractors. Children who were least efficient at suppressing distractors (i.e., showed greater RT cost) showed the best memory for relevant distractors. This effect increased with age, such that older children who were least efficient at suppressing distractors showed the greatest memory benefit for relevant distractors. These findings suggest that relevant distraction can boost children's memory while the selective attention system is still developing.

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ASSOCIATIONS BETWEEN THE GUT MICROBIOME, COGNITIVE PERFORMANCE, AND NEUROIMAGING PHENOTYPES IN TYPICALLY DEVELOPING HUMAN INFANTS

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In humans, the first year of life is a dynamic time in gut colonization and brain development, but little is known about the relationship between these processes. In this preliminary study, fecal samples were collected from 89 typically developing one-year old infants. 16s rRNA amplicon sequencing was used for identification and relative quantification of bacterial taxa. Measures of alpha diversity were generated and distance metrics and cluster scoring methods were used to identify genus level enterotypes. Cognition was assessed at 1nd 2 years of age using the Mullen Scales of Early Learning. Brain scans were acquired on a Siemens head-only 3T TIM-Trio scanner (Siemens Medical System, Erlangen, Germany) during unsedated natural sleep. Microbial composition at 1 year of age was associated with cognitive outcomes and regional gray matter volumes at 2 years. In addition, we observed significant associations between the infant gut microbiome and functional connectivity at 1 year. Microbial composition influenced connectivity between sensorimotor and language networks, and between right amygdala and bilateral insular cortex, key nodes in circuits for fear-reactivity and salience processing. Ultimately, with further research, it may become possible to guide the development of the gut microbiome through targeted interventions, thereby supporting cognitive development and reducing risk for later psychiatric disorders.

FRIENDS GIVE BENEFITS: AUTUMN SOCIAL FAMILIARITY PREFERENCES PREDICT REPRODUCTIVE OUTPUT

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Fission-fusion dynamics create social instability, as individuals must adjust to changes in group size and composition. In many social species, group changes are associated with increases in aggression, stress responses, and individual mortality. It has been hypothesized that fission-fusion processes select for strong bonds between familiar individuals that provide a predictable social environment across group changes. This study explored if familiar social networks remain predictable across periods of social instability in brown-headed cowbird (*Molothrus ater*) flocks, and if females who sustained stronger fall familiarity preferences show higher reproductive output during the spring. During autumn, the organization of familiar social networks remained predictable across a series of introductions with novel flocks. Familiar individuals were able to maintain their relationships with each other despite large-scale group perturbations. During the spring, I found that fall familiarity preferences was the only predictor of reproductive output, with female cowbirds that sustained the strongest familiarity preferences laying more eggs than other females. These findings suggest that familiarity preferences have a cascading influence on later reproductive performance, and that the social dynamics of fission-fusion groups select for a familiarity-based social organization.

INFANT CRY ACOUSTIC FEATURES: AN EARLY WINDOW INTO PHYSIOLOGICAL CONSTRAINTS ON EMERGING LANGUAGE DEVELOPMENT?

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The Polyvagal Theory (Porges, 2007; 2011) proposes that over the course of evolution the neural regulation of the muscles of the face and head – including the larynx, pharynx, and middle ear – became integrated with the vagal pathways that regulate body states to form an integrated social engagement system (SES). These connections provide the foundation for the regulation of behavioral and physiological state, affiliative social orienting, vocalization feature modulation, and propagation of language-carrying frequencies in the middle ear (Porges & Lewis, 2009; Kolacz, Lewis, & Porges, in press). We examined whether infant cry acoustic features may serve as an index of SES function and a predictive tool for language development. The sample consisted of an ethnically and socio-economically diverse group of 37 children. At 6 months infant cry spectral-temporal instability was measured using the modulation power spectrum (Singh & Theunissen, 2003) and vagal regulation of the heart was indexed via respiratory sinus arrhythmia (RSA) derived from an ECG signal. Language development at 12 months was measured using the Bayley Scales of Infant and Toddler Development. Unstable (more modulated) cries at 6 months were related to lower amplitude RSA (β = −.421, *SE* =.151, p =.009, R^2 =.206) and predicted poorer receptive language skills at 12 months (β = −.486, *SE* =.143, p =.004, R^2 =.236). These results provide evidence that infant cry acoustic features are

functionally integrated with the SES and may provide an early, non-contact window into physiological constraints that affect language development.

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THE RELATIONSHIP BETWEEN WEIGHT-BEARING LOCOMOTION AND TENDON CHARACTERISTICS IN RATS II: EFFECT OF NEONATAL SPINAL CORD TRANSECTION

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The aim of the current study was to examine the effect of impaired locomotor development on hindlimb tendon development in spinal transected rat pups. Rats received a low thoracic spinal cord transection surgery or sham surgery on postnatal day 1 (P1; 24 hr after birth). Subjects were tested on P10 in an open-field environment for a 20-minute test session, and locomotion, posture, and weight-bearing activity were measured. Immediately following testing, subjects were euthanized, hindlimbs were removed and Achilles tendons were extracted for further testing. Spinal transected subjects generally do not show the same level or amount of locomotor and weight-bearing activity compared to controls. In regards to Achilles tendon development, data indicate that pups that underwent spinal cord transection had tendons with altered mechanical properties, specifically a reduced average maximum force (1.0 ± 0.7 N), compared to controls (sham subjects: 3.2 ± 0.9 N). These results demonstrate the potential for mechanical stimuli associated with postnatal locomotor development to significantly influence the functional properties of tendons, and for bidirectional developmental influences between musculoskeletal and neurobehavioral systems.

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BEHAVIORAL EFFECTS OF PRENATAL EXPOSURE TO SERTRALINE, AN SSRI ANTIDEPRESSANT, AND ITS DISCONTINUATION IN THE OFFSPRING IN AN ANIMAL MODEL OF DEPRESSION

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Major depressive disorder is classified by the World Health Organization as the leading cause of disability worldwide. Women suffer from depression at higher rates than men, and are frequently prescribed antidepressant medication. However, should a woman become pregnant, she must choose whether to continue treatment, as both maternal depression and antidepressant treatment can negatively impact fetal development. This study investigated this question using an animal model of depression. The developmental implications of maternal depression, and its treatment with sertraline, a frequently prescribed selective serotonin reuptake inhibitor (SSRI), and the discontinuation of treatment during pregnancy were assessed. For this, 36 female Sprague-Dawley rats were treated with a vehicle or corticosterone (CORT; 40 mg/kg, s.c.) for 21 days to create a depressive-like phenotype. On the 16th day of CORT/oil treatment, rats were given sertraline (SER; 20 mg/kg, p.o.) or a vehicle daily, then mated with males at the end of the CORT treatment period. To investigate any differential effects of SER discontinuation, half of the SER-animals discontinued treatment at gestational day (GD) 16, and the other half continued receiving the medication through parturition. Adult offspring then underwent behavioral testing to determine the effects of each condition on anxiety-like and depressive-like behavior, and stress reactivity. Results indicate sex-dependent effects of both CORT and SER treatment and its discontinuation in the behavior of the offspring. There is a critical need for more research on the effects of these exposures, and the discontinuation of antidepressant medication during pregnancy in order to better advise pregnant women.

BEHAVIORAL AND WEIGHT EFFECTS OF PERINATAL EXPOSURE TO PHTHALATES AND A HIGH-FAT DIET IN MALE AND FEMALE RATS

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Humans are ubiquitously exposed to phthalates, a class of endocrine-disrupting chemicals used as plasticizers or solvents with diet, especially fatty foods, presumed to be the main source due to environmental contamination. Given this correspondence and since phthalates and high fat diets (HFDs) are separately capable of increasing oxidative stress and inflammation, it is important to study their potential interaction. Since phthalates and many inflammatory cytokines can cross the placenta, the prenatal period appears to be a particularly vulnerable window to environmental insult. Here, we use a rat model of human prenatal exposure to investigate the effects of phthalates and a HFD. From gestation through postnatal day 10, dams ate an environmentally relevant mixture of phthalates (0, 200, or 1000 μg/kg/day) and were also fed a control or HFD. Results indicate that a HFD didn't exacerbate phthalate-induced effects, though there were small interactions with pubertal onset. However, dams fed a HFD consumed more calories and had greater gestational weight gain. Likewise, an early postnatal HFD generally increased pup body weight that persisted only in males into adulthood. The HFD dams displayed more maternal care behaviors, specifically licking while nursing pups and nest building. Additionally, perinatal phthalate exposure resulted in lower prepubertal body weights in

males and a dose-dependent decrease in periadolescent social play behaviors in both sexes.

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CPS-REFERRED MOTHERS' PSYCHOPHYSIOLOGICAL RESPONSES TO OWN VERSUS OTHER CHILD PREDICT SENSITIVITY TO CHILD DISTRESS

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Maltreating mothers often struggle to respond sensitively to their children's distress. Examining psychophysiological processing of own child cues may offer insight into neurobiological mechanisms that promote sensitive parenting among high-risk mothers. The current study used event-related potential (ERP) methodology to examine associations between mothers' neural responses to their own child versus other children and observed sensitivity to distress. Participants included 73 mothers: 42 with histories of child protective services involvement and 31 low-risk comparison mothers. Maternal sensitivity to child distress was coded from observations of children's blood sample collection. Late positive potential (LPP) ERP responses, which reflect sustained attention to emotionally salient stimuli, were measured when mothers viewed photos of their own child and other children. An own-other LPP difference score was computed by regressing the mean amplitude of mothers' LPP to their own child on the mean amplitude of mothers' LPP to other children. CPS-referred mothers and low-risk mothers did not differ in their LPP responses to own child, other children, or the own-other LPP. However, there was a significant interaction between group (CPS-referred vs. low-risk) and own-other LPP in predicting maternal sensitivity. Among the CPS-referred mothers, own-other LPP was significantly correlated with maternal sensitivity, with greater LPP amplitude to own versus other child associated with higher maternal sensitivity. In contrast, among the low-risk group, own-other LPP was not significantly correlated with maternal sensitivity. Findings add to our understanding of the neurobiology of sensitive parenting among high-risk mothers.

IMPACT OF NEST QUALITY ON DAM-LITTER INTERACTIONS IN LONG-EVANS RATS AND DEVELOPMENT OF CENTRAL OXYTOCIN SYSTEMS

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Mother-infant interactions during early life shape neurobiological circuits needed for affiliative behavior beyond the mother-infant relationship in early life, including relationships with peers, potential mates, and offspring in the next generation. Oxytocin has not only been implicated in adult affiliative behaviors (maternal behavior, mating behavior, social bonding, social buffering of stress), but is also thought to facilitate behaviors that promote typical mother-infant interactions in young rats. Serious disruptions in mother-infantinteractions can lead to changes in hypothalamic-pituitary-adrenal (HPA) regulation, which can be explained in part by changes in maternal regulation of infant's stress response through maternal buffering of stress. We explored the impact of developmental stress on short and long-term development of oxytocin systems using bedding deprivation, a manipulation that induces more fragmented mother-litter interactions, inability to construct a proper nest, or maintain a huddle. Female Long-Evans dams gave birth and received standard housing or reduced bedding on postnatal day 2–14. A subset of offspring from each litter was sacrificed on P15 while the remaining animals were sacrificed as adults. Outcomes include acute and chronic hormone levels (chronic cortisol in hair following stress manipulation, baseline cortisol, and oxytocin), oxytocin receptor levels in brain areas important to social buffering of stress (PVN, amygdala, hippocampus), and behavioral outcomes (huddling behaviors in infants, social interaction in adulthood). We build on previous work suggesting oxytocin systems are affected by early experience by connecting experience in the nest, oxytocin, and social behavior later in life.

CONSISTENCY OF HAND PREFERENCE DEVELOPMENT ACROSS CHILDHOOD

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Hand preference is a trait that emerges during early development. Cascade theory states that the development of hand preference for a simple action early in infancy will influence the development of hand preference for more complex actions later in development. This study will analyze the consistency of these preferences across three age periods: infancy (6–14 months old), early toddlerhood (18–24 months old) and the preschool period (at 5 years). The study is designed to determine whether the preferences that develop early in infancy are maintained as the children add more complex actions to their repertoire. The infant's manual preference for acquiring objects is assessed longitudinally during the 6–14 month age period. This preference is compared to their manual preference for role-differentiated bimanual manipulation assessed during the 18–24 month age period and finally these preferences are compared to a hand preference for a peg-moving task that is commonly used at 5 years of age. Consistency will be measured by chi-square assessment of the contingency of the individual's hand classification (right, left, no preference) across the infant and toddler tasks. Subsequently, infant and toddler handedness will be used to predict 5-year-old speed differences between the hands in transferring the pegs. Consistent with cascade theory, it is predicted that infants with an identifiable preference for the 6–14 month age period will maintain this preference into toddlerhood and childhood.

THE NEUROSCIENCE AND TREATMENT OF IRRITABILITY IN YOUT

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Irritability is one of the most common reasons that youth present for mental health care, but its biological mechanisms remain largely unknown. We (1) recently proposed a translational heuristic model for the pathophysiology of irritability, focusing on the roles of aberrant responses to frustration and aberrant approach responses to threat. Frustration can be modeled during functional scanning i.e., by having children play rigged games. In irritable youth, studies show prefrontal and striatal abnormalities when irritable youth attempt to exert cognitive control after frustration. Of note, irritability can be conceptualized as aberrant responses to threat, whereas anxiety is characterized by aberrant avoid responses to threat. Indeed, anxiety and irritability have cross-sectional, longitudinal, and genetic associations. On social threat paradigms, irritability is associated with aberrant amygdala-striatal-frontal activity, whereas anxiety is associated with aberrant amygdala-prefrontal connectivity. These pathophysiological findings will be discussed, along with their implications for novel treatment development.

PHYSIOLOGICAL WAKE-UP CALL IN POST-INSTITUTIONALIZED ADOLESCENTS – DIFFERENCES IN THE CAR FOR EARLY- VERSUS LATE-ADOPTED CHILDREN

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Exposure to chronic stress early in life has been consistently associated with disruptions of physiological stress systems important for social and cognitive outcomes, especially the hypothalamic-pituitary-adrenal (HPA) axis. The cortisol awakening response (CAR) is one measure of HPA axis functioning that is superimposed on the diurnal cortisol rhythm and considered a type of physiological preparation for the day. While some work has been done examining the impact of early life stress (ELS) on the CAR, strict guidelines on measurement and analysis have since been published. Using updated guidelines, the present analysis examined CAR data from 277 adolescents between the ages of 7 and 15. Of these, 123 youth were adopted from institutional care settings before 60 months of age and were further divided into early-adopted (N = 66, 6 to 16 mos) and late-adopted (N = 57, 16–60 mos) groups. The CAR was shown to be blunted, evidenced by a flatter morning cortisol slope, for the late-adopted group when compared to the early- and non-adopted groups, with no difference in CAR between the early- and non-adopted groups. These results suggest that ELS is related to modified HPA axis functioning, but that being removed from adverse environments earlier in life might correspond with mitigated detrimental impacts.

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PRENATAL EXPOSURE TO MATERNAL ACCULTURATIVE STRESS, SOCIAL SUPPORT, AND ACUTE INFANT HPA ACTIVITY IN INFANTS OF MEXICAN DESCENT

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Prenatal stress exposure may negatively impact the developing fetal hypothalamic-pituitary-axis (HPA), a likely risk factor for later adverse health outcomes. Mexican Americans may be particularly vulnerable as they experience high levels of psychosocial stressors, including cultural adaptation, i.e., acculturative stress. Social support may positively influence infant development. Whether it buffers the effects of prenatal acculturative stress is unknown. We hypothesized that higher maternal acculturative stress and decreased perceived social support would be associated with exaggerated acute cortisol responses in neonates. Acculturative stress and perceived social support measures were collected from 41 pregnant Mexican-American women. Infant salivary cortisol was collected at birth and 6 months following a mock medical exam and Still-Face paradigm, respectively. Area under the curve (AUC) was calculated. Neither prenatal acculturative stress nor perceived social support were associated with birth AUC (p>.05). Less acculturative stress (R^2 = .079, B = −.101, t = −2.27, p = .027) and more social support (R^2 = .253, B = .196, t = 3.14, p =.004) were associated with higher 6 month AUC. Social support did not moderate the relationship between acculturative stress and AUC (p > 0.05). Infants with a higher AUC at birth were also higher at 6 months (t = 3.053, p = .005). Prenatal exposure to acculturative stress may be a risk factor for infant HPA development. Social support may not buffer against these effects. These data may increase our understanding of sociocultural factors associated with HPA programming in Mexican Americans.

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NEURAL ACTIVITY IN RESPONSE TO ANXIETY IN LACTATING DAMS AND VIRGIN MICE IN BRAIN AREAS ASSOCIATED WITH ANXIETY CONTROL

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Lactating dams show less anxious-like behaviors and changes in neural activity when exposed to stress compared to virgin mice. It is unclear if these changes are due circulating postnatal hormones or pup exposure and if these changes occur in individual regions or amongst a network. To answer this question, lactating dams, sensitized virgins (virgins

exposed daily to donor pups), and naïve virgins (no pup exposure) were exposed to a mild stressor and maternal behavior test. Brains were then collected and stained for c-Fos, an indirect marker neuronal activity. The c-Fos positive cells from brain regions Bed Nucleus of the Stria Terminalis dorsal (BNSTd), Bed Nucleus of the Stria Terminalis ventral (BNSTv), Central Amygdala (CeA), Medial Amygdala (MeA), and Medial preoptic Area (MPOA) were counted since they are areas relevant for control of anxiogenic and stress-related behaviors. Results showed naïve virgin's head poked less than lactating dams ($p = 0.002$), but no difference amongst the three groups in c-Fos counts in any of the tested regions. However, each group demonstrated a differential cluster of neural circuitry amongst the five regions tested, with mPOA not being involved in the circuitry in sensitized virgins and related to only amygdalar regions in lactating dams, but correlated with both amygdalar and BNST regions in the naïve virgin group. This work suggests naïve virgins are less anxious than lactating dams and need to recruit a more extensive network. As there was no difference between lactating dams and sensitized virgins, these effects may be driven by pup exposure.

DIFFERENTIAL SUSCEPTIBILITY TO WEIGHT GAIN IN INFANCY

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Impoverished and ethnic minority children are at elevated risk of obesity and associated health problems. Children who are biologically susceptible (indexed by resting respiratory sinus arrhythmia [RSA]) may experience more unhealthy weight gain in high-risk environments but may be resilient to unhealthy weight gain in low-risk environments. This study assessed infant weight seven times from birth to age two in a sample of 322 low-income Mexican-origin mother-infant dyads. Weights were converted into weight-for-length z-scores (WLZ; WHO, 2006). Infant five-minute resting RSA was assessed at six weeks. Mothers reported their depressive symptoms (EPDS; Cox et al., 1987) every three weeks from 6- to 24-weeks postpartum; offspring total exposure was then calculated using area under the curve. A linear growth model was estimated with MPlus that predicted the intercept and slope of infant WLZ from the RSA X postpartum depression interaction, adjusting for birth weight and maternal BMI. The model showed good fit (e.g., RMSEA = .037; CFI = .93; Hu & Bentler, 1999). The slope was positive across the sample, indicating excessive weight gain relative to population norms. The interaction term was a statistically significant predictor of the slope ($p = .009$). In low-risk (i.e., low maternal depression) environments, infants with low RSA exhibited the healthiest weight gain trajectories (i.e., smaller positive slope). However, in the context of higher depression, higher RSA was protective against excessive weight gain. Results suggest that social-ecological influences on infant weight gain are moderated by biological factors, especially among susceptible infants.

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NEURAL AND BEHAVIORAL CORRELATES OF CHILDREN'S ATTENTION BIAS TO REWARD AND SOCIAL ADJUSTMENT: EXAMINING THE ROLE OF PARENTING

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Parenting styles provide the emotional climate for young children, influencing their social adjustment. Authoritative parenting, characterized by demanding yet sensitive parenting, has been linked to social competence (e.g., Maccoby & Martin, 1983). Alternatively, authoritarian parenting, characterized by demanding and unresponsive parenting, has been associated with poor social adjustment (e.g., Williams et al., 2009). Research suggests that cognitive biases toward emotions may affect links between parenting and psychopathology (e.g., Gulley et al., 2014). Event-related potential (ERP) studies indicate that maltreated children show increased attention to angry faces (e.g., Pollak & Tolley-Schell, 2003). Reward processes, captured by bias to happy faces, are understudied, particularly in parenting contexts. We examined how neural and behavioral reward biases moderated associations between parenting and children's adjustment. Children (62-to-date, 27 boys; $M_{age} = 5.5$ years, $SD_{age} = 0.65$) completed the dot-probe task to measure behavioral (RT) and neural (ERP) attention bias to reward. ERP analyses used mean amplitudes for frontal N2 and P2, elicited by face pairs. Parents completed the Parenting Style Questionnaire (Smith et al., 1993) and the Child Behavior Checklist (Achenbach & Rescorla, 2000). Notably, the authoritative parenting and N2 amplitude interaction predicted internalizing problems ($\beta = -.08$, $SE = .04$, $p = .04$), such that children with smaller N2 amplitudes to reward had more internalizing problems when parents were less authoritative. The interaction between authoritarian parenting, P2 amplitude, and reward bias predicting internalizing problems was also significant ($\beta = .001$, $SE = .001$, $p < .01$), indicating that children who allocated less attention to reward at both neural and behavioral levels had more internalizing problems when parents were more authoritarian.

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EFFECTS OF EARLY LIFE STRESS ON EARLY BEHAVIORAL AND NEURONAL DEVELOPMENT

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Early life stress (ELS) increases the lifelong risk for developing stress-related disorders, including anxiety, depression and PTSD. It is estimated that over seventy-five percent of adults with stress-related

disorders met diagnostic criteria as children and adolescents, however, fewer than one in five children or teens are expected to receive adequate treatment. The mechanisms underlying increased risk for stress-associated pathology following ELS are not known. It is hypothesized that the roots of later emotional disturbance may lie in altered development and long term functioning of cortico-limbic circuits that regulate emotional reactivity and threat evaluation, including the basolateral amygdala (BLA), the site of threat learning, and the infralimbic (IL) and prelimbic (PL) cortices. Elegant work in control reared animals have shown that these regions are late maturing and in adult animals these regions have been shown to be highly sensitive to stress. Here, we use a mouse model of ELS in the form of limited maternal bedding from P4-P11. Previous work by our lab and others has shown that Limited Bedding Stress (LBS) induces a fragmentation in maternal care and results in stress in the developing pup. LBS reared animals recapitulate behavioral endophenotypes of stress-associated illness in humans, including increased risk for anxiety and depressive-like behaviors and cognitive disturbance as well as precocious emergence of some forms of threat-associated learning. To determine effects of ELS on the development of threat assessment, we tested control and ELS reared mice for the development of anxiety-like behavior in the open field and elevated plus maze and threat-associated learning in a contextual and cued conditioning paradigm. We find a general decrease in anxiety-like behaviors in standard reared mice at P28. In a context and cued conditioning paradigm, we find that ELS mice show decreased cue and context-associated freezing at P21 while standard reared mice show decreased contextual fear expression at P28. Interestingly, at P21, ELS reared mice show what appears to be a decrease in risk assessment. Along with these behavioral assays, we will provide evidence from immunohistochemical, molecular and optogenetic techniques to provide evidence for the hypothesis that this altered development of risk assessment is due to asymmetrical effects of ELS on the timing of cortical and limbic development.

CHANGES IN SITTING CONTROL AFFECT TOY EXPLORATION DURING INFANCY

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The development of sitting changes how much infants are able to explore toys. Infants who can sit with their arms free and more upright can explore their environment more effectively than propped sitters, as their hands are free to explore. Thus, advances in infants' sitting likely enable infants to explore toys more effectively. We seek to understand how propped sitters change the amount of toy exploration from arms-free sitters. Infants younger than 7 months (n = 36) were recruited at sitting emergence, either prop-sitting or arms-free without the ability to change positions. Infants were grouped into sitting stage at baseline (propped or arms-free). Across 3 visits (baseline, 3 weeks later, 6–8 weeks later), researchers assessed the infants' sitting angles as a measure of control and toy exploration. To measure sitting angle, infants' right side were video-recorded side and sitting angle was calculated between the leg (knee/hip) and trunk (hip/shoulder) using Angles Application. Infant-supported sitting angle was subtracted from researcher-supported angle to create an angle difference score. To measure exploration, the average duration of time/seconds infants spent exploring was coded on three toys (pop-up, nesting cups, gumball machine), one-at-a-time. Preliminary analyses ($\alpha < 0.06$) using multilevel modeling (n = 20) found that arms-free sitters decreased angle difference scores more quickly, than propped ($\beta = -13.60$, $p < 0.07$) and arms-free sitters initially explored toys for longer than propped ($\beta_{01} = 15.38$, $p < 0.05$). More advanced sitters explored toys for longer, than propped sitters; however, analysis of the larger sample is needed to investigate more complex relations between sitting stage, sitting angles and exploration.

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SUBCLINICAL NEWBORN METABOLITE LEVELS PREDICT NEURODEVELOPMENTAL SYMPTOMATOLOGY

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Newborn metabolite screenings are routinely utilized to detect rare congenital disorders leading to neurodevelopmental deficits, if left untreated. Neonatal metabolite levels show a normal distribution, yet only the most extreme levels warrant a diagnosis and immediate intervention. Despite the significant impact metabolic disorders have on neurodevelopment, little research has been done to determine the effects of subclinical variation among these metabolites. Our study aimed to determine whether subclinical metabolite levels are associated with neurodevelopmental symptomatology. We hypothesized that the metabolites used to diagnose a disorder can also be used to predict the subclinical phenotypes associated with that condition. 122 children from age two to twelve, spanning a spectrum of social, behavioral, and cognitive capabilities, were recruited from hospitals and clinics across the state of Iowa. Parent-reports were corroborated with medical records to determine the children's symptomatology and medical history. Newborn screening results, covering 73 metabolites, were obtained for each child from the Iowa Department of Public Health. None of our participants' newborn screening results led to a diagnosed congenital disorder, yet subclinical metabolite levels were found to predict neurodevelopmental phenotypes. Metabolites (e.g. Arg/Orn) used to diagnose disorders characterized by cognitive deficits (e.g. Argininemia) were significantly associated with our measures of cognitive skills. Metabolite correlations were also observed for social impairments, sleeping patterns, eating habits, and gastrointestinal distress. Newborn metabolite levels can predict neurodevelopmental symptomatology. This suggests that the pathways impacted by

congenital metabolic disorders function along a continuum, and even subtle metabolic irregularities can impact neurodevelopment.

PROGRESSION OF SUSTAINED ATTENTION DEFICITS IN THE HIV-1 TRANSGENIC RAT

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Life expectancy for individuals with human immunodeficiency virus type 1 (HIV-1) dramatically increased following the advent of combination antiretroviral therapy. Although HIV-1 seropositive individuals are living longer; the progression of HIV-1 associated neurocognitive disorders (HAND) has not been systematically evaluated. Progression of sustained attention deficits in the HIV-1 transgenic (Tg) rat; a sequelae of long-term HIV-1 viral protein exposure; was examined using a longitudinal experimental design. At two months of age; male and female HIV-1 Tg and control animals were trained in a signal detection operant task with varying signal durations (1000–100 msec) until meeting criteria (70% accuracy for five consecutive or seven non-consecutive days). Animals were retested every sixty days across their functional lifespan. At 18 months of age; animals were challenged with shorter signal durations (1000–10 msec). HIV-1 Tg and control animals displayed improved performance in signal detection across retests. HIV-1 Tg animals; however; improved significantly more slowly and to a lesser degree than control animals. No significant effect of genotype was observed in signal detection at initial acquisition. At the first retest; however; HIV-1 Tg animals exhibited deficits in sustained attention relative to controls; a deficit that became most prominent when challenged at 18 months of age. Increased variability across retests in HIV-1 Tg; but not control animals; suggests individual differences in the progression of HAND. Understanding the progression of neurocognitive deficits provides a critical foundation for developing therapeutic treatments aimed at altering the trajectory of HAND.

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INTERSENSORY PROCESSING IN 12 MONTH OLDS IS RELATED TO SHARED GAZE TO TOYS

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Joint attention, shared gaze to an object with a social partner, is foundational for early language development (Morales, et al., 2000). Intersensory processing, coordinating temporally synchronous patterns of stimulation across sensory modalities, allows infants to perceive unitary multisensory events (people speaking; labeling an object) and is a proposed foundation for language and social development (Bahrick & Lickliter, 2012). The present study tests our hypothesis that individual differences in intersensory processing skills predict shared gaze to toys in infant-parent social interactions. Thirty-seven 12-month-olds participated in the Multisensory Attention Assessment Protocol (MAAP; Bahrick et al., under review) and an 8-minute caregiver-child interaction (CCI). The MAAP is a 24-trial video-based procedure with 12s trials depicting side-by-side events of either faces speaking or objects dropping. One event is synchronous with its natural soundtrack; the other is asynchronous. Intersensory matching was calculated as the proportion of total looking time (PTLT) to the sound-synchronous event. During the CCI, caregivers and infants played together with toys. Gaze was coded frame-by-frame. Shared gaze was calculated as the dyad's frequency of temporally co-occurring looks to toys. Average PTLT was .524 (SD=.06). Median frequency of shared gaze was 73 (range: 39–146). Poisson regression indicated that intersensory matching significantly predicts shared gaze, $X^2(1) = 19.474$, $p < .001$, $R^2_{deviance} = .09$, indicating infants who better detect temporal synchrony are better able to coordinate their gaze to toys. Findings are among the first to demonstrate a relationship between intersensory processing and gaze coordination in social interactions. Future research will address how these skills interact to promote social and language development.

FAMILY STRESS, HAIR CORTISOL, AND CHILDREN'S AMYGDALA AND HIPPOCAMPAL VOLUMES

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Although severe early life stressors (e.g., abuse, institutionalization) have a well-documented impact on the structural development of the amygdala and hippocampus, less is known about the roles of less extreme family stress. In this ongoing study, we focused on hair cortisol concentrations, which represent a relatively novel biomarker of chronic stress. We examined associations of parent and child hair cortisol and family stress with amygdala and hippocampal volumes in 5- to 9-year-old children. Participants included 18 children with hair cortisol and brain data, 18 with parent hair cortisol and child brain data, and 30 with family stress and child brain data. Children completed a structural MRI scan and provided a hair sample. Parents provided hair samples and reported on perceived stress and stressful life events. In regression analyses, covariates included parent age, child age, sex, and whole brain volume. Results indicated that both higher parent hair cortisol ($\beta = -.79$, $p = .0028$) and higher parental perceived stress ($\beta = -.28$, $p = .0485$) were significantly associated with smaller hippocampal volume in children. Greater stressful life events was marginally linked with larger right amygdala volume in children ($\beta = .27$, $p = .0987$). Child hair cortisol was not significantly associated with amygdala or hippocampal volume. These findings suggest that higher parental hair cortisol and perceived

stress may represent unique pathways leading to smaller hippocampal volume in children, which may have implications for children's emotion processing, memory, and capacity for efficient HPA axis regulation.

HAIR CORTISOL, PERCEIVED STRESS, AND BRAIN DEVELOPMENT

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Chronic overexposure to stress is a risk for poor health and development. Traditional measures of salivary, urine or blood cortisol, which are exquisitely sensitive to momentary acute fluctuations of the individual's experience, may not capture chronic variation in stress exposure. In contrast, hair cortisol concentration (HCC) is the result of long-term integration of cortisol as hair growth occurs, thus serving as an index of chronic stress exposure. Because cumulative or ongoing stress is a central feature of childhood socioeconomic disadvantage, HCC may be a better index of the type of stress experienced by socioeconomically disadvantaged parents and children. Methodologically, HCC also confers several advantages, in that traditional cortisol metrics vary as a function of time of day, and are affected by a host of factors that induce noise in the data, whereas HCC is unaffected by most of these methodological challenges. We recently reported lower parental education and lower family income were each associated with higher HCC among parents. Further, lower family income was associated with higher HCC among children, even when adjusting for parent HCC. Here we consider the relationship between HCC and parental perceived stress among socioeconomically disadvantaged families. Preliminary work suggests that higher maternal HCC is related to higher maternal perceived stress. Further, preliminary analyses suggest that higher maternal perceived stress, but not HCC, is associated with reduced infant high-frequency EEG power. Implications for interventions to reduce stress exposure will be discussed.

NMDA RECEPTORS AND THE ONTOGENY OF POSTSHOCK AND RETENTION FREEZING FOLLOWING CONTEXTUAL FEAR CONDITIONING

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In “foreground” contextual fear conditioning, rats that are exposed to a context for 2–3 min followed by foot-shock form a context-shock association within the same trial. The rats can then be tested for freezing immediately during a postshock freezing test or during a retention test 24 hr later. Postshock freezing following context conditioning is seen as early as PD 18 (Rudy & Morledge, 1994), while 24-hr retention of freezing emerges between PD 17–24 (*ibid*, Schiffino et al., 2011). The current study replicated these findings and began to examine the role of NMDA receptors in post-shock vs. retention-test freezing. Systemic injections (0.1 mg/kg) of the NMDA receptor antagonist MK-801 or saline vehicle were given prior to contextual fear conditioning or immediate-shock control training in both PD 17 and PD 31 rats. PD17 rats given saline injections froze significantly more than immediate shock controls during the postshock freezing test, while their MK-801 counterparts did not. However, post-shock freezing in saline animals was only marginally higher than MK-801 animals (reflecting low levels of freezing in both groups at PD17). PD 31 rats that received MK-801 showed intact post-shock freezing relative to both saline and immediate-shock controls. Retention freezing was found only in PD31 rats given saline. These findings confirm that post-shock freezing is present in weanling and juvenile rats whereas long-term retention of context conditioning emerges during the juvenile period (Rudy & Morledge, 1994). Moreover, NMDA receptor may play a role in post-shock freezing at PD17 but only in long-term retention at PD31.

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EMOTIONAL CONNECTION IN MOTHERS AND PRETERM INFANTS AND INFANT BIOBEHAVIORAL RESPONDING TO THE STILL-FACE PARADIGM

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Mothers and their 76 preterm infants who participated in the Family Nurture Intervention were video-taped during face-to-face interaction at 4 months corrected-age and then rated using the Welch Emotional Connection Scales (WECS). The WECS is a novel instrument that separately assesses mother and infant on 4 dimensions of social behavior using a 3-point scale: Attraction, Vocalization, Affect, and Sensitivity/Responsiveness. Three WECS scores were computed: *WECS-M* (sum of mother's 4 items—mother's emotional connection with infant); *WECS-I* (sum of infant's 4 items—infant's emotional connection with mother); and *WECS-EC* (sum of all eight items—level of *mutual* emotional connectedness). At this follow-up, mothers and infants underwent the still-face paradigm (SFP), and were coded in Observational Software for *Approach* (positive affect, gazing at) behaviors. ECG was acquired from infants to measure vagal tone. Vagal tone, maternal and infant approach were scored separately for play, still-face and reunion. Higher WECS-EC scores were associated with infant approach behavior during the play episode of the SFP; WECS-I scores were associated with infant approach during reunion;

and WEC-M scores were associated with maternal approach during SFP reunion. WECS-EC scores were associated with infant vagal tone during the course of the SFP, with dyads high on WEC-EC showing vagal suppression to the still-face and slight recovery, while infants of dyads low on WECS-EC showed vagal augmentation to maternal still-face as well during reunion. These results indicate that emotional connectedness between mothers and preterm infants supports healthy physiological regulation during socio-emotional stress.

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LONG-TERM BIOBEHAVIORAL OUTCOMES FOLLOWING REDUCED MATERNAL CARE AND NEONATAL PAIN.

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Preterm infants are exposed to a multitude of painful procedures while in the neonatal intensive care unit. Although these procedures are in place to promote the survival of the infants, recent research suggests that exposure to many painful procedures may result in impaired brain development. In addition to pain, preterm infants also experience reduced maternal care with traditional incubator care. Preclinical models have indicated that reduced maternal care during the neonatal period results in impaired biobehavioral development. Thus, the current study sought to investigate the biological and behavioral consequences of neonatal pain in combination with reduced maternal care using a rodent model. Rat pups within a litter were assigned to one of five groups: unhandled control, tactile control, pain, reduced maternal care, and pain and reduced maternal care. Painful procedures consisted of needle insertion into alternating paws several times a day. Pups in the reduced maternal care groups were placed in a tea-ball infuser for 30 min immediately following administration of painful procedures or tactile stimulation. Pain and reduced maternal care exposure were administered during the first 4 days of life. After maturing into adulthood, animals performed the novel object recognition test and the Morris water maze to assess cognitive outcomes. Further, animals also underwent the open field test and restraint stress testing to investigate long-term changes to anxiety-like behaviors and hypothalamic-pituitary-adrenal axis reactivity. It is hypothesized that exposure to either early life stressor will produce cognitive and affective behavioral deficits, that will be exacerbated in animals that experience both.

THE DIFFERENTIAL OUTCOMES EFFECT IN ADULTS AND YOUNG CHILDREN USING AN EYE-TRACKING PARADIGM

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Previous studies have found that when different stimulus pairings are matched with distinct reinforcers in a learning task, the learning is significantly better than when stimuli are matched with the same or randomly paired reinforcements; the *differential outcomes effect* (DOE). Evidence from adults, children, and other species characterize the DOE by robust learning gains in speed of acquisition and accuracy performance. Due to the pervasiveness of this effect, we hypothesized that the differential outcomes procedure (DOP) can be used as a means of rapid discrimination learning with young children. Previous tasks demonstrating the DOE would not be suitable for children under 4 years due to various required aspects of the tasks, such as requiring children to understand complex verbal instructions, undergo extensive training, and/or make overt motor responses. Eye-tracking, however, has been a useful tool to measure visual working memory in young children (Kaldy, Guillory, & Blaser, 2015), and may effectively overcome such limitations. Therefore, we implemented the DOP using gaze contingent eye-tracking as the response mechanism in a discrimination learning task. A positive audiovisual reinforcement was given after each correct response and importantly, was either differential or nondifferential. Adult data were collected first, to ensure replication of the effect using the eye-tracking methodology. The DOE was observed in adults, who demonstrated significantly higher accuracy and a faster rate of learning. Data collection in 3- to 5-year-old children is underway.

SNIFFING RESPONSE TO THE MAMMARY PHEROMONE IN RABBIT PUPS AT DIFFERENT DEVELOPMENTAL AGES

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In altricial mammals, chemosensory signals are essential for newborns' survival. Lactating rabbit females release a molecule, named the mammary pheromone (MP), that induces in rabbit neonates the typical orocephalic response usually involved in nipple localization and sucking. Experimentally, this response is triggered by the presentation of a glass rod carrying the MP in front of the pup's nose, without physical contact, thus showing that the stimulus is detected distally through the olfactory sense. For most mammals, perception of an odor induces an increase in respiratory rhythm called sniffing. In rat pups, sniffing behavior undergoes considerable postnatal development and these ontogenetic changes were suggested to be important precursors to the development of olfactory-perceptual functions. The aim of the present study was to assess the development of odor-induced sniffing behavior in rabbit pups. Three postnatal ages have been studied: PN2, PN5 and PN10. Two odors were used: peppermint and MP. The pups were introduced in a plethysmograph cage allowing noninvasive monitoring of respiratory signal. Each odor was delivered four times in two separate sessions and changes in respiratory rhythm were assessed. Preliminary data suggest that before PN5, MP induces a greater increase in respiratory rate than peppermint while the reverse

is observed at PN5 and PN10. If confirmed, these observations may point to a change in MP perception around PN5 that could be related to some previously described changes in MP dual activity, as a releasing and reinforcing signal, displayed throughout development.

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INFANT MEMORY FOR A STRESSFUL SOCIAL EVENT AT 4-MONTHS: PHYSIOLOGICAL AND BEHAVIORAL CORRELATES

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Research on infant memory is typically based on non-stressful stimuli such as novelty- or imitation-paradigms, but our understanding of infant memory for a social stressor is limited. To fill this gap, the present study uses the Face-to-Face Still Face (FFSF) procedure, a paradigm that elicits a well-documented behavioral stress response in infants. Infants in the experimental condition (n = 40) were exposed to the FFSF on two consecutive days, while the control group (n = 40) completed a time-matched play-session on day 1 and the FFSF on day 2. Changes in behavior, heart rate (HR) and salivary cortisol were evaluated. Infants in the experimental condition showed a significant decrease in positive affect and an increase in HR on day 2, compared to controls. The change in infant HR was independent from maternal HR which did not differ between day 1 and day 2 or between groups. The groups did not differ in salivary cortisol on day 2. Findings suggest that a previous stressful experience may elicit a behavioral and physiological response in infants 24 hr later. The results could have implications for further research on stressful and traumatic events in early childhood.

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SELF-MONITORING OF MYOCLONIC TWITCHES BY THE INFERIOR OLIVE AND LATERAL RETICULAR NUCLEUS: EVIDENCE OF COROLLARY DISCHARGE

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Developing mammals receive two kinds of proprioceptive input. One arises from stimulation in the external environment ("exafference"), such as that from a mother or littermate. The other arises from self-produced movements ("reafference"), especially those associated with the myoclonic twitches that occur abundantly during active (or REM) sleep. Neural recordings in infant rats have established that exafferent and reafferent proprioceptive inputs activate sensorimotor structures throughout the brain, but it is not known whether twitches are also accompanied by the production of corollary discharge (or efference copy) signals that inform the nervous system that the movements are self-generated. Based on recent recording studies in the red nucleus and cerebellum, we hypothesized that two precerebellar nuclei—the inferior olive (IO) and the lateral reticular nucleus (LRN)—receive twitch-related corollary discharge signals. Here, we test this hypothesis by recording the twitch-related activity of the IO and LRN during sleep and wake in infant rats. In the majority of IO units and in a subset of LRN units, neural activity was particularly pronounced at the time of twitch onset. This twitch-related activity was remarkably sharp and precise, reaching a peak in firing rate within 0–5 ms after twitch onset. This unique pattern of peritwitch activity suggests that, unlike sensory structures that receive reafference from twitches, these two precerebellar nuclei receive corollary discharge signals from areas involved in the production of twitches. Next, we identified non-overlapping premotor areas in the midbrain mesodiencephalic junction that send projections to the IO and LRN; these areas include the red nucleus, which projects to the LRN, and the rostral nucleus of Darkschewitsch, which projects to the IO. Recordings from those areas indicate that they contribute to the production of twitches. All together, these results demonstrate for the first time that, due to the presence of corollary discharge, the infant brain has the capacity to distinguish between exafferent stimulation and twitch-related reafference. This capacity may underlie the developing infant's burgeoning ability to distinguish between other-generated and self-generated movements.

NEONATAL IMITATION REVISITED: NEONATAL IMITATION REVISITED: A GENERAL RESPONSE, ADAPTIVE ENGAGEMENT

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It has been suggested that neonatal imitation is more easily triggered by some gestures than by others. If perinatal imitation were subserved by innate releasing mechanisms or innate motor schemes, orofacial gestures would be more readily imitated than fine motor manual gestures are. If there were a general mechanism subserving imitation, a broad range of gestures would be equally likely to be imitated. If imitation were reflexive, a narrow range of events would trigger responses within millisecond-to-second latencies. A series of eight studies will be reported on the imitation of individual finger movements, tongue protrusion movement and imitation of four different facial, head and manual gestures. The analysis, using frame-by-frame microanalytic methods followed how the behaviour of the neonates (aged 0–5 days of age) unfolded over time. The results showed that all gesture groups were imitated. The temporal analysis showed that response latencies were variable and from seconds to minutes, and that complex movements were broken up sequentially. Based on the results, perinatal imitation is found to be a non-reflexive response involving intentional, voluntary movements.

SOCIOECONOMIC INEQUALITY AND CHILDREN'S COGNITIVE AND BRAIN DEVELOPMENT

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Socioeconomic disparities in childhood are associated with remarkable differences in cognitive and socio-emotional development during a time when dramatic changes are occurring in the brain. Recent work has focused on understanding the neurobiological pathways through which socioeconomic factors shape development. Behavioral evidence suggests that language, memory, social-emotional skills, and executive functions exhibit relatively large differences across socioeconomic lines, and more recent work has found differences in socioeconomic differences in brain structure in the very regions that support these skills. It is likely that socioeconomic factors operate via multiple mechanisms to explain the development of different neural circuits. A theoretical model will be presented whereby differences in the home language environment and family stress likely impact particular brain systems, which in turn support distinct neurocognitive skills. Evidence for the model, as well as ongoing and future work testing aspects of the model, will be discussed. Finally, the question of interventions will be addressed. It remains an empirical question whether ameliorating socioeconomic disparities in child development is best accomplished by focusing on education, proximal mediators, societal inequalities, or a combination. A brief review of various approaches will be presented, along with an overview of plans for the first clinical trial of poverty reduction in early childhood.

BOBWHITE QUAIL NEONATES CAN USE OLFACTORY CUES TO DIRECT SPATIAL EXPLORATION

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Most research on early perceptual development in precocial birds has focused on chicks' auditory and visual responsiveness. Olfactory responsiveness has received little research attention, as precocial birds were thought to have limited olfactory abilities in the days and weeks following hatching. However, in recent years this belief has been questioned, as olfactory cues may help in food and nest location, predator detection, navigation, and kin identification. This preliminary study investigated whether bobwhite quail (*Colinus virginianus*) neonates could detect and demonstrate a preference for an olfactory stimulus in a simultaneous choice test. Two-day-old naïve hatchlings were tested in a paired scent choice task within an I-maze. Strawberry or vanilla scented cotton balls were paired with a neutral odorless cotton ball at opposite ends of the maze. Results indicated quail neonates could detect and prefer the scented cotton ball from the unscented cotton ball; a Wilcoxon signed rank test revealed chicks spend more time near the scented stimulus ($p < 0.001$) and more time closer to the scented stimulus ($p = 0.003$) than the unscented one during testing. These findings suggest that young quail chicks can use olfactory cues to direct their spatial exploration in the days following hatching and that this olfactory sensitivity may be more developed at hatch than previously thought. This preliminary study is the first in a series designed to examine how prenatal chemosensory experience may facilitate postnatal olfactory responsiveness and how such responsiveness may affect the efficiency of other senses and peer recognition following hatching.

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EMOTIONAL ABUSE AND GENETIC VARIANTS FOR OXYTOCIN AND OXYTOCIN RECEPTOR GENES INCREASE RISK OF DEPRESSIVE SYMPTOMS IN PREGNANT WOMEN

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Several studies show a high incidence of depression during pregnancy. This emotional disturbance is associated with negative effects on the outcome of pregnancy and fetal development, such as pre term birth and low birth weight. Oxytocin (OXT) is a peptide that has recently been related to depression. In the present study, we investigated which factors better predict prenatal depression in a heterogeneous population of pregnant women in Uruguay. Two hundred pregnant women were randomly invited to participate in the study, provided blood samples and completed several questionnaires and scales that evaluated early experiences, demographic information, current family context, and depression symptoms, among other information. Several polymorphisms of the OXT and OXT (OXTR) receptors were also investigated. We found a high incidence of symptoms of depression (24%) in the Uruguayan population. Emotional abuse of the pregnant women in her family of origin, and lack of social support during pregnancy were the best predictors of depression. Genetic variant CC and AA of the polymorphisms rs2740210 (OXT) and rs237887 (OXTR) respectively increased the risk of depressive symptoms in pregnant women that suffered emotional abuse in their family of origin. Our study suggests that screening of early experiences in pregnant women and their social and family context may contribute to the early detection of emotional disturbances and the mitigation of the adverse effects that depression has on mothers and fetuses. Analysis of the OXT/OXTR variants may also contribute to predict depressive symptoms in a subpopulation that suffered emotional abuse during childhood or adolescence.

FORAGING IN THE PLAYROOM: RANDOM WALK BEHAVIOR IN HUMAN INFANTS

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Dozens of studies report a random movement pattern called Levy walk behavior (or Levy Flights) in a diverse set of organisms including microbes, insects, sharks, birds, and mammals. This movement pattern reflects how organisms experience and interact with the world across a wide range of ecological contexts. The Levy walk hypothesis suggests that the optimal strategy for searching in an unknown environment is to make successive movements in uniformly random directions where the length of each movement is drawn from a probability distribution that is 'heavy-tailed.' The probability *Pr(d)* that the walker performs a bout of length *d* is given by: $Pr(d) \sim d^{-y}$ where $1 < y < 3$. Here, we examined whether human infants' exploratory patterns can be explained in terms of Levy walk behavior. To this end, we observed infants' ($N = 33$) locomotion in a laboratory playroom for 20 min and tracked their locomotor bouts. We fit a set of candidate distributions to the observed bout distances using maximum likelihood methods. We found that the paths are best fit by a heavy-tailed Levy walk distribution. This is the first study reporting the use of Levy walk behavior as a tool for characterizing and modeling infant walking. Our findings provide evidence that infants use exploration strategies during locomotor play similar to those used by optimally foraging animals.

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NEURAL PATTERNS UNDERLYING THE DEVELOPMENT OF PLANNING IN TOOL USE

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Flexible, purposeful tool use requires action planning. Adults' action plans keep both the initial contact with the tool and the end goal in mind, even when the end goal stretches far into the future. Children, however, show dramatic deficits in planning when the end goal is not immediately accessible to perception. For example, participants of all ages normally reach for the handle of a hammer using an overhand radial grip. But when the handle points away from the dominant hand, an initially uncomfortable underhand grip is required to ensure the desired final position of the tool. This phenomenon of sacrificing comfort in the initial grip to allow for a comfortable end position is called "*end-state comfort*." Here, we examined the possible sources of differences in action planning between young children and adults. We innovated a novel method for obtaining electroencephalography (EEG), head-mounted eye tracking, motion tracking, and video simultaneously in an end-state comfort hammering task. At the neural level, we found differences in readiness potential over sensory-motor sites preceding end-state comfort grips in adults compared with no differences in readiness potential preceding similar grips in young children. We used machine-learning algorithms to describe preparatory neural patterns underlying differences in planning between the groups. We also show that participants' fixation location and motion kinematics are correlated with their grip. These results indicate that young children's deficits in planning for end-state comfort stem from differences in neural activity and visual attention prior to moving the hand.

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DANCING TOGETHER: THE NATURE OF INFANT-MOTHER LOCOMOTOR SYNCHRONY

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Infants' and mothers' behaviors are sometimes so beautifully synchronized and coordinated in space and time that, in the case of face-to-face social interactions, researchers have referred to their joint behavior as a "dance." Here, we examined whether infants and mothers continue the dance during free play on the floor. We observed 30 infant-mother dyads during 20 min of free play in a laboratory playroom filled with toys, furniture, and elevations. We identified periods when each partner was stationary or locomoting, the number of steps and distance traveled per bout of locomotion, their step-to-step location in the room, and the distance between infant and mother at each moment. We found that more active infants had more active mothers in terms of accumulated steps, distance traveled, and unique locations visited. However, infants took more steps than their mothers and visited more unique room locations. Moreover, dyads showed temporal and spatial synchrony in their moment-to-moment spontaneous locomotor activity. We used density peak clustering with multivariate autoregressive modeling and granger-causality analysis to determine periods when one partner was more likely to take the lead and the other to follow, when partners took turns taking the lead, and when dyads seamlessly coordinated their activity. Findings support the notion that freely mobile infants and their mothers continue their synchronized "dance" when they are on the floor. During locomotor free play, dyads do not share mutual gaze, but they still maintain temporally and spatially coordinated locomotor activity.

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SEX DIFFERENCES IN RELAPSE FOLLOWING FEAR EXTINCTION IN JUVENILE RATS

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By 6 years of age, girls are more than twice as likely to have experienced an anxiety disorder than boys. This indicates sex differences in fear learning may emerge from early childhood. Thus, our study investigated sex differences in the fear relapse behaviours, a core pathology of anxiety disorders, in juvenile rats (postnatal day 17 ± 1). All rats first received three white-noise – footshock pairings and the freezing to the white-noise was then extinguished. In experiment 1, rats were tested for freezing to the white-noise in the same or different context to extinction. Female rats showed renewal of extinguished fear when tested in the different context to extinction ($p < 0.05$), whereas male rats did not ($p > 0.05$). In experiment 2, rats received either a reminder footshock or context exposure the day after extinction and were tested for freezing to the white-noise the next day. Female rats that received the reminder showed reinstatement of extinguished fear ($p < 0.05$), whereas the male rats did not ($p > 0.05$). In experiment 3, rats were tested for freezing to the white-noise either the day after or 5 days from extinction. Female rats tested after 5 days showed spontaneous recovery of extinguished fear ($p < 0.05$), whereas the male rats did not ($p > 0.05$). Our findings indicate the fear relapse behaviours in juvenile male and female rats may be qualitatively different. These differences may underlie the higher likelihood to experience anxiety disorders in young female children compared to male children.

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THE RELATION BETWEEN UNIMANUAL MANIPULATIONS AND RDBMs DURING INFANCY

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Unimanual manipulation appears temporally before the onset of role-differentiated bimanual manipulations (RDBM) (Nelson, Campbell, & Michel, 2013). Campbell, Marcinowski, Babik, & Michel (2015) observed that unimanual manipulations (UMs), in which one hand performs an action, become more distinctive across 6 to 14-months. Babik and Michel (2016a) found that simple forms of RDBMs, which require the use of two hands to perform complementary tasks simultaneously, appear during infancy beginning around 9 months. In the current study, we examine the relation between the development of UMs and the development of RDBMs by observing the hand preference of both behaviors across the 9 to 14-month period in infancy. Thirty infants were observed during an RDBM play situation in which a researcher presented 32 objects to an infant. During the UM portion of the trials, the objects were placed into the infant's hands, while during the RDBM manipulations, the objects were placed on the table. Videos were then analyzed for the number of UMs and RDBMs that the infant performed during each monthly session. An ANOVA was performed to determine whether the hand preference for UM predicts the frequency of RDBMs that are performed. The results indicated that infants with no preference for UM performed more RDBM actions than infants with a hand preference for UMs. Using a multilevel longitudinal model, hand preference for UM was found to be related to hand preference for RDBM. Specifically, infants who were right handed for UM show increasing right hand preference for RDBM hand preference over time.

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DEVELOPMENTAL TRAJECTORIES FOR FULLY ROLE-DIFFERENTIATED BIMANUAL MANIPULATION IN INFANTS

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Fully differentiated bimanual manipulation (fRDBM) is characterized by clear and distinct roles for each hand such that one hand supports the object for the other hand's manipulation. Previously, we found that toddlers (18 to 24 months) exhibit one of three stable hand use patterns for fRDBM: (1) predominantly right-handed with a mild amount of left hand use; (2) predominantly right-handed with a moderate amount of left hand use; or (3) predominantly left-handed with a moderate amount of right hand use. However, the origins of these patterns earlier in development at the onset of the skill are unknown. The goal of the current study was to track the emergence of fRDBM during infancy (9 to 14 months) in the same sample of typically developing children. fRDBM was assessed monthly over 28 trials for infant visits, and hand use was coded offline with the Noldus Observer. Preliminary results using mixed ANOVA found a significant main effect of toddler trajectory ($F(2, 76) = 9.857$, $p < .001$, $\eta_p^2 = .206$) on infant right hand fRDBM frequencies. Children in toddler pattern one were significantly different from those in patterns 2 and 3, although two and three were not significantly different from each other. There was also a significant interaction between toddler trajectory and time ($F(10, 380) = 5.211$, $p < .001$, $\eta_p^2 = .121$). Descriptively, patterns 1 and 2 increased linearly across all infant timepoints while pattern 3 increased to asymptote at 12 months. Data analysis is ongoing.

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YOUNG CHILDREN'S AFFECTIVE AND PSYCHOPHYSIOLOGICAL RESPONSES TO ACCEPTANCE AND REJECTION FROM PEERS

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Positive peer relations are an important predictor of socioemotional adjustment during early childhood. The transition to school may be a critical period as children face expanding social environments and more salient peer interactions. Children's interpretations and responses to peer feedback contribute to social competence, and may ultimately lead to more successful peer interactions. Experimental paradigms with strong ecological validity would help evaluate children's response to social information across behavioral, psychological, and biological levels of analysis. Recently, we developed a laboratory-based paradigm relying on simulated social evaluation in young children. We discuss findings that demonstrate the validity of this paradigm and illustrate behavioral and psychophysiological markers of social information processing. Children are shown pictures of young children and asked to sort them into two equal groups: (1) Interested–children they did wish to play with and (2) Not Interested–children they did not wish to play with. They were later told that half of the pictured children did wish to play (Accepted) and half did not (Rejected). Affective response was rated on a 4-point scale (1 = very unhappy; 4 = very happy). In two independent studies, 5-to-6-year-olds showed systematic variations in their affective response, in line with both their intentions and the social feedback (S1: $F(1,47) = 36.72$, $p < 0.001$, S2: $F(3,136) = 41.54$, $p < .001$. Individuals differences in temperament (study 1: $F(1,43) = 6.61$, $p = 0.01$; S2: $F(1,127) = 3.77$, $p = .05$) and RSA (Study 2: $F(1,131) = 4.14$, $p = .04$) were linked to the children's affective responses. These findings illustrate the potential to examine social responsivity in very young children in an ecologically valid manner.

EARLY BIPARENTAL CARE IMPACTS EPIGENETIC REGULATION OF THE OXYTOCIN RECEPTOR GENE IN A SOCIALLY MONOGAMOUS RODENT

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Early experiences impact displays of many social behaviors associated with variation in oxytocin receptor density, especially in the nucleus accumbens. Mechanisms regulating effects of these experiences are not fully understood. Here we studied the socially monogamous prairie vole (*Microtus ochrogaster*), examining the hypothesis that early parental care impacts epigenetic regulation of the oxytocin receptor gene (*Oxtr*). Two models that affect oxytocin-regulated species-typical social behaviors were used: one where parental care differed spontaneously, and a second where parental care differed after families received early handling, or not. Four CpG sites in the *Oxtr* promoter were studied; these are conserved from the human *OXTR* and are associated with several mental health conditions. Methylation levels did not differ between prenatal offspring and offspring receiving high amounts of early care. Offspring receiving decreased parental care had increased *Oxtr* DNA methylation in both the nucleus accumbens and whole blood at the four conserved CpG sites. Methylation levels were strongly correlated between central and peripheral tissues. Methylation was also negatively correlated with gene expression and receptor protein levels. Results suggest parental care regulates *Oxtr* epigenetic markers and these markers are functionally significant. Peripheral measures are also likely good indicators of central *Oxtr* regulation. These data are the first to show functionally significant changes in epigenetic regulation of *Oxtr* in the prairie vole that are sensitive to early life experience. These findings further implicate changes in the oxytocin receptor as a mechanism through which early experiences may drive lasting changes in behavior.

[Autism Speaks #7110; NICHD HD07575]

THE ROLE OF MATERNAL NURTURANCE AND SYNCHRONY IN THE ASSOCIATION BETWEEN CHILDHOOD ADVERSITY AND CHILD DIURNAL CORTISOL

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Exposure to adversity, such as poverty, has been associated with HPA axis dysregulation in early childhood (Cutuli et al., 2010; Zalewski et al., 2012). However, few studies have examined mechanisms by which adversity disrupts children's physiological regulation. One possible mechanism is the quality of parenting (Bernard et al., 2015; Pendry & Adam, 2007), which is often disrupted by adversity in the environment (Grant et al., 2003). The present study aimed to examine the role of maternal sensitivity in mediating the association between cumulative risk and children's diurnal cortisol rhythms. Given recent studies suggesting that maternal sensitivity to child distress and non-distress should be considered distinct constructs (Leerkes et al., 2012), we examined both maternal sensitivity to distress (i.e., nurturance) and maternal sensitivity to non-distress (i.e., following the lead) as potential mediators. Participants include 45 4- to 6-year-old children and their mothers. Dyads were video-recorded during a play task (coded for following the lead) and during a finger prick (coded for nurturance), and completed surveys to assess for indicators of adversity (summed to form a cumulative risk score). Mothers collected child saliva samples twice daily across three consecutive days. Whereas the indirect effect of adversity on cortisol slope through nurturance was significant ($\beta = .26$, $p < .01$), the indirect effect of adversity on cortisol slope through following the lead was not ($\beta = 0.08$, $p = .23$). These results suggest that maternal nurturance may play a significant role in explaining the pathway from adversity to physiological dysregulation during early childhood.

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EARLY-LIFE STRESS INITIATES LATER-LIFE SOCIAL BEHAVIORAL DIFFICULTIES: EXPLORING THE NEUROBIOLOGICAL PATHWAY TO PATHOLOGY

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Typical social behavior is essential for many species' survival, ensuring access to care in early life, as well as safety, resources, and opportunities for reproduction in adulthood. Conversely, atypical social behavior is a common feature of myriad psychiatric disorders (Kennedy & Adolphs, 2012). However, the underlying neurobiological mechanisms resulting in social behavior difficulties are unclear. Here we present a rodent model for social behavior difficulties induced by early-life stress, in order to assess mechanisms by which early-life stress places the developing infant at increased risk for social behavior difficulties.

In this model, rodent litters were housed in control or low resource conditions of scarcity-adversity. Scarcity-adversity conditions resulted in negative caregiving behaviors and elevated corticosterone (CORT) levels in pups. Following these early-life rearing conditions, offspring displayed social behavior difficulties in peri-adolescence, which correlated with blunted hypothalamic-pituitary-adrenal (HPA) activation in response to a social stimulus, as indicated by decreased blood CORT levels and elevated glucocorticoid receptor levels in the medial prefrontal cortex (mPFC) and dorsal hippocampus. Pharmacologically increasing CORT prior to social behavior testing normalized the amount of time that scarcity-adversity reared rodents interacted with a social stimulus. Furthermore, pair housing scarcity-adversity reared subjects with control reared subjects naturalistically repaired social behavior following early-life stress rearing. These findings provide important insight into how early-life stress alters social behavior skills, and identify a need for regulation of the HPA axis, the mPFC, and dorsal hippocampus as potential therapeutic targets. Furthermore, our results imply that inclusive environments may provide protective factors to at-risk individuals.

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NEURAL CORRELATES OF LINKING COMMUNICATIVE SIGNALS AND COGNITION IN 6-MONTH-OLDS

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To acquire language, infants must first distinguish the sounds of their native language and then ascertain how these sounds are linked to the objects and events they encounter. At 3 and 4 months, listening to both human (speech) and nonhuman primate vocalizations (Madagascar, blue-eyed lemur: *Eulemur macaco flavifrons*) support infants' object categorization, a core cognitive capacity (Ferry, Hespos, & Waxman, 2010; 2013). By 6 months, only human speech confers this advantageous effect. Moreover, backward human speech—a sound equally complex to forward human speech—does not have this effect at any age. Here we use EEG to reveal the neural correlates of listening to these three types of sounds. Our results indicate that for 6-month-olds, both lemur vocalizations and backward speech elicit robust P300s in right parietal regions, suggesting that these unfamiliar sounds draw more of infants' attention relative to forward speech. In addition, lemur vocalizations elicit enhanced gamma activation (40–60 Hz) in right frontal regions relative to forward or backward speech, suggesting that these sounds are affectively arousing (Muller, Keil, Gruber, & Elbert, 1999). These results, which suggest that there may be multiple routes by which a signal can support infant cognition, converge with neuroanatomical evidence that indicate dual-pathways for the evolutionary origins of human language (Ackermann, Hage, & Ziegler, 2014).

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LEVERAGING NEUROSCIENCE TO IMPROVE TREATMENT OF ADOLESCENTS: ANXIETY AS AN EXAMPLE

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Due to cross-species conservation in brain-behavior relations, studies of anxiety provide unique opportunities for clinical translation of basic science. Such work is important among adolescents, when rates of social and generalized anxiety disorders markedly increase. In this context, the current presentation will review research on the capacity of threats to influence attention orienting. This presentation will begin by describing insights from basic science on threat-related attention orienting. Next, paradigms for extending such basic research to humans will be reviewed, describing how clinical variation in anxiety relates to individual differences in brain function and behavior on these paradigms. Finally, data on therapeutics will be described, from research that leverages basic science in ways that creates promising, novel treatments.

DELAY EYEBLINK CONDITIONING IN PRESCHOOL CHILDREN WITH AUTISM SPECTRUM DISORDER

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Pavlovian eyeblink conditioning (EBC) is a paradigm widely used to examine associative learning as well as the brain regions (i.e., hippocampus

and cerebellum) underlying such learning in typically and atypically developing populations. EBC is a safe and non-invasive technique that does not require social or verbal skill competency, making it suitable for children with autism spectrum disorder (ASD). Previous work has found that children with ASD do not exhibit properly timed eyeblinks in a cerebellar-dependent delay conditioning paradigm, in which the conditioned (i.e, tone) and unconditioned (i.e, airpuff) stimuli overlap. These findings indicate a deficit in the cerebellar cortex, which is involved in motor control, causing inaccuracy in conditioned responses during EBC. The current study utilizes a delay conditioning paradigm to investigate whether there are any abnormalities in EBC in preschool children with ASD. Preliminary analyses revealed that children exhibited significantly higher learning on the last block compared to the first block of trials ($t(12) = 4.422$; $p < .01$), but did not show an increase in learning across blocks covarying for age ($F(9, 99)=.487$; $p=.880$). Findings suggest that although children with ASD did not exhibit a steady increase in associative learning across the procedure, they did show a capability to learn by the end of the procedure compared to the start. Moreover, the current findings implicate the cerebellum in ASD.

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TRAJECTORIES OF SOCIAL ANXIETY IN CHILDREN: INFLUENCE OF CHILD CORTISOL REACTIVITY AND PARENTAL SOCIAL ANXIETY

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Little research has examined the interactive effect of multiple intra- and extra-individual vulnerability factors on the trajectory of social anxiety in children. In this study, we examined the joint influence of familial vulnerability (i.e., parental social anxiety) and child biological stress vulnerability (i.e., cortisol reactivity) on trajectories of social anxiety. Children (N = 143 (80 males), M_{age} = 9.54 years, $S.D.$ = 3.06) were followed over three visits spanning approximately three years. Parental social anxiety was assessed using the *Social Phobia and Anxiety Inventory*; children's salivary cortisol reactivity was measured following a speech task; and children's social anxiety was assessed at all three visits using the *Screen for Child Related Emotional Disorders* (SCARED; Parent-report). Growth curve analysis was used to examine trajectories of child social anxiety as predicted by children's cortisol reactivity and parental social anxiety, adjusting for relevant covariates. We found a significant interaction between parental social anxiety and child cortisol reactivity in predicting child social anxiety across time. Having a socially anxious parent coupled with heightened cortisol reactivity predicted the highest levels of child social anxiety, with scores that remained above clinically significant levels for social anxiety across all visits. Children with familial risk for social anxiety and who also exhibit high stress-reactivity appear to be at risk for persistent, clinically significant social anxiety. These findings highlight the importance of considering both biological and contextual factors in dynamic transaction with one another when considering the development, maintenance, and treatment of social anxiety in children across time.

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PREADOLESCENT OXYTOCIN ADMINISTRATION TO AMELIORATE EFFECTS OF MATERNAL CORTICOSTERONE AND SSRI EXPOSURE ON MALE AND FEMALE OFFSPRING

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Exposures to serotonin reuptake inhibitors (SSRIs) during the maternal peripartum and postpartum period may increase the risk of Autism Spectrum Disorder in children. Oxytocin can enhance social interactions in rodents, and intranasal oxytocin is currently being investigated in clinical trials as a treatment for children with Autism Spectrum Disorder. The aim of this study is to investigate the effects of maternal postpartum corticosterone (to induce depressive-like behavior in the dam) and maternal fluoxetine administration on male and female offspring. Oxytocin is a peptide hormone that does not readily cross the blood-brain barrier. Here we used a nanoparticle drug delivery system Triozan™ to facilitate oxytocin entering the central nervous system in pre-adolescent offspring. We hypothesized that Fluoxetine given dams will decrease social behaviour in both male and female offspring. We expect that oxytocin, given to preadolescent offspring, will reverse the adverse effect of maternal fluoxetine and normalize social behaviour, microbiome composition, proinflammatory cytokines, and adult neurogenesis compared to controls. Dams will be given corticosterone (40 mg/kg) to simulate postpartum depression and fluoxetine (10 mg/kg) for 23 days. Administration of oxytocin (0.5 mg/kg) and Triozan™ (0.25 mg/mL) in offspring will occur for 10 days from postnatal day 25 to day 34. Offspring will be tested for social, anxiety and locomotor behaviour during adolescence (postnatal day 35–37) and again in adulthood (postnatal day 70–73). The results of the current study will determine whether preadolescent exposure to oxytocin mitigates any adverse effects of maternal corticosterone and concurrently fluoxetine on offspring behavior, microbiome, and neuroinflammatory profile.

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THE JOINT PATTERNS OF MOTHERS' AND INFANTS' RSA DURING THE STILL-FACE PARADIGM IN RELATION TO CHILD OUTCOMES

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During the still-face paradigm, the typical RSA pattern of infants is to experience vagal withdrawal during the still-face episode and recovery during the reunion episode (Mesman et al. 2009). For sensitive mothers, the typical RSA pattern is to experience an increase in RSA during the still-face episode, and vagal withdrawal during the reunion episode (Moore et al., 2009). However; the joint patterns of mothers' and infants' RSA in relation to children's later outcomes have been overlooked. This study included 207 mothers and infants, who completed the still-face paradigm procedure at 6 months. Mothers completed BITSEA (Problem subscale) at 1 year and 2 years and the Emotion Regulation Questionnaire (Regulation subscale) at 4.5 years. Latent profile analysis was conducted using infants' and mothers' mean RSA scores during each episode. Three profiles emerged. Both profile 1 and profile 2 mothers showed an increase in RSA during the still-face episode and vagal withdrawal during the reunion episode (the typical pattern); profile three mothers did not demonstrate changes in RSA. Profile 1 and profile 3 infants did not exhibit changes in RSA. Profile 2 infants engaged in vagal withdrawal during the still-face and showed no recovery during the reunion. Generally, child outcomes were best for children in Profile 2, in which both members of the dyad demonstrated the prototypical pattern of RSA responding, worst in Profile 3 in which neither mother or infant demonstrated the prototypical pattern; and mixed in Profile 1 in which the mother but not the infant demonstrated the prototypical pattern.

EARLY SOCIAL DEPRIVATION AND THE DIURNAL CORTISOL REGULATION OF CHILDREN ADOPTED INTERNATIONALLY

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Early attachment relationships are believed to play a crucial role in regulating the functioning of the hypothalamic-pituitary-adrenocortical (HPA) axis. International adoption offers a powerful test of the effects of early adversity on HPA functioning because many of the children experience profound early social deprivation before being adopted into highly-resourced families. Prior studies of internationally adopted children have not produced consistent evidence regarding the consequences of early deprivation for children's diurnal HPA outcomes. This may be because studies have focused on a variety of individual indicators of early social deprivation. The present study examined the significance of a comprehensive set of indicators of early social deprivation for the diurnal cortisol rhythms of 130 internationally adopted children who were between 6 and 48 months old. Six commonly studied indicators of pre-adoptive deprivation were examined, including late age of adoption, long duration of institutional care, adoption from Russia or Eastern Europe, stunted physical growth, parent-reported poor pre-adoptive caregiving quality, and parent-reported social neglect. A principal components analysis supported the creation of a single measure of early social deprivation. Children's diurnal cortisol levels were assessed by collecting saliva at wake-up and bedtime across three days. Results indicated that experiencing more severe social deprivation prior to adoption was associated with lower wakening cortisol levels ($\beta = -.23$, $p = .03$). This association was robust to controls for prenatal alcohol exposure and adoptive parents' sensitive caregiving. Altogether, these findings support the idea that severe early adversity disrupts the regulation of children's HPA axes.

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CHALLENGES TO DEVELOPMENTAL RESEARCH ON SITTING AND REACHING

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Development always occurs in an environmental context. Researchers typically ignore this context by considering the endpoint of sitting development to be maintaining balance on a horizontal surface, or the endpoint of reaching development to be the ability to guide the hand to a toy. Studying motor skill acquisition in context yields a richer, more nuanced, and more valid view of developmental processes. We present two studies inspired by these claimIn Study 1, 6- to 8-month-old infants sat on an adjustable slope (0° − 50°). Trials began with the slant at 0°; we increased slant in 2° increments until infants lost balance ($M = 24°$). Despite the novelty of the variable environmental context, infants showed impressive ability to adapt sitting posture by moving their trunk in opposition to changes in degree of slant. Sitting experience predicted more adaptive postural adjustments. In Study 2, 6- to 12-month-old infants sat on a rotating chair that brought targets into view. Infants were required to quickly gather visual information about target location to guide arm movements while maintaining posture. All infants lifted their arm and touched the target. However, successful grasping improved with sitting experience. Moreover, head-mounted eye tracking showed that successful object prehension required a consistent sequence of behaviors: visually locate the target, move the arm, then fixate and contact the target. These non-standard paradigms challenge current research on sitting and reaching and allowed us to explore the development of adaptive behavioral responses to perceptual information about the changing status of the environment.

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EFFECT OF EARLY-LIFE ADVERSITY ON IMMUNE SYSTEM FUNCTION IN ANIMALS PRENATALLY EXPOSED TO ALCOHOL: IMPLICATIONS FOR MENTAL HEALTH

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The contribution of the postnatal environment to the pervasive effects of prenatal alcohol exposure (PAE) is poorly understood. Dysregulation of immune function may play a role in how pre- and/or postnatal adversity/stress alter brain development. Here, we combined two animal models to examine whether PAE differentially increases vulnerability to immune dysregulation in response to early-life adversity (ELA), which may further alter brain development and lead to psychopathologies. PAE and control litters were exposed either to limited bedding (postnatal day [PN] 8–12) to model ELA or normal bedding, and maternal behavior and pup vocalizations were recorded. Peripheral (serum) and central (amygdala) immune (cytokine and CRP) responses to ELA were evaluated at PN12. Male and female offspring were tested in early (PN30) or late (PN45) adolescence using the open field (OF) and elevated plus maze (EPM). Insufficient bedding increased abusive-like maternal behavior in both groups. ELA increased vocalization in all animals; however, PAE pups vocalized less than controls. In infancy, adversity reduced serum cytokine levels in control but not PAE animals. PAE increased serum CRP at PN12; and adversity exacerbated this effect. PAE reduced KC/GRO and increased IL-10 amygdala levels. Behavioral assessments indicated that, in females, PAE induced anxiety-like behaviors in the OF in both ages. In males, PAE with ELA increased anxiety-like behaviors in the EPM in both ages. Our results indicate that PAE alters immune system development and both behavioral and immune responses to ELA, which could have subsequent consequences for brain development and later life mental health.

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BRAIN-BEHAVIOR ASSOCIATIONS DURING COGNITIVE FLEXIBILITY PERFORMANCE

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The present study examined patterns of brain electrical activity associated with cognitive flexibility performance in a sample of 6-year-old children ($N = 152$). Continuous electroencephalogram (EEG) measures were recorded at the 8–10 Hz frequency band during the post-switch and border phases of the Dimensional Change Card Sort (DCCS) Task. Children were divided into high and low performance groups based on whether they passed or failed the Border task. Repeated measures MANOVAS revealed a performance group X condition interaction, $F(1, 150) = 5.141$, $p < .05$. Children in the high performance groups (i.e., children who passed the border phase of the task) exhibited an increase in EEG power from post-switch to border phases [$t(85) = -2.635$, $p < .05$]. In contrast, children in the low performance group who failed the border phase showed no change in EEG power from post-switch to border phases, $t(75) = .264$, $p = .792$. These findings shed light on the neurocognitive mechanisms that underlie individual variation in cognitive flexibility performance in early childhood.

INDIVIDUAL DIFFERENCES IN SELF-REPORTED ATTENTIONAL CONTROL MODERATES THE RELATION BETWEEN ERROR MONITORING AND ANXIETY IN CHILDREN AND ADOLESCENTS

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There is growing concern for the profound effects anxiety may have on cognitive processes, and of particular interest is attention control. Attention control refers to one's ability to choose what to pay attention to and what to ignore. Within anxiety, this ability is suggested to be impaired. One neural mechanism that has been identified as an electrophysiological correlate of anxiety is the error-related negativity (ERN), and is reflective of error monitoring. As little work has focused on attentional control and increased ERN amplitudes, the current study examined the relation between this component and individual differences of attention in youth with ($N = 21$, 9 female, $M = 11.52$ years) and without ($N = 18$, 6 female, $M = 10.67$ years) an anxiety disorder. Youth completed a flanker task while simultaneous EEG was collected. The Attentional Control Scale was used to assess attention, and the Screen for Child Anxiety Related Disorders to assess anxiety. Partial correlation controlling for age, number of error trials, medication, and ADHD revealed a negative correlation between anxiety and attentional control, such that higher levels of anxiety were related to lower levels of attentional control, ($r = -.369$, $p < .05$). Regression analyses suggest that attention may play a moderating role in the ERN/anxiety relation, such that youth with better attentional control, had the lowest levels of anxiety, $\beta = -.308$, $b = -3.136$, $p < .05$. Further analyses indicate the importance of shift ability in reducing error monitoring and high levels of anxiety, $\beta = -.349$, $b = -3.371$, $p<.05$. Taken together, results suggest that attentional control may serve to protect against more severe levels of anxiety.

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LONG-TERM NEUROBEHAVIORAL CHANGES IN MICE FOLLOWING NEONATAL REPEATED EXPOSURE TO SUCROSE AND PAIN

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Sucrose is recommended for pain of minor procedures in preterm infants in the NICU. No human or animal studies of effects of early repeated sucrose exposure on long-term neurobehavioural outcomes have been done in the context of pain. We examined effects of repeated neonatal sucrose treatment on long-term neurobehaviour in mice. Neonatal C57Bl/6J mice (N = 160, 47% male) were randomly assigned to one of two treatments (sucrose vs water) and one of three interventions (needle-prick, touch, handling). Pups received 10 intervention/day from postnatal day 1–6. A single dose of 24% sucrose or water was given orally 2 min pre-intervention. In adulthood (8–12 weeks), mice underwent a series of behavioural testing (memory, anxiety/depression, sugar preferen). When exposed to needle-pricks, pups treated with sucrose or water did not differ on their short- and long-term memory performance at adulthood ($p = 0.16$). Water-exposed mice in the needle-prick group had significantly poorer short-term memory compared to the handling group ($p = 0.0003$). In the handling groups, short-term memory was poorer in sucrose-exposed compared to water-exposed mice ($p = 0.009$). Mice in the sucrose/needle-prick or sucrose/touch groups consumed less sugar solution as adults ($p = 0.017$). Memory in adulthood was poorer for mice exposed to pain during the first week of life, regardless of sucrose treatment, suggesting that sucrose is not protective for memory performance when administered for pain. In the absence of pain, early sucrose exposure induced poorer short-term memory, stressing importance of accurate pain assessment. Sugar preference in adulthood was altered in pups exposed to sucrose before intervention, indicating possible conditioned memory.

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THE IMPACT OF EARLY LIFE ADVERSITY AND GROWTH STUNTING ON PUBERTAL DEVELOPMENT AND BODY COMPOSITION IN ADOLESCENCE

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There is evidence that early life adversity that increases the risk of growth stunting also increases the risk of obesity and, in girls, early onset puberty. Children adopted from orphanages provide an interesting case to test hypotheses about the sequelae of early adversity, as institutional care can represent a discrete period of adversity when children are adopted into highly-resourced homes. This hypothesis was tested in the first two years of a longitudinal study of youth (aged 7–15 years) who were either adopted from orphanages (post-institutionalized; PI) or reared in comparable families (non-adopted; NA). Current anthropometrics, pubertal stage, and fat mass were collected in a nurse's exam; anthropometrics at adoption were obtained from US clinics. Contrary to hypotheses, Year 1 result found that PIs had lower BMI-for- age, height-for- age, and less body fat than NAs, but did not differ by sex. Pubertal status did not differ by group or sex. The anthropometric findings held when the stunted-at- adoption subset was examined; they were also less likely to be in central puberty than other PI youth. Thus, early deprived orphanage care increases the risk of growth stunting but not the risk of obesity in children adopted into US families and does not independently contribute to early onset puberty for PI girls. Results from Year 1 and Year 2 of study will determine if this surprising finding holds true as PI and NA youth age as they progress in puberty.

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PROSPECTIVE ASSOCIATIONS BETWEEN SLEEP, POST-TRAUMATIC STRESS, AND PSYCHOSOCIAL HEALTH OUTCOMES IN CHILDREN WITH TRAUMATIC BRAIN INJURY

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Sleep disturbance is a common and often persistent consequence of pediatric traumatic brain injury (TBI). Research has linked childhood sleep problems to adverse psychosocial and adaptive outcomes post-TBI. However, these findings could be explained by sleep disturbance associated with post-traumatic stress (PTS), which has also been shown to influence children's psychosocial recovery post-injury. The literature examining sleep in pediatric TBI has largely failed to account for the effects of PTS. Given this, the current study examined prospective associations between sleep problems, PTS symptomology, and psychosocial functioning in a cohort of 205 children (6–15 years old) with TBI. Youth represented a full range of TBI severity and were followed for 12 months post-injury. Multiple regression analyses revealed that relative to premorbid measures, higher levels of parent-reported youth sleep problems at 6 months post-injury predicted psychosocial functioning at 6 months post-injury ($t = -2.550$, $p = 0.012$), after controlling for the effects of injury severity, post-traumatic stress, premorbid anxiety and premorbid psychosocial functioning. Individuals with worsening sleep problems post-injury were significantly more likely to have poor psychosocial functioning at both 6 months (χ^2 (1, $N = 145$) = 6.720, $p = 010$) and 12 months post-injury (χ^2 (1, $N = 118$) = 4.130, $p = .042$). These findings suggest that childhood sleep quality influences psychosocial recovery post-TBI independently of other risk factors, and highlight the need for early screening and sleep-related intervention for youth with TBI. Future work is needed to elucidate the mechanisms by

which sleep disturbance confers psychosocial risk for children post-injury.

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PRENATAL CORTISOL PREDICTS MATERNAL SELF-EFFICACY

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Maternal self-efficacy—the degree to which mothers perceive themselves capable of performing tasks associated with parenting—has been suggested as a robust predictor of positive parenting practices, but is negatively predicted by poor mental health. A separate literature has suggested positive parenting practices are negatively related to both perceived and physiological measures of stress. In the present study, we test unique associations of both physiological and perceived stress with maternal self-efficacy in an international sample of 482 first-time mothers. Mothers were enrolled in the study during their third trimester of pregnancy. Saliva samples were taken at three times during two consecutive days when mothers were in their last month of pregnancy: upon waking, 30 min after waking, and immediately before sleep. Samples were assayed for salivary cortisol (CORT), a marker of hypothalamic-pituitary-adrenal axis activation. Area under the curve with respect to ground was calculated to capture an estimate of total cortisol production. Prenatally and when infants were 4 months old, mothers completed questionnaires of depression, stress, and anxiety. When infants were 4 months, mothers also completed a questionnaire that assessed self-efficacy. Self-efficacy was regressed onto cortisol, education, country, and latent factors of maternal mental health prenatally and postnatally. The structural model fit the data well: Net of mental health and other covariates, CORT was negatively related to ratings of maternal self-efficacy. This suggests physiological stress may be associated with parenting—and confidence as a parent—over and above perceptions of stress. Implications of these findings will be discussed.

FAILURE TO REPLICATE THE PREDICTION OF ATTENTION PROBLEMS AT 8 YEARS FROM MOVEMENT-GAZE COUPLING AT 3 MONTHS

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Infants rapidly reduce spontaneous body movement at the beginning of looks. For *Suppressors*, movement remains below baseline through the first second; for *Rebounders*, it returns to baseline or above. We recently found that 3-month-old Rebounders have more parent-reported attention problems at 8 years (Robertson et. al, 2014), replicating our original finding that infant movement-gaze coupling predicts later attention problems (Friedman et. al., 2005). The current study is a new replication attempt. Methods: At 3-months, infants looked freely at an interesting 3-D object until looking time habituated. Rebounders (N = 9) and Suppressors (N = 12) were identified from analysis of their pre-habituation looks. At 8 years, parents completed a questionnaire that included the inattention and hyperactive-impulsive symptoms from the DSM-IV diagnostic criteria for ADHD, and the Attention Problems and ADHD scales of the Child Behavior Check List (CBCL). Results: Rebounders and Suppressors did not differ on any outcome measure. In contrast, in the first replication study Rebounders had more DSM-IV inattention symptoms, scored higher on the CBCL Attention Problems scale, and more reached the DSM-IV diagnostic threshold for ADHD (inattentive subtype). Conclusions: Among numerous potential explanations for the failure to replicate the prediction of childhood attention problems in the current study (e.g., the original and first replication studies were false positives), key differences in the infant experiments (e.g., active visual foraging with multiple objects in the original and first replication studies, habituation to a single object in the current study) may be important.

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EVIDENCE OF NMDA-INDEPENDENT ACQUISITION OF CONTEXT MEMORY IN DEVELOPING RATS

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Acquisition of contextual fear requires NMDA-receptor activation in the rodent brain. However, NMDA-independent learning has been observed during contextual fear re-acquisition (Sanders & Fanselow, 2003; Hardt et al., 2009; Tayler et al., 2011). Infant rodents show NMDA-independent learning even though they show no memory for the initial conditioning (Li & Richardson, 2013; Chan, Baker & Richardson, 2015). This suggests that fear conditioning in developing animals produces persistent molecular changes regardless of memory retention. The current experiment extended these findings to adolescent rats in the context preexposure facilitation effect (CPFE), a variant of standard contextual fear conditioning (sCFC) that requires NMDA-receptor activity to acquire the representation of the training context. During early adolescence (PD31), animals were or were not exposed to a novel alternate-context (not the CPFE context). Five days later, they underwent the CPFE protocol-context preexposure, immediate shock training, context testing, 24 hr apart (PD36-38). Prior to context preexposure, animals were given MK-801, an NMDA-receptor antagonist, or vehicle. In controls without prior alternate context exposure MK-801 impaired the CPFE. In contrast, previous alternate context exposure prevented this MK-801-induced learning deficit. Subsequent studies in infant and juvenile rats could show a

transition to NMDA-independent context acquisition similar to that observed here or in studies of cued fear and sCFC (Li & Richardson, 2013; Chan, Baker & Richardson, 2015). Alternatively, the separation of context learning from context-shock association during the CPFE may cause this transition to emerge later in ontogeny. Future experiments will assess these possibilities.

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ANS FUNCTION IN NEWBORNS AND LATER NEURODEVELOPMENTAL OUTCOMES

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Assessment of the autonomic nervous system (ANS) can provide a window into investigations of neurodevelopmental trajectories. Such studies can determine whether early measures of heart rate (HR) and heart rate variability (HRV) are related to cognitive and behavioral outcome in childhood. The current study investigates differences in ANS measures at birth and associations with outcomes at 24–36 months. 90 newborns (35–40 weeks GA) were followed up using parental report of developmental assessments: the BITSEA (Social Emotional Assessment) and the PARCAR (Cognitive and Linguistic Assessment). All ANS parameters differed as a function of GA and in both quiet (QS) and active sleep (AS) states (p's < .03). Controlling for HR, sex, GA, and age at the time of the newborn assessment, the standard deviation of HR in QS and the interquartile range of HR (IQR) were both negatively related to socio emotional problems (β = −.48, p =.04, R^2 =.14; β = −.44, p =.04, R^2 =.14 respectively). IQR showed a marginally significant positive association with language scores (β =.38 p =.06, R^2 =.35). Significant positive associations were also found for HRV in AS and later language scores (SD: β =.46, p =.008, R^2 =.39; IQR: β =.35, p =.07, R^2 =.35). These results suggest that neonatal HRV may be useful in predicting neurodevelopmental function at 2 to 3 years of age.

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NEONATAL EEG PREDICTS SOCIO-EMOTIONAL AND BEHAVIORAL OUTCOMES IN TODDLERS

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The increased prevalence of Autism Spectrum Disorder (ASD) has motivated researchers to find reliable early markers of developmental disorders and delays. Past studies have shown links between higher frequency neonatal electroencephalogram (EEG) and better memory and language outcomes at 15 months of age. Others studies have reported positive correlations between higher frequency EEG power in the frontal regions and cognitive assessments at 16 to 36 months of age. The current study examines associations between neonatal EEG of 207 newborns (37–40 weeks gestational age) in active sleep and later developmental assessments at 24–36 months of age. Parental report measures of socio-emotional development and ASD risk (BITSEA) and cognitive and language outcomes (PARCAR) were administered over the phone. Analyses focused on higher frequency EEG activity (Gamma: 22–36 Hz) in the frontal, temporal, and parietal brain regions. Controlling for sex, gestational age at birth (GA), and age at the time of assessment, significant negative associations were found between high frequency EEG power in the frontal polar (β = −.205, p = .011, R^2 = .07), frontal (β = −.215, p = .008, R^2 =.06), and temporal (β = −.255, p = .002, R^2 = .08) brain regions and BITSEA ASD risk scores. Infants with higher EEG gamma power were more likely to have lower risk of ASD symptoms. These results demonstrate some promising associations between early neural biomarkers and later risk for neurodevelopmental delays.

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INTERSENSORY REDUNDANCY AND INFANT SELECTIVE ATTENTION TO NATIVE AND NON-NATIVE AUDIOVISUAL SPEECH.

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The current study utilized eye-tracking to investigate the effects of intersensory redundancy on infant visual attention and discrimination of a change in affect in native and non-native audiovisual speech. The Intersensory Redundancy Hypothesis states the synchronous and redundant presentation of multimodal stimuli selectively recruits infant attention to and facilitates processing of amodal stimulus properties (Bahrick & Lickliter, 2000). Monolingual English learning infants viewed either synchronous (redundant) or asynchronous (non-redundant) video clips of a woman speaking in English (native speech) or Spanish (non-native speech). Halfway through each trial, the speaker changed affect from adult-directed speech to infant-directed speech or vice versa. Participants completed four 1-min trials. Order of presentation was counter-balanced. Infant scanning patterns were measured using an EyeLink 1000 Plus. We hypothesized that intersensory redundancy would direct infant attention to amodal properties of speech and facilitate discrimination of a change in affect. Specifically, we predicted infants viewing synchronous videos would

demonstrate differential scanning based on a change in affect on both English and Spanish trials. In contrast, we predicted infants in the asynchronous condition would only demonstrate differential scanning patterns based on change in affect on English trials. The findings revealed differential scanning patterns across groups and conditions. Infants in the synchronous condition spent a greater proportion of each trial fixated on the mouth area, whereas infants in the asynchronous condition spent a greater proportion of each trial fixated on the nose area. These findings highlight the role of intersensory redundancy in directing infant selective attention to amodal stimulus properties.

EPIGENETIC AND BEHAVIORAL CONSEQUENCES OF ADVERSITY IN THE CONTEXT OF CAREGIVING

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Epigenetic alterations have emerged as biomarkers for measuring the impact of stress and adversity and as important mechanisms by which such environmental factors could interact with DNA to affect physical and mental health outcomes. We have designed a rodent model to understand the capacity of adversity experienced in the context of caregiving to cause epigenetic alterations in the brain and their relevance for behavioral outcomes. This model employs resource scarcity (i.e., insufficient nesting materials) to elicit adverse caregiving conditions (including maltreatment) toward rat neonates. When these animals are adult, we have observed sexually-dimorphic epigenetic alterations throughout brain. In this talk I will highlight some of these data as well as more recent data from our laboratory regarding the impact of these infant experiences on adult behavior and whether broad-scale epigenome modifiers are successful in altering brain epigenetic patterns and behaviors associated with maltreatment.

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THE DEVELOPING FRONTAL-PARIETAL NETWORK: SPATIAL IMITATION PERFORMANCE PREDICTS ACTIVATION IN YOUNG CHILDREN

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The neural signature of visuo-spatial working memory (VSWM), the short-term ability to retain and manipulate information, is well characterized in school-aged children and adults by frontal-parietal activation that strengthens with development and memory load (Moriguchi & Hiraki, 2013). Due to the technical difficulties associated with studying young children using fMRI, knowledge of the neural basis of VSWM in preschoolers is limited. Functional near infrared spectroscopy (fNIRS) may be a suitable alternative. Due to a lack of standardization of VSWM measurement in fNIRS studies, prior findings have been mixed (Buss et al., 2014; Moriguchi & Hiraki, 2013). In the present study, we collected fNIRS data from 5- to 8-year-olds during two multi-step spatial imitation tasks: one well-established (Subiaul et al., 2015, 2014) and one novel. An experimenter demonstrated a sequence of actions and then the child was tested. We hypothesized that these tasks would activate fronto-parietal networks during the test phase due to the demands of holding multiple steps in mind. Memory load was manipulated by length of sequence (2 to five steps), with all children performing at ceiling across loads. Both younger and older children exhibited frontal-parietal activation during the test phase of each task. However, for high relative to low load younger children showed only parietal activation, while older children exhibited the canonical frontal-parietal activation. Data collection with 3- to 8-year-olds is ongoing. Understanding the neural mechanisms underlying the development of imitation and load-dependent VSWM in very young children has important implications for our understanding of the science of learning.

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ASSOCIATION BETWEEN 5-HTTLPR AND BEHAVIORAL APPROACH SENSITIVITY (BAS)

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The aim of the study was to examine the association between EEG frontal asymmetry/5-HTTLPR polymorphism and BIS/BAS sensitivity. Thirty-five Japanese participants (20 girls) aged between 8 and 16 years old who lived in Tokyo joined in the study. EEG was measured during Wisconsin Card Sorting Test. Saliva was collected by Oragene (DNA genotek). 5-HTTLPR polymorphism and RS25531 SNP were analyzed by the capillary sequencing method. Behavioral inhibitory/approach sensitivity was measured with BIS/BAS questionnaire (Carver and White,1994) . The FFT analysis extracted Fp1/Fp2 alpha value (8-13 Hz, μV^2) from EEG data. 5-HTTLPR was in Hardy-Weinberg equation ($p < .05$). RS25531 SNP G allele with 5-HTTLPR long allele (16-repeats, L) as well as short allele (14-repeats, S) was regarded to reduce 5-HTTLPR transcriptional efficacy and designated as LG. We combined genotype of S/S and S/LG into S/S. There was no L/L. Generalized estimating equations revealed that 5-HTTLPR genotype associated with BAS Drive score (p=.000), but neither 5-HTTLPR genotype nor EEG frontal alpha asymmetry associated with BIS. Means of BAS Drive scores for S/S and S/L were 2.50(n22, sd .81) and 1.71(n13, sd .48) respectively. Our result did not confirm preceding 5-HTTLPR/EEG nor 5-HTTLPR/BIS researches. The study

was approved by the ethical review board of the first author's college. Written informed consent was obtained from all mothers and participants who were over 15 years old and written informed assent from participants under 15 years old.

DIFFERENCES BETWEEN JUVENILE AND ADULT FEAR MEMORY CAPABILITIES: THE ROLE OF IP3/MAP KINASE ACTIVATION AND TRAFFICKING OF GLUA2 INTO MATURE SPINES

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It is well known that young organisms do not maintain memories as long as adults, but the mechanisms for this ontogenetic difference are unknown. Here we demonstrate that 1h pedestal stress produces a long-lasting behavioral change in adult rodents indicative of fear memory. Sprague Dawley rats were assigned to either pedestal stress (1h) or no stress control. All animals were placed in an open field at the base of a 6 × 6 sq. inch pedestal (4 ft high). Both groups were allowed an initial 5 min exploration of the novel environment before control subjects were placed back in their home cages, while the stress animals were placed on the pedestal for 1h. There were no differences between groups for any of the measurements: exploration (s), freezing (s), or number of rears ($p>0.05$), during initial exposure. For the 1d re-exposure test, the stress group shows a significant reduction in both number of rears, and exploration time, along with a significant increase in freezing time, compared to the controls. For the 7d re-exposure, the stress group shows a significant decrease in exploration time and a significant increase in freezing time. Juvenile animals are currently undergoing testing. We predict that in adults there will be increased expression of hippocampal mushroom spines that contain a significant increase in AMPA − GluA2 subunit expression providing insight into the ontogenetic differences in fear memory consolidation.

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PRENATAL SOCIAL SUPPORT, ACCULTURATIVE STRESS, HAIR CORTISOL, AND MATERNAL MENTAL HEALTH SYMPTOMS IN MEXICAN-AMERICAN WOMEN

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Mexican-American women report high levels of prenatal anxiety and depression, which contribute to adverse maternal outcomes, including changes in the hypothalamic pituitary adrenal (HPA) axis. Mexican-American women experience high levels of psychosocial stressors that contribute to mental health symptoms, including those associated with cultural adaptation, such as acculturative stress. Home country contact may be contributing to acculturative stress, such that the clash between cultures is more constant, however it may also provide social support. Social support has been shown to buffer the adverse effects of maternal mental health, but the role of social support plays in the relationship between acculturative stress, cortisol, and maternal mental health systems in Mexican-American women is not known. It was hypothesized that high levels of contact with Mexico would be associated with stress and mental health symptoms. Mexican-American pregnant women (n = 104) were recruited and administered acculturative stress, anxiety, depression, and social support surveys throughout pregnancy as well as contact with Mexico. Hair cortisol was analyzed every trimester. High perceived social support was associated with elevated maternal hair cortisol early in pregnancy ($R^2 = 0.201$, $B = -.410$, $p < .003$), but not acculturative stress. Elevated maternal hair cortisol was also marginally associated with elevated depressive symptoms late in pregnancy ($R^2 = .041$, $B = 1.252$, $p = .070$) and high acculturative stress postpartum ($R^2 = .055$, $B = 3.631$; $p = .076$). Moderation analyses showed that low social support and less contact with Mexico was associated with increase depressive and anxiety symptoms during pregnancy. Maternal prenatal physiology is associated with sociocultural factors with consequences for maternal mental health in Mexican-American women.

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THE DEVELOPMENT OF A NOVEL IMITATION GENERALIZATION TASK TO MEASURE COGNITIVE FLEXIBILITY IN THREE-YEAR-OLDS

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Cognitive flexibility is defined as the ability to shift information across cues and update this information to new learning situations (Carroll, Blakey, & Fitzgibbon, 2016). The goal of the current study is to develop a new cognitive flexibility task for 3-year-olds, called the "Robots," task for measuring imitation generalization, which is the ability to apply learned information to novel stimuli that are similar in function but differ in shape and color. A 2-, 3-, 4- and 5-step sequence was developed. Performance of the target actions was assessed during baseline and test phases, which were then totaled to form both a composite baseline and composite test score. Data from 27 3-year-olds showed a significantly higher total composite score in the test phase (after demonstration) than in the baseline phase of the Robots task. Additionally, the frequency of performing one target action after another in order, called a "pair," was significantly higher in the test phase than chance for each

multi-step sequence. These results indicate that the Robots task is an appropriate measure of imitation generalization in this age group. Prior research with infants has demonstrated that bilingual infants show greater memory generalization (e.g., Brito & Barr, 2012, 2014). We are currently testing monolingual and bilingual children to assess whether there continues to be a difference in memory generalization in 3-year-olds as well. There are few imitation tasks for 3-year-olds, and this new task has the potential to test the consequences of bilingualism on cognitive flexibility development.

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EFFECTS OF CORTICOSTERONE ADMINISTRATION ON CONTEXTUAL FEAR CONDITIONING USING PERI-ORBITAL SHOCK

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Past studies from our lab have shown that corticosterone (CORT) can impair or facilitate hippocampal-dependent learning in young rats using trace eye-blink conditioning, depending on the method of administration. Here we use an alternative hippocampal-dependent paradigm, contextual fear conditioning, to replicate these findings. Corticosterone was administered by either osmotic mini-pump or injection. Starting on Day 15, rats either underwent surgery to have a 3-day osmotic mini-pump implanted at the nape of the neck or received injections at 9am and 5pm for 3 days. For each administration method there was a CORT group and a vehicle control group (PEG for mini-pumps, sesame oil for injections). On Day 23, rats underwent surgery to implant the bipolar stimulating electrode for the periorbital shock and context fear conditioning began on Day 25. Rats were placed into the conditioning chamber and observed for 3 min each day before receiving one 1.5 mA 100-ms shock. Observations were made for 6 days with no shock delivery on the final day. Corticosterone impaired contextual fear conditioning, whether administered by mini-pump or by injection. Lower levels of freezing were observed in both corticosterone groups (25% mini-pump, 30% injection) relative to vehicle control groups (55% both). These data indicate that early-life stress and elevation of corticosterone results in learning deficits using contextual fear conditioning. Differences in neural substrates between contextual fear and eye-blink conditioning may explain the different pattern of results seen here for mini-pump versus injection administration of corticosterone.

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PARENTING PLAY: DOES RESTRICTIVE CHILDREARING AFFECT INFANT PLAY WITH OBJECTS?

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In Western cultures, objects are abundant and varied. Parents constantly offer toys, scaled to infants' interests and abilities, thereby offering opportunities for object engagement. Over the first two years, infants show advances in object play from visual inspection to symbolic engagements, discovering possible actions on objects. Here, we examined visual-manual exploration in 8- to 24-month-olds in Tajikistan, who have been reared in a "gahvora" cradle from birth. The gahvora constrains infants' posture, limbs, and visual input—infants spent $M = 11.00$ hours/day in the cradle (range from 0 to 21 hours)—and may influence how infants explore objects. We observed 97 infants with a novel "busy cube" toy for 2 min and examined amount of exploration and interest in the object, simple actions on the object (e.g., mouthing, banging), and discovery of elements of the object and adapting their actions (e.g., using fingers to push bead along spiral path). Results show a developmental trajectory—adapted actions increased over age. Simple actions decreased slightly but remained high in older infants. Infants ($n = 75$) were video-recorded during spontaneous activities for $M = 43.50$ min when out of the gahvora. We are coding infants' spontaneous interactions with objects found in their environment to examine whether infants' everyday experiences with objects affect their exploration in the object task. We will also consider whether daily cradling hours relate to infants' spontaneous object exploration and in turn affect their behaviors in the object task. These findings highlight cultural influences on infants' everyday experiences and subsequent effects on infant development.

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FATHERHOOD ALTERS GENE EXPRESSION WITHIN THE MPOA

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Parental care, and especially maternal care, is a common behavioral characteristic of mammals. Female parenting is obligate because mammalian offspring need to nurse, but fathering behavior among mammals is rare. Only 3–5% of mammalian species exhibit biparental care. A great deal is known about the neural and hormonal mechanisms underlying maternal behavior, but the mechanisms of fathering

behavior are less clear. Here we attempt to identify new targets involved in the regulation of fathering behavior using RNA sequencing. Subjects were male prairie voles that experienced one of three social conditions: virgin males, pair bonded males, and males with fathering experience. Tissue punches were taken from the medial preoptic area (MPOA) and RNA was extracted. The RNA was sequenced, and sequences were compared between groups to identify genes that were differentially expressed in fathers. The top 500 differentially expressed genes from each comparison (Virgin vs Paired, Virgin vs Fathers, and Paired vs Fathers) were evaluated using the Gene Ontology enrichment analysis. Further analysis entailed the use of Kegg Pathways to reveal metabolic pathways associated with specific differentially expressed genes. Using these tools, we identified 23 genes within the MPOA that are differentially expressed in voles with fathering experience, including *Adora2a*, *Chrm1*, *Gabrd*, *Grin2a* and *Grin2b*, and *Kcnj2* and *Kcnj4*. These genes are involved in a variety of processes ranging from immune function and metabolism to learning and memory and the remodeling of dendritic spines. The identification of these genes will lead to novel insights into the biological basis of fathering behavior.

THE IMPACT OF PHTHLATE EXPOSURE DURING THE PERINATAL PERIOD ON THE NUMBER OF SYNAPSES IN THE MEDIAL PREFRONTAL CORTEX

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The perinatal period is both a critical time for brain development and a time when the brain is especially prone to environmental insult. One such environmental concern is exposure to phthalates, a class of endocrine-disrupting chemicals used as plasticizers, solvents, and emulsifiers in a variety of products that are known to readily cross the placenta and can be passed to offspring though lactation. Previously, we have shown perinatal phthalate exposure in rats can lead to sex-specific behavioral and cognitive changes in adolescence and adulthood that rely on the medial prefrontal cortex (mPFC). Due to these behavioral findings, in this study we examine the effect of perinatal phthalate exposure on the number of synapses in the adult mPFC. Dams were dosed orally with an environmentally relevant phthalate mixture composed of 35.35% DEP, 21.12% DEHP, 15.12% DiNP, 15.10% DBP, 8.16% DiBP, and 5.15% BBP at 0, 200, or 1000 μg/kg/day. Pups were sacrificed in adulthood and their brains harvested. Immunohistochemistry was performed on coronal slices of the mPFC for synaptophysin, a presynaptic vesicle marker, and then stereologically analyzed. Our preliminary results indicate that increasing phthalate exposure generally decreases synaptic density, particularly in layer V/VI, in both sexes. However, the addition of mPFC volume measurements will allow for the calculation of total synapse number in the mPFC, which will provide a more complete picture of the lasting impact of perinatal phthalate exposure on mPFC synaptic development.

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THE EFFECTS OF POSTNATAL CLOMIPRAMINE ON THE DEVELOPMENT OF OBSESSIVE COMPULSIVE DISORDER: A TWO-GENERATIONAL EPIGENETIC MODEL IN LABORATORY RATS

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Obsessive Compulsive Disorder (OCD) affects approximately 2% of adult Americans and involves repetitive, intrusive thoughts–obsessions–that lead to repetitive and ritualistic behaviors–compulsions. The postpartum period shows increased vulnerability to anxiety disorders including OCD. Anxiety disorders can be transferred to offspring through epigenetic effects, mediated by suboptimal maternal care. Clomipramine, a tricyclic antidepressant that targets serotonin and norepinephrine transporters, is normally used to treat adult OCD. However, exposure during the postnatal period can induce OCD in adulthood in male rats. We examined the effects of postnatal exposure to clomipramine on the development of OCD-like behavior in dams and their offspring. During postnatal days (PND) 9–16, females were treated with either saline or 15 mg/kg clomipramine. Around PND 90, females were mated and maternal behavior was observed during postpartum days (PPD) 1–6. On PPD 7, females were tested on the hole board to observe OCD-like behavior. Offspring were tested on the hole board on PND 30 and 90. During PPD 3–4, we observed that postnatal clomipramine-treated dams engaged in more passive nursing compared to postnatal saline-treated dams. In addition, postnatal clomipramine-treated dams made more hole pokes compared to postnatal saline-treated dams. We also found an epigenetic effect of clomipramine treatment, with peri-adolescent offspring of clomipramine-treated females making more hole pokes compared to offspring of saline-treated females. We are currently investigating the molecular mechanisms behind clomipramine-induced epigenetic effects. These findings help to elucidate how development of OCD in offspring may be an indirect effect of early maternal exposure to clomipramine.

GENES, ENVIRONMENT, AND EARLY LIFE STRESS: LIFE SPAN EFFECTS

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In the mouse, a powerful paradigm of early life stress, infant maternal separation (IMS), can trigger emotional and cognitive dysfunctions in adulthood similar to those found in humans with a history of childhood adversity. The magnitude of IMS effects differs among diverse inbred strains suggesting an interaction between the genetic background of pups and the maternal care they received. Here we investigated this interaction with studies on reciprocal F1 hybrid mice of the stress-susceptible Balb/c and the resilient C57Bl/6 strains that were either raised by Balb/c mothers (low maternal care) or by C57Bl/6 mothers (higher maternal care) with or without IMS exposure. The ultrasonic vocalization response to isolation was recorded from infant F1 pups, and their emotional, executive cognitive, and epigenetic phenotypes were assessed in adulthood. These studies showed that, regardless of the maternal care received, the emotional phenotype of F1 hybrids was not significantly affected by IMS exposure. However, F1 pups raised by Balb/c (but not C57Bl/6) mothers during IMS exposure exhibit deficits in working memory and attention-set-shifting in adulthood. They also exhibit reduced histone deacetylase 1 levels at promotors of brain-derived neurotrophic factor and early growth response 1 genes, and abnormally high induction of expression of these genes during cognitive testing. Since one of affected genes was previously shown to associate with the Balb/c and the other with the C57Bl/6 genetic background, these findings indicate that both parental alleles interact with the maternal environment to modulate the cognitive and epigenetic phenotypes of F1 mice exposed to the IMS.

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A LACK OF A SEX DIFFERENCE IN CELL PROLIFERATION IN THE DENTATE GYRUS OF THE DORSAL AND VENTRAL HIPPOCAMPAL FORMATION IN MALE AND FEMALE MICE

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There are sex differences in the frequency and manifestation of many neuropsychological dysfunctions, yet the neurobiological mechanisms for these differences remain unclear. Changes in the hippocampal formation are implicated in some of these dysfunctions, such as depression and Alzheimer's disease. The dentate gyrus of the hippocampal formation displays cellular proliferation throughout the lifespan, and disruption of this process may be a neural substrate for these dysfunctions. Moreover, the proliferative rate and survival of newly born cells in the dentate gyrus are different between males and females of many species. Previous work in adult mice, however, has shown that cell proliferation in the dentate is similar in males and females, yet these studies only focused on the dorsal aspect of the hippocampal formation. Given the role of the ventral hippocampal formation in emotional behaviors and stress reactivity, factors that display sex differences, we quantified the number of proliferating cells in both the dorsal and ventral dentate of male and female C57BL/6 mice. Using Ki-67 immunohistochemistry, we found no sex differences in the number of proliferating cells in either the dorsal or ventral dentate. Furthermore, we found no correlation between uterine weight, an index of circulating estradiol, and cell proliferation in females. These data compliment and extend the previous studies showing a lack of sex differences in cellular proliferation in the dentate gyrus of mice. Future studies could establish the phenotype of these newly born cells and assess their potential contribution to the differential neuropsychological vulnerabilities observed in males and females.

MAKING SENSE OF ANTISENSE: TRANSLATING COMPLEX IDEAS INTO SIMPLE TERMS

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Scientific researchers are fluent in an advanced language and are able to communicate complex ideas and processes. Understanding these terms comes from many years of education and work, and scientists are often surrounded by people who share the same experience. However, the ability to translate complicated concepts into clear language is a key research skill. Not only does it allow the sharing of research with non-specialists, such as politicians, students, or the public; being able to clearly explain complex science can help foster connections across other scientific fields. Science communication is becoming increasingly important, particularly when addressing a wider public audience, who now have unprecedented access to the scientific literature. While this increased access has many positive implications, it also raises serious issues, such as the misinterpretation of pre-clinical studies, as well as the overstating of pre-clinical research in attention grabbing headlines favoured by mainstream media. We will discuss the issues that currently face science, and how we can best translate complex ideas into simple terms, without loss of the scientific message.

PUBERTAL- AND SEX-DEPENDENT CHANGES IN CELL PROLIFERATION IN THE DENTATE GYRUS OF RATS

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Pubertal development is associated with many changes in the structure and function of the central nervous system, including significant decreases in the rate of cellular proliferation in the dentate gyrus of the hippocampal formation. These studies examining pubertal-related changes in hippocampal cellular proliferation have largely focused on male rats. In adulthood, sex differences in cell proliferation are present in

this species, but the influence of sex on pubertal changes in this parameter are unknown. Thus, we examined cellular proliferation, as measured by Ki-67 immunohistochemistry, in the dentate gyrus in the dorsal hippocampal formation in pre-pubertal (30d), mid-pubertal (45d) and post-pubertal (70d) male and female rats. We found significant pubertal decreases in the number of Ki-67-positive cells in both males and females, but this decrease was significantly greater in males than females. This sex difference is driven by the significant difference in the number of Ki-67-positive cells between the 30d-old males and females, with males showing significantly higher levels of cellular proliferation compared to females. These data show both pubertal- and sex-dependent changes in hippocampal cellular proliferation in rats. Given the widespread influence of hippocampal cellular proliferation on neurobehavioral functions and dysfunctions, future studies will need to address the implications of these differences. Moreover, additional studies are being conducted to assess if these differences are specific to the hippocampus or if they occur in other proliferative zones of the brain, such as the subventricular zone.

THE AMYGDALA AS A BIOLOGICAL LINK BETWEEN ADVERSITY AND ANXIETY

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Early adversity is commonly associated with alterations of amygdala circuitry and increased anxiety. While many theoretical and clinical accounts of early adversity suggest that it increases vigilance to threatening stimuli, the present study tested whether heightened anxiety and amygdala reactivity associated with early adversity enhanced goal-directed attention for threatening stimuli. Showing this association would provide support that these adversity-induced alterations are developmental adaptations of the individual. 34 children and adolescents who experienced early adversity in the form of previous institutionalization (PI) (26 female, mean age = 13.49 years) and a comparison group of 33 children and adolescents who were reared by their biological parents since birth (16 female, mean age = 13.40 years) underwent fMRI scanning while completing a visual search task that involved quickly locating a negative (fearful face) or positive target (happy face) in an array of neutral distractor stimuli (neutral faces). Across both groups, individual differences in vigilant behavior were positively associated with amygdala responses for negative versus positive stimuli. However, a moderation analysis revealed that the degree to which amygdala responses were greater for negative versus positive stimuli was associated with greater anxiety symptomology for PI youth, but not comparison youth. Together, these findings suggest that institutional care strengthens linkages between amygdala reactivity and anxiety, perhaps serving to enhance goal-directed attention.

TESTING THE AROUSAL HYPOTHESIS OF NEONATAL IMITATION IN INFANT RHESUS MACAQUES (MACACA MULATTA)

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Neonatal imitation is the matching of (often facial) gestures by newborn infants. Some studies suggest that performance of facial gestures is due to general arousal, which may produce false positives on neonatal imitation assessments. Here we examine whether facial gesturing and arousal are associated in newborn infant rhesus macaques. We tested 152 infants in a neonatal imitation paradigm, tested in three conditions, every other day in the first week of life. We analyzed infants' lipsmacking gestures—rapid opening and closing of the mouth—as well as their yawn responses, which is a measure of arousal. Arousal increased throughout the assessment, and arousal and lipsmacking gestures were associated with each other, yet we found no evidence suggesting that arousal on its own could explain the condition-specific increase in lipsmacking gestures when infants viewed a lipsmacking model. Thus, we found no support for the arousal hypothesis of neonatal imitation. We discuss optimal testing conditions to minimize potentially confounding effects of arousal on measurements of neonatal imitation.

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DOES LOCATION MATTER? AN INVESTIGATION OF ATTENTIONAL BIAS TO AFFECTIVE FACIAL EXPRESSIONS IN INFANCY

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Although previous research indicates that infants take longer to disengage from fearful faces compared to happy faces in the presence of non-face peripherally-located stimuli (Peltola, Leppänen, Palokangas, & Hietanen, 2008), no research has explored disengagement from centrally-located facial targets in the presence of peripherally-located facial targets. Therefore, it is unclear if infants would maintain a bias for centrally-located fearful faces if the peripherallylocated target was also of a similar affective valence. The current study uses an Overlap eye tracking task to investigate the role of peripherally-located emotional stimuli in facilitating disengagement from centrally-located emotional stimuli. Twenty-eight 5- to 24-month-olds were shown trials in which a fearful, angry, happy, or neutral face was displayed in the center of the monitor for 500 ms, followed by the onset of a fearful, angry, happy, or neutral face in the periphery for 1500 ms. Preliminary data analysis indicates a main effect of central emotion ($F(3, 20) = 3.79$, $p < .03$, hr2 =.36) and no main effect of peripheral emotion (F(3,

20) =.72, p =.55, hr2 =.10). This suggests that the emotion of the centrally-located face, not the peripherallylocated face, is most influential in facilitating disengagement from the centrally-located face. Data collection is ongoing, and future analyses will investigate the average number of latencies to each emotional expression (by location), the average duration of first fixation to each emotional expression (by location), as well as potential links between infant temperament and fixation patterns.

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FNIRS IN TODDLERS: NEURAL DIFFERENTIATION OF COMMUNICATIVE CUES AND RELATION TO FUTURE LANGUAGE ABILITIES

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Functional Near Infrared Spectroscopy (FNIRs) is a comfortable, motion-tolerant neuroimaging technique that can be used to assess brain activity on the surface of the cortex. Here, we use fNIRS to assess neural differentiation of communicative stimuli in toddlers (ages 2 and 3 years), ages where neural representations of communicative development have been difficult to measure previously. fNIRS was measured in 30 children across the frontal regions while they observed gesture and speech stimuli that were either communicative or noncommunicative. Three and two-year olds both differentiated whether stimuli were communicative (including gestures and words) via activity in the left lateral frontal region (for words, $t = 3.1$, $p < .01$; for gestures $t = -2.5$, $p < .05$). Activity in the left lateral frontal region also discriminated between meaningful speech and gestures across both 2 and 3 year olds ($t = 2.4$, $p < .05$). However, two and three year olds differed in their neural differentiation of stimuli in the right medial frontal regions(for communicative vs. noncommunicative gestures, $t = -2.5$, $p < .05$; for gestures vs speech $t = -2.2$, $p < .05$). Finally, in a sample of 15 two year olds, including both those with typical development and language delays, neural differentiation of communicative stimuli in the right lateral frontal region predicted expressive language outcomes at age 3, as measured with the Mullen Scales of Early Learning. Specifically, after accounting for variance related to Mullen performance at age 2, increased neural activation for words compared to nonwords, noncommunicative versus communicative gestures, and communicative speech versus gestures at age 2 predicted better expressive language at age 3. These results are discussed in the context of the underlying mechanisms of toddler speech development and use of fNIRS in prediction of language outcomes, including delay.

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QUANTITY AND PATTERNING OF REM-SLEEP TWITCHES ACROSS THE FIRST POSTNATAL YEAR

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Human newborns spend 16 hr each day asleep, with half of that time spent in REM (or active) sleep. Noting that the proportion of REM to non-REM sleep decreases over development, it was hypothesized that REM sleep contributes to early brain development. Consistent with this hypothesis, we have shown in infant rats that sensory feedback arising from twitching activates sensorimotor structures throughout the brain. In contrast, activity is suppressed in these same structures when the rat is awake and vigorously moving its limbs. These findings suggest that twitches provide the developing infant with unique information about the functional features of its continuously growing body. Although sleep has been studied extensively in human infants, the quantity and patterning of twitching have never been directly assessed. Therefore, we recorded and analyzed daytime sleep in normally developing, full-term human infants from 2 weeks to 12 months of age. Infants twitched at steady rates across the first postnatal year, averaging approximately 6 limb twitches per minute of REM sleep. Interestingly, the patterning of twitching changes with age. For example, twitches of the head predominate at birth and decline in relative frequency over the first three postnatal months; in contrast, around the same time, twitches of the hands and fingers increase in relative frequency. Overall, this initial study lays a foundation for investigating of the roles that sleep and sleep-related twitching play in the development of the sensorimotor system.

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RELATION OF EMOTION REGULATION TO NEURAL INDICES OF INHIBITORY CONTROL IN EARLY CHILDHOOD

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Emotion regulation predicts children's academic success; however, early cognitive skills that facilitate emotion regulation have not been fully explored (Hudson & Jacques, 2014). An emotion regulation strategy called suppression requires inhibiting the expression of emotion. Indeed, inhibitory control assessed with behavioral measures has been related to emotion regulation in children (Carlson & Wang, 2007; Liew et al., 2004). However, the neural bases of emotion regulation in early childhood are not well understood. This study explored contributions of both behavioral and neural inhibitory control to emotion regulation in 4.5–5.5 year old children (N = 97). Inhibitory control was measured

using a go/no-go game, where children pressed a button for every animal except orangutans. Accuracy on no-go trials indexed behavioral inhibitory control. Mean amplitudes of the P300 ERP component were computed for midline parietal electrodes for correct no-go trials. The P300 is thought to index neural inhibition processes (Lewis et al., 2006). Emotion regulation was assessed using parent-ratings on the Emotion Regulation Checklist (Shields & Cicchetti, 1997). Behavioral inhibitory control was unrelated to emotion regulation. However, there was a main effect of emotion regulation on P300 amplitudes using a repeated-measures ANOVA with electrode location as a within-subjects factor, $F(1, 48) = 4.40$, $p = .041$. The effect was such that better emotion regulation related to larger P300 amplitudes, indexing better inhibition. Results suggest that the neural circuitry of inhibitory control may support the development of emotion regulation, though longitudinal research is needed to understand potential bi-directional relations between these constructs.

ARE REWARD PROCESSES CAUSALLY INVOLVED IN THE PATHOGENESIS OF DEPRESSION

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Reward processing has been proposed as a plausible candidate mechanism for depression and as an attractive treatment target. In this talk I assess the involvement of reward processing in the aetiology of depression that can also be applied to other candidate mechanisms. I present evidence from our own research encompassing task-based and resting-state neuroimaging using longitudinal studies and pharmacological interventions. I embed these findings into a broader network of fMRI and EEG meta-analytic findings and review current computational models proposed to understand reward in depression.

ADVERSE CHILDHOOD EXPERIENCES AND PHYSIOLOGICAL RESPONDING TO STRESS IN YOUNG ADULTS

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This study examined biological and behavioral markers of health and physiological responding to stress in a selected sample of young adults recruited from a residential liberal arts college campus. We screened 239 students via online questionnaires to identify those with no adverse childhood experiences (ACEs) or four or more ACEs. Participants meeting selection criteria (no ACEs [controls], n =15; 4 or more ACEs [ACEs], n = 14) participated in a laboratory visit to assess in-vivo physiological responding to stress. Laboratory tasks included the cold presser test; a finger-stick blood sample; a five-minute speech sample about childhood; an interview about disappointing experiences; and the speech portion of the Trier Social Stress Test. Relative to controls, the ACEs group reported significantly more trait anxiety, fewer hours of sleep per night, and demonstrated less tolerance for pain in the cold presser test. The groups did not significantly differ on biomarkers of health risk, including blood pressure, HDL cholesterol, percent body fat, or BMI. Significant differences in autonomic responding during laboratory tasks were found. The control group showed a consistent pattern of the expected, reciprocal mode of autonomic responding, that is, reciprocal changes in heart rate (HR) and respiratory sinus arrhythmia (RSA) across all tasks. In contrast, the ACEs group exhibited atypical profiles of nonreciprocal modes of responding on 4 of the 6 tasks. Autonomic dysregulation was robustly evident in the ACEs group and may be a key biological mechanism involved in the association between childhood adversity and stress-related illness across the lifespan.

EFFECTS OF CHRONIC CORTICOSTERONE EXPOSURE ON NEUROENDOCRINE FUNCTION OF ADOLESCENT AND ADULT MALE MICE

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Adolescence is associated with the maturation of the hypothalamic-pituitary-adrenal (HPA) axis and is marked by a variety of stress-related vulnerabilities, including neurobehavioral dysfunctions. Many of these vulnerabilities are accompanied by a disrupted HPA axis. A mouse model of disrupted HPA function has been developed using oral chronic corticosterone (CORT) administration, which results in various abnormalities in stress reactivity and anxiety-like behaviors. This model has only been established in adults; therefore, to extend this model, we tested how disrupting the HPA axis in adolescent mice would influence stress reactivity. Specifically, we exposed adolescent and adult male C57BL/6 mice to 4wks of oral CORT exposure (25 mg/ml) and tested their plasma CORT and neural activity patterns in response to 30 min of restraint stress. We show that CORT treatment during adolescence or adulthood leads to hormonal hypo-responsiveness, such that stress failed to elevate plasma CORT levels in treated mice. Despite this reduced hormonal response, we found significant neural activation in both adult- and adolescent-treated mice in the paraventricular nucleus of the hypothalamus (PVN), the neural initiator of the hormonal stress response. These data indicate a dissociation between stress-induced peripheral and central responses following CORT treatment during either adolescence or adulthood. Moreover, we found that stress-induced neural activation in the PVN was highest in animals treated during adolescence, indicating an age-dependent effect of chronic CORT treatment on PVN reactivity. These experiments extend this model of HPA disruption to include adolescent

animals and highlight unique effects of HPA disruption during adolescence.

FAMILY NURTURE INTERVENTION FOR PRETERM INFANTS IN THE NICU INCREASES VAGAL TONE AT 5 YEARS OF AGE

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Premature infants are delayed in maturation of their autonomic nervous systems (ANS; Patural et al., 2004).). Vagal tone is a widely used measure of functionality of the parasympathetic branch of the ANS. Vagal tone is estimated by calculating heart rate variability (HRV) associated with respiration, i.e. respiratory sinus arrhythmia (RSA), using spectral (HF-HRV) and time domain measures (rMSSD). It is hypothesized that vagal tone can be used as a physiologic marker of emotion regulation (Porges et al., 1994). Family Nurture Intervention (FNI) was designed to enhance emotional connection between mothers and infants (Welch et al., 2012). FNI is hypothesized to increase mother and infant physiological co-regulation which, in turn, would promote ANS maturation, in particular, vagal tone. A randomized controlled trial of FNI was conducted at Columbia University Medical Center comparing 150 preterm infants who received standard care (SC) versus those who received FNI. FNI was administered by nurture specialists who facilitated mothers to engage in activities including: sustained touch, eye contact, scent cloth exchange, vocal soothing, and skin-to-skin touch, all of which designed to increase the opportunity for emotional connection. A subset of infants (25 SC, 27 FNI) have been followed to 5 years of age. Ten-minute ECG samples were taken during a cognitive battery and HRV was quantified. FNI children exhibited ~30% greater vagal tone as assessed by HF-HRV and rMSSD, p = 0.014, 0.018, respectively). These results support the hypothesis that FNI has a positive long-term effect on physiological and emotion regulation of preterm infants.

EXPOSURE TO TRAUMATIC EVENTS IN CHILDHOOD SHAPES STRESS PHYSIOLOGY DURING PREGNANCY: IMPLICATIONS FOR THE INTERGENERATIONAL TRANSMISSION OF RISK

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Childhood exposure to traumatic events can have profound and lifelong consequences for physical and mental health, including an elevated risk for dysregulated stress physiology in adulthood. In current study, we evaluate the impact of childhood traumatic events on prenatal stress physiology, indexed by hair cortisol concentrations. As a secondary aim, we assess whether childhood traumatic events sensitize the individual to the consequences of subsequent trauma exposures on cortisol concentrations during pregnancy. The current study included 88 pregnant women (M = 28.6 gestational weeks, SD = 3.2). Maternal life events in childhood (0–10 years), adolescence (11–17 years), adulthood (18+ years), and during the current pregnancy, were assessed using a modified form of the Life Events Checklist (LEC). Maternal hair cortisol was assessed during the beginning of the third trimester, providing a measure of cumulative cortisol production over the previous three months of gestation. Hierarchical linear regression revealed that more traumatic events in childhood predicted elevated cortisol concentrations during pregnancy, event while accounting for adulthood exposures ($p < 0.001$). We also report a novel finding, that childhood traumatic events may increase vulnerability to the dysregulating impact of subsequent exposures in adulthood ($p < 0.01$). Our results highlight the profound effect of childhood traumatic experiences on maternal HPA-axis functioning. Prenatal stress physiology has important consequences for the developing fetus and offspring outcomes. Thus, taken together, findings suggest that childhood traumatic experiences can have pervasive consequences for maternal stress regulatory systems, an effect which may have implications for the next generation.

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THE RELATIONSHIP BETWEEN WEIGHT-BEARING LOCOMOTION AND TENDON CHARACTERISTICS IN RATS I: POSTNATAL DEVELOPMENT

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Factors involved in the regulation of normative tendon development are largely unknown. The aim of the current study was to examine relationships between specific locomotion and posture patterns and tendon characteristics during postnatal development in rats. Rats were tested on postnatal day 1 (P1; 24 hr after birth), P5, or P10 in an open-field environment for a 20-minute test session. Locomotion, posture, and weight-bearing activity were measured. Immediately following testing and euthanasia, hindlimbs were removed to extract Achilles tendons for further testing. Data indicate that crimp patterns in the collagen structure of Achilles tendons are visible at P5 and increase in organization by P10. Additionally, changes in the mechanical properties of tendons occur from P5 to P10, such that tendons of P10 rats withstand higher levels of force. These findings are interesting given that

spontaneous locomotion changes from pivoting and crawling to walking (increased weight-bearing) around P9. Increased understanding of the relation between neurobehavioral and musculoskeletal development is important for addressing developmental neuromotor disorders, such as spina bifida, where altered locomotor development is seen.

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THE IMPACT OF INCREASING SITTING ABILITY AND AGE IN DEVELOPING EARLY PROBLEM SOLVING SKILLS

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Advancements in infant motor function can support further interactions with the environment. Problem solving, a cognitive process, is grounded in infants' everyday experiences and emerges, in part, through exploration of objects. Infants who are more stable sitters may be more capable of exploring toys. Subsequently, sitting may affect the development of problem solving skills. The study purpose is to evaluate if there is a change in early play-based problem solving skills in response to change in sitting ability in typically developing infants. Infants (n = 36) were recruited when they could sit propped or arms free, without the ability to change positions. Assessment visits were completed at baseline, after 3 weeks, and after 6–8 weeks. The Early Problem Solving Indicator (EPSI) is a measure of early behaviors related to the development of problem solving used during play with 3 standard toys. Gross Motor Function Measure Sitting Scale (GMFM-SS) is a standardized assessment of sitting skills of children. A preliminary analysis (n = 19) using linear mixed modeling was performed to describe the interaction effect of Age and GMFM-SS on two EPSI behaviors (looks, explores). Results indicated significant interaction effects of age and sitting ability on frequency of looks (b = 0.08, df = 39.24, p = .002) and explores (b = −0.47, df = 39.48, p = .007). Our results suggest that it is important to account for age as well as sitting ability when studying the development of behaviors related to problem solving.

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MATERNAL ELECTROCORTICAL RESPONSES TO OWN VERSUS OTHER CHILD PICTURES AND CHILD INTERNALIZING SYMPTOMS

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Maternal responsiveness to their children is an important factor in promoting positive mother-child relationships and child well-being across a number of domains. Recent studies have begun to elucidate biomarkers of maternal responsiveness to their children. One promising biomarker is the Late Positive Potential (LPP), an event-related potential reflecting emotional engagement, which has been shown to be potentiated to own versus other child stimuli. However, little is known about how maternal LPP to own child may be related to child outcomes (e.g., symptoms of anxiety and depression). The current study included 37 mothers recruited based on at least one of the following risk factors: history of depression, history of anxiety, high authoritarian parenting, low authoritative parenting. We examined the associations between maternal LPP to own child and parent-report measures of child anxiety (SCARED-P) and depression (CDI-P). Replicating previous work, we found that maternal LPP was potentiated to own child pictures compared with other child and neutral pictures. Further, we found that maternal LPP to own child was negatively correlated with child anxiety symptoms, such that mothers who showed larger LPP responses to their own children had children with fewer anxiety symptoms than mothers who showed smaller LPP responses to their own children. Furthermore, we found that these associations were driven by associations with symptoms of separation and social anxiety. These preliminary findings suggest that maternal LPP to own child may be a valuable biomarker in predicting child anxiety symptoms, and may be a useful target for relational interventions.

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DEVELOPMENTAL DIFFERENCES IN EVENT-RELATED POTENTIALS TO SOCIAL EXCLUSION IN CHILDREN, ADOLESCENTS, AND ADULTS

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Although neural correlates of social exclusion have been well-documented, most studies have examined age groups separately or linear age effects in mixed samples of children and adolescents, rather than nonlinear specific age-differences across children, adolescents, and adults. This study directly compared age-related differences in the medial frontal N2 ERP during social exclusion across children, adolescents, and adults. We focused on the N2 ERP as increases in N2 amplitudes have been linked to cognitive control, behavioral monitoring, and self-regulation processes (Van Noordt et al., 2015). Thirty-four children (ages 10–12), 44 adolescents (ages 14–16), and 63 adults (ages 17–28) completed the Cyberball game (Williams et al., 2000) while wearing a 128-channel Hydrocel net. Participants also provided ratings of fear of negative evaluation during the game. A repeated measures ANOVA with condition (favor, not my turn, and reject) as within-subjects factor and age group (children, adolescents, adults) as between-subject factor revealed a condition X age group interaction for the N2 ERP, $F(4,276) = 2.62$, $p < .04$. In rejection events, adolescents showed smaller (i.e., less negative) N2 amplitudes than

children and adults, $F(2,140) = 3.10$, $p < .05$. In not my turn events, children and adolescents showed larger N2 amplitudes than adults, $F(2,140) = 11.32$, $p < .01$. Moreover, more negative N2 amplitudes to not my turn events were related to higher fear of negative evaluation, controlling for age, partial correlation, $r(140) = -.17$, $p < .05$). These developmental differences in brain functioning suggest the engagement of lower cognitive control to social exclusion in adolescence and enhanced cognitive control to threats of exclusion beginning in early adolescence.

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EARLY CARE EXPERIENCES AND ADULT PSYCHOPATHOLOGY: AN INVESTIGATION OF HISTORY OF EARLY CARE EXPERIENCES AS PREDICTORS OF ADULT PSYCHOPATHOLOGICAL AND PHYSICAL HEALTH CONDITIONS ACROSS CULTURES

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Emerging research in neuroscience and developmental psychology demonstrates that early care experiences influence neuronal development and subsequently, shape both psychological and physical outcomes. Within this framework, there exists a heterogeneous approach of best practice for caring for children and infants in the early years of life. In order to address the question of best early care practices for children, we created an online survey utilizing Research Electronic Data Capture software, and translated this survey into Dutch, Japanese and Arabic. The survey includes the following measures: Experiences in Close Relationship Scale-Short Form (ECR-S), Trauma Symptom Checklist (TSC-40), Three-Item Loneliness Scale, Social Phobia Inventory (SPIN-17), six questions about the respondent's early care experiences and two physical health questions. The goal is to procure 45 completed surveys in each of the five languages; collaborators in each of the above-mentioned countries are facilitating the dissemination of the survey. To date, we have procured n = 97 surveys (n = 68 complete) from English speakers, n = 67 complete surveys from Dutch speakers and are currently collecting data from the two remaining countries. Hierarchical regression analysis of English speakers data demonstrate that previous history of sleeping condition together with trauma symptomology, degree of loneliness and type of adult attachment significantly predict adult social phobia scores, $F(5,62) = 3.97$, $p = .0035$. Additional regression analyses suggest that alone, the degree of secure adult attachment and degree of loneliness significantly predict social phobia, $F(2,65) = 3.70$, $p = .03$, and anxiety scores, $F(2,65) = 13.77$, $p = .0004$. Clinical application of findings is discussed in terms of sensitivity to diverse populations.

PATTERNS OF REACHING IN INFANT RHESUS MONKEYS (*MACACA MULATTA*)

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Kinematic studies have provided valuable insights into the structure of reaching over human development, but comparable data from nonhuman primates are limited. The goal of the current study was to conduct the earliest assessment of reach kinematics in the rhesus monkey *(Macaca mulatta)*. Forty-five nursery-reared monkeys completed a reaching task at 3 weeks of age in a 2 × 2 design varying object size and object location (peripersonal vs. extrapersonal space) across 8 trials. Motion analysis was conducted offline from videotape using the software program MaxTRAQ 2-D, and kinematic variables were calculated in Matlab. Linear mixed effects models were used to examine the effects of hand, object size, and distance relative to the monkey on average reach speed, reach smoothness, and reach straightness. There was a significant effect of hand on reach straightness, $\beta = -0.095$, $SE = 0.036$, $t(165.91) = -2.627$, $p < .01$, such that left hand reaches were straighter than right hand reaches. There was also a significant interaction between object size and location on reach smoothness, $\beta = -0.477$, $SE = 0.191$, $t(166.87) = -2.491$, $p < .05$. Reaches to the small object in the monkey's peripersonal space were smoother than reaches to the small object in the monkey's extrapersonal space. Reaches to the large object did not vary in smoothness based on object location. There were no effects on average reach speed. Kinematic findings will be discussed with respect to grip selection, as well as within a comparative perspective with human patterns.

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A ROLE FOR VISUAL EXPERIENCE IN ACTIVITY-DEPENDENT DEVELOPMENT PRIOR TO EYE-OPENING

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As early as when the eyes first open, light is known to play a critical role in the development of visual circuitry. However, whether light interacts with the developing visual system before eye opening is not well understood. In mice, the eyelids remain closed for the first two weeks of postnatal life during which cells of the retina exhibit retinal waves, a term used to describe spontaneous correlated activity. These waves are the predominant type of neural activity before vision and have been implicated in the refinement of retinal projections to the

brain. Several days before eye-opening, rod and cone photoreceptors become active components of retinal circuitry, suggesting that light-mediated responses and retinal waves could interact. Here, using two-photon imaging, we show that light modulates the frequency and area of propagation of waves, and we will present data testing the impact of light on the directionality of wave propagation. Second, we show that dark-rearing mice before eye-opening leads to reduced eye-specific segregation of axonal projections from retinal ganglion cells to the dorsal lateral geniculate nucleus. These studies will provide critical new insights on the importance of light stimulation even before eye-opening for the proper development of the visual system.

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MECHANISMS FOR A DEVELOPMENTAL CRITICAL PERIOD OF HIPPOCAMPAL LEARNING

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Episodic memories formed during the first postnatal period are rapidly forgotten, a phenomenon known as *infantile amnesia*. Infantile amnesia is conserved throughout evolution, as it has been described in rodents as well as humans. It remains to be understood whether this amnesia is the result of immaturity of the infant brain, impaired memory retrieval, or failure in memory storage. Furthermore, in spite of this apparent memory loss, early life experiences influence brain development and predispose to psychopathologies, raising the question of which mechanisms underlie infantile memories. Using contextual fear-based task inhibitory avoidance (IA) in infant rats, we found that early life experiences are stored as latent memory traces for a long time: later reminders reinstate a robust, context-specific and long-lasting memory. The formation and storage of this latent memory requires the hippocampus and employs mechanisms typical of developmental critical periods, including a BDNF- and mGluR5-dependent expression switch of NMDA receptor subunits from 2B to 2A. Moreover, BDNF administration after training rescues the infantile amnesia, hence closing the critical period. We suggest that the hippocampus, like sensory systems, undergoes a developmental critical period to become functionally competent.

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INFANT SLEEP ONSET TIME AND COSLEEPING: ASSOCIATIONS WITH INFANT AND PARENT CHRONIC PHYSIOLOGICAL STRESS

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Infant sleep characteristics have been shown to have an association with acute physiological stress as indexed by salivary cortisol awakening response (CAR). However, associations between infant sleep characteristics and infant chronic physiological stress as indexed by hair cortisol concentration (HCC) have been understudied. Given that infants who have later sleep onset at night have higher CAR (Stalder et al., 2013), it is possible that infants with later sleep onset have greater cumulative cortisol exposure over time. Because infant and parental HCC are associated (Flom et al., 2017), it is also important to assess factors associated with parental HCC. Potential discomfort associated with cosleeping with infants could be a factor contributing to parental HCC. The current study investigated the relation between sleep onset time at night and HCC in 12-month old infants ($N = 76$, $M_{age} = 12.22$, Female = 39). Additionally, we investigated whether engaging in cosleeping was related to infant and parent HCC. We found that infants with later sleep onset time had greater HCC (r=.30, p=.010). Parents who shared the same bed with their infants for at least a part of the night had greater HCC compared to those who did not engage in cosleeping, $t(71) = -2.55$, p=.013. Cosleeping was not related to infant HCC. Results suggest that later sleep onset time may contribute to infants' cumulative exposure to physiological stress and cosleeping may contribute to parents' cumulative exposure to physiological stress. Thus, infant sleep characteristics are related to both infant and parental cumulative cortisol exposure.

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CHILDHOOD STRESS EXPOSURES AND INTERLEUKIN-6: A LONGITUDINAL ANALYSIS

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The association between childhood stress and circulating interleukin-6 (il-6), a key inflammatory marker, was assessed in a sample of 188 children aged 9–10 years. The study over-sampled low-income, high psychosocial stress families (e.g., 67% minority; 30% high school graduation or less). Families were assessed every 6-months over a period of 3 years. Stress measures included the child-reported Disagreements with Parent Questionnaire and the MacArthur Subjective Social Status Ladder – Youth Version, which indexes an individual's perception of rank in the social hierarchy. In children, this scale asks the child where they rank themselves in relation to other students in their school. Blood from venipuncture was collected for immune analyses of il-6. The General Estimating Equation method was used to test the associations of stress and il-6 over the three-year time period. Il-6 concentration was log-transformed for normality; both stress measures were considered as time-varying covariates. Child age, sex, race and annual household income, BMI, parent education, and the

presence of illness in the last 2 weeks were also controlled for. Child subjective social status was significantly associated with il-6 ($p < .05$): Across the three-year observational period, children who perceived lower socioeconomic status had higher il-6 activation (95% CI, −.04–0.02), even after accounting for objective SES and other covariates. The results indicate that higher psychosocial stress and socioeconomic disenfranchisement is associated with immune system activation in a pediatric sample, and may partly explain the socio-economic health gradient reported in pediatric samples.

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BLUNTED CORTISOL LEVELS AND DYSREGULATED FEAR RELATE TO REDUCED SOCIAL APPROACH IN TODDLERS

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Research indicates that dysregulated fear, characterized by high fear to low-threat situations, during early childhood may predict later social inhibition more precisely than general fearful temperament (Buss, 2011; Buss et al., 2013; Buss et al., 2017). Research also suggests that physiological markers of stress may interact with dysregulated fear to predict social inhibition (Buss et al., 2017). Elevated cortisol levels, a marker of stress (Simons et al., 2017), have been linked to social inhibition in children (Kertes et al., 2009); however, research has not examined if cortisol is important for understanding social inhibition in toddlers exhibiting dysregulated fear, characterized by high fear to low threat (Buss, 2011). 155 toddlers were assessed for dysregulated fear at 24 months by completing six structured tasks designed to elicit fear. Behaviors during the tasks were coded second-by-second and a latent profile analysis was conducted, creating three groups of children—normative, high fear to high threat, and dysregulated fear. Cortisol was collected at home in the morning and evening to capture typical stress levels. Difference in cortisol levels was computed by subtracting morning cortisol from evening cortisol. Toddler social inhibition was captured by maternal report of social approach on the ITSEA. Results indicate that, relative to the normative group, toddlers exhibiting dysregulated fear and a flatter diurnal cortisol slope, driven by blunted morning cortisol levels, displayed less social approach ($p = .04$). The findings suggest biological markers of stress coupled with behavioral observation may best identify toddlers struggling with social engagement.

HIGH STRESS IN PREGNANT MOTHER IS ASSOCIATED WITH REDUCED GLOBAL BRAIN EFFICIENCY IN THE FETUS

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Maternal prenatal stress has detrimental and lasting effects on children's neurobehavioral health. Harmful effects to the child are thought to be transferred through the intrauterine environment, but human data to support this is lacking. Advances in fetal functional connectivity MRI (fcMRI) make it possible to, for the first time, examine the human connectome before birth to address fetal neural programming hypotheses *in utero*. We examined the effect of stress on fetal brain development in N = 47 pregnant women. Using maternal self-report measures and fetal fcMRI, we addressed the primary hypothesis that fetal neural functional connectivity is related to maternal stress. Associations between variables were tested with structural equation models that included age and motion as covariates. Scales from six questionnaires assessing maternal stress were best represented as single latent factor, showing high loadings and good model fit ($\chi 2 = 19.11$, df = 9, $p = .02$; CFI = .97; TLI = .96; RMSEA = .08). Maternal stress, represented as a single latent factor, was related to fetal neural connectivity. Specifically, higher maternal prenatal stress was associated with reduced strength of neural efficiency (B = − .007, SE = .003, β = .24, $p = .04$). Post-hoc local analyses showed that maternal prenatal stress mostly affects efficiency of regions in the cerebellum, medial temporal lobe, and prefrontal cortex. For the first time, we report that maternal prenatal stress exerts intrauterine programming of in vivo human neural functional networks. This discovery has implications for transfer of risk via early brain programming, which may be relevant to long-term psychiatric health.

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MIDFRONTAL THETA POWER IN RESPONSE TO SOCIAL EVALUATIVE FEEDBACK: A CANDIDATE MARKER OF REJECTION SENSITIVITY?

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Recent evidence suggests that midfrontal theta oscillatory activity – originating from the midcingulate cortex – reflects a common mechanism implicated in the adaptive control of behavior.

However, the role of theta oscillations in affective control processes (e.g., feelings of anxiety) remains largely underexplored. In this talk, I will present a series of studies that have used the Social Judgment Paradigm to examine whether midfrontal theta power is a candidate neural marker of rejection sensitivity, a hallmark feature of a wide range of internalizing disorders (e.g., social anxiety, depression). In these studies, participants were led to believe that they had been evaluated by peers based on a first impression evaluation of their portrait photograph (evaluation: like/dislike) and during the experiment the participants were shown feedback from this peer evaluation. At the group-level we observed that theta power was highest when participants received unexpected rejection feedback. This increase in theta power could be source-localized to neural substrates that are part of the saliency and cognitive control networks (e.g., insula, dorsal anterior cingulate cortex). During this talk, I will show how this neural response is modulated by individual differences in social anxiety, fear of negative evaluation, and self-esteem. These findings should contribute to our understanding of midfrontal theta oscillations in the control of negative affect.

DEVELOPMENTAL CHANGE IN FOUR-CHOICE REVERSAL LEARNING COINCIDES WITH PUBERTY ONSET

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Cognitive flexibility is an important component of executive functioning that guides goal-directed behavior. Most studies in human subjects show age-related improvements in cognitive flexibility during set-shifting and rule-reversal tasks, with adult like performance emerging at age 10 to 15 (Crone et al., 2006; Huizing et al., 2007). These developmental increases in cognitive flexibility are supported by maturation of prefrontal regions, which may be driven by changes in pubertal hormones (Piekarski et al., 2017). However, recent research suggests that in specific contexts, pre-pubertal juvenile rodents may show more flexible goal-directed behavior relative to adults (Johnson & Wilbrecht, 2011). In the current study, we examined the effects of puberty on developmental changes in cognitive flexibility from ages 6–30 (N = 56) using a positively reinforced 4-choice reversal task. This task was adapted from a rodent study, which found that change in reversal learning was driven by pubertal hormones (Piekarski et al., 2017). We found that the pre-pubertal group made more perseverative errors ($F(2,52) = 5.04$, $p < .01$) and took more trials to learn reversal ($F(52,2) = 3.29$, $p < .05$) relative to both the pubertal group and adults, whose performance did not differ. Although the younger participants did not out-perform adults, the current results extend prior literature to suggest that the non-linear developmental change in flexible goal-directed behavior coincides with pubertal change, such that adult-like performance emerges at puberty onset.

SYNCHRONIZED MOTION INFLUENCES BOBWHITE QUAIL CHICKS' PREFERENCE FOR A ROBOTIC MATERNAL HEN

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Determining which features of avian hen behavior attract chicks following hatching has primarily focused on auditory and to some extent visual stimulation. No studies have examined the importance of redundancy across auditory and visual stimulation during the early postnatal period. In this study we assessed the social preferences of bobwhite quail chicks using robotic hen models that allowed us to manipulate hen movement with her vocalizations. At 96hr following hatching, naïve chicks were exposed individually to two robotic hens in a large circular arena; each model was paired with a recording of an identical maternal call. Three conditions were tested, and chick preference was assessed by the total time spent in proximity to each robotic hen during a 5 min choice test. In condition 1, both hen models remained motionless, in condition 2 one robotic hen randomly head bobbed while one remained motionless, and in condition 3 both models head bobbed; one synchronously with the five notes of the maternal call and one asynchronously with the five note call. Results revealed that chicks showed no preference between the models when motionless, preferred the moving model over the motionless model, and preferred the synchronous model over the asynchronous model. These results suggest that hen movement, and particularly redundancy across auditory and visual maternal stimulation, can influence social preference in bobwhite quail hatchlings. Further research is needed to determine how prenatal and early postnatal experience facilitates postnatal motion preferences and contributes to early social development.

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THE ROLE OF EXPERIENCE IN GENDER DIFFERENCES IN SPATIAL APTITUDE

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Spatial reasoning predicts college students' pursuit of science and math careers, in which women are typically underrepresented. Previous research has found gender differences in spatial reasoning (i.e., mental rotation) from preschool through adulthood, with boys outperforming girls. The basis for sex differences in spatial aptitude is still debated, but explanations include use of different strategies, higher levels of spatial anxiety, and less spatial experience in women compared to men. The current study seeks to determine whether childhood wayfinding (i.e., navigation) experience relates to sex differences in performance on spatial tasks. One-hundred-forty-three undergraduate psychology students reported their anxiety levels,

childhood wayfinding experience, and wayfinding strategies, and performed a variety of spatial memory tests. Independent samples t-tests revealed significant gender differences in childhood wayfinding experience ($t(138) = 2.645$; $p < .01$), spatial anxiety ($t(140) = -2.871$; $p < .01$), spatial orientation ($t(140) = 3.160$; $p < .01$), and mental rotation ($t(140) = 3.203$; $p < .01$), with women reporting less childhood wayfinding experience and more spatial anxiety than men, and men scoring higher than women on the mental rotation and spatial orientation tests. Furthermore, bivariate correlations revealed that childhood wayfinding experience was negatively associated with spatial anxiety in adulthood ($r = -.231$; $p < .01$). The current findings corroborate previous research on sex differences in spatial reasoning, while providing some potential explanations for these differences. Namely, sex differences in spatial anxiety and past wayfinding experience may help us understand why men and women perform differently on spatial tasks. In addition, findings suggest that environmental exploration during childhood may lessen spatial anxiety, which may, in turn, boost confidence in performing spatial tasks.

PTSD SYMPTOMS AND CHRONIC PAIN IN YOUTH: SHARED NEUROBIOLOGY AS A MUTUALLY MAINTAINING MECHANISM

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Chronic pain (pain for ≥3 months) is alarmingly prevalent in adolescence (15–40% of youth), poses enormous costs to society, and can lead to persistent pain problems and mental health conditions into adulthood. Youth with chronic pain report having a greater number of traumatic events early in life compared to those without chronic pain, and this is associated with higher posttraumatic stress disorder (PTSD) symptoms. PTSD is a mental health condition characterized by prolonged distress following exposure to a traumatic event (e.g. injury, sexual violence). PTSD and chronic pain have been found to co-occur at high rates in both adolescent and adult samples (10–80%), and are linked to heightened impairment and disability. Comorbid chronic pain and PTSD has been explained by the presence of shared neurobiology. There are a number of regions within the central nervous system where nociceptive signals and responses to threat converge and interact to potentiate neural activation. However, the underlying neurobiology of comorbid pediatric chronic pain and PTSD has not been empirically examined. To examine the relationship between PTSD and chronic pain, we will assess PTSD symptoms in 30 youth with and without chronic pain, and use state-of-the-art neuroimaging methods (i.e. task-based and resting state functional magnetic resonance imaging) to assess and compare their neural activation patterns. Given the heightened impairment experienced by youth with comorbid chronic pain and PTSD, research is critically needed to examine neuronal mechanisms, and inform the development of targeted interventions to improve pain trajectories and health outcomes for these vulnerable youth.

VAGAL REGULATION IN INFANCY AND THE DEVELOPMENT OF LANGUAGE: IMPLICATIONS FOR EXECUTIVE FUNCTION AND EMOTION REGULATION IN CHILDHOOD

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Advances in early language may contribute towards improvements in children's self-regulatory skills. Parasympathetic influence on the heart (vagal tone) may influence language development through its influence on attention (Porges, 1992). In infants, decreased vagal tone during information processing has been linked to greater sustained attention and recognition memory (Bornstein & Suess, 2000), both of which are important for learning. In contrast, increased vagal tone during social interaction, a primary context for language learning, may foster social responsiveness by allowing attention to be directed towards anticipated events (Stroganova et al., 2006). Thus, understanding how modulation of vagal tone (vagal regulation) in both social and non-social contexts relates to language development is important. We examined the associations between 10-month vagal regulation, 2- and 3-year language (composite), and cognitive and emotional self-regulation at 6-years (N = 296). Path analyses (Mplus, v.12; FIML for missing data) were conducted with parent education as a covariate. Vagal tone was assessed at baseline, during a cognitive challenge, and during social interaction (vagal regulation = task − baseline). Larger numbers reflect increases in vagal tone (augmentation) and smaller numbers reflect decreases (withdrawal). Model fit was good (CFI>.95, RMSEA = < .05). Toddlers' vocabulary size was positively associated with their observed Executive Function skills (backwards digit span) and parent-reported Emotion Regulation at age 6. Both vagal withdrawal and augmentation at 10 months were associated with larger vocabulary. Indirect effects to both 6-year outcomes were significant. Vagal regulation in infancy may influence language acquisition and subsequently children's self-regulatory skills.

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50 YEARS LATER; THE FOUNDERS OF THE ISDP

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On December 30th, 1968, during the AAAS meeting in Dallas, Texas, the first meeting of the International Society for Developmental Psychobiology (ISDP) was held. Gilbert Meier, the society's first

executive secretary, has described how Grant Newton and himself got together in the early fall of 1966, and discussed publishing frustrations in developmental physiological psychology. Together they decided to form: (1) a journal, *Developmental Psychobiology*, (2) a society, the International Society for Developmental Psychobiology and (3) a research center, which never came to fruition. Meier credited Newton's intense focus and drive for the founding of the journal and society. Throughout the rest of the year, Newton and Meier would contact many of the researchers active in the field of developmental psychobiology representing both human and animal research to form the society. Many of these founding members of the ISDP would come from the contributors of Grant Newton and Seymore Levine's influential book, *Early Experience and Behaviour: The Psychology of Development* (1968) resulting in a focus on early experience research early in the foundation of the society. Grant Newton and contributors Wagner H. Bridger, Victor H. Denenberg, John A. King, William A. Mason, Gilbert W. Meier, Howard Moltz, Mark R. Rosenzweig and J.P. Scott would be joined by Joseph Altman, James E. Birren, Samuel Eiduson, R.J. Ellingson, John L. Fuller, Herman Harvey, B. J. Key, Howard Moltz, Hanus Papousek, and F. J. Schulte to form the society in 1967.

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CALLOUSNESS AND PHYSIOLOGICAL INDICATORS OF EMOTION REGULATION MEDIATE THE RELATIONSHIP BETWEEN EARLY LIFE STRESS AND AGGRESSION

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Though previous studies have implicated early life stress (ELS) in the development of aggression, the exact mechanisms by which this process unfolds remain unclear. The current study tested associations between early life stress, callousness, and stress reactivity in the prediction of school-age and persistent early childhood aggression. A longitudinal sample of 185 mother-child dyads participated in a lab-based visit and online follow-up. Children participated in a standardized LAB-tab frustration task during the preschool-age lab visit, at which time both cortisol and behavioral measures of stress reactivity were collected. Mothers completed ratings of child aggressive behavior (Child Behavior Checklist), callousness (Inventory of Callous-Unemotional Traits), and ELS (Life Experiences Survey) during the preschool period and for the school-age follow-up. Overall, the results suggested that ELS was related to measures of both school-age and persistent early childhood aggression, and that callousness played both a mediating and moderating role in this process. Specifically, higher levels of child callousness were associated with stronger associations between ELS and aggression. Cortisol reactivity also moderated the association between ELS and persistent childhood aggression, such that the ELS-aggression relationship was stronger in cases where children had higher levels of cortisol reactivity in preschool. These findings highlight the potential importance of assessing subgroups of children at risk for aggression based on their emotional and physiological profiles.

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THE EFFECT OF FETAL SLEEP STATE AND SEX ON AUTONOMIC FUNCTION

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Differences in measures of fetal autonomic function as a function of sleep state and fetal sex were investigated. Eighty-one healthy fetuses at 36 weeks were included in the analysis. Fetal heart rate and movement, recorded with a Doppler ultrasound monitor, were used to code fetal behavioral states (quiet sleep—1F, quiet awake—2F, and active awake—4F). A fetal ECG monitor was used to measure heart rate (FHR) and two measures of heart rate variability—standard deviation of FHR (SD) and beat-to-beat variability (RMSSD). Fetuses in states 1F and 2F had significantly lower FHRs than those in 4F. Fetuses in 1F had significantly lower SDs than fetuses in 2F, those in 1F and 2F had significantly lower SDs than those in 4F. There was a main effect for sex on FHR, where females had significantly higher FHRs than males. There was also a main effect for sex on SD, where males had significantly higher SDs than females. Within-subjects results (N = 23) showed a significant difference in FHR, SD and RMSSD between 1F and 2F. Overall, between-subjects results reveal that heart rate is lower in quiet states than the active state. Heart rate variability is lowest for 1F, followed by 2F, and highest in 4F. Differences in RMSSD by state were only significant within-subjects indicating that there are individual differences in the absolute values of beat-to-beat variability for each fetal sleep state.

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SOCIAL MEDIA FOR RESEARCH IMPACT

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We all have skills in communications, which we demonstrate every time we chat to friends and family about our latest work. These skills can be translated to promote research. Indeed, science truly comes alive when we engage with others about our challenges and our discoveries. Although scientists and clinicians have a long history of public

engagement, our greatest tool for sharing research is a relatively recent discovery: the Internet. Through her experience across both academia and online engagement, Dr. Zbukvic will open a discussion on why and how researchers can harness this remarkable tool to build their impact. Dr. Zbukvic will share her tips for using Twitter, Wikipedia, and academic social networks to build your engagement across academia and beyond, and will discuss the rise of alternative metrics for measuring research impact, known as Altmetrics.

ONTOGENY OF INDIVIDUAL DIFFERENCES IN BEHAVIOR IN THE DOMESTIC RABBIT: THE ROLE OF PRENATAL AND EARLY POSTNATAL LIFE

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Consistent and stable individual differences in behavior, known as animal personality, have been studied for several decades by behavioral ecologists and psychobiologists in a wide range of taxa, from arthropodes to apes. However, studies of the ontogeny of personality are scarce, at least in vertebrates. In this work we asked if prenatal development (relative position in utero), in interaction with the first postnatal week (position within the litter huddle), drive the expression of personality traits across the preweaning period. In a first step, from postnatal days (PD) 1–7 we measured growth and position in the huddle in 36 pups from six litters. We performed two pre-weaning behavioral tests: handle-restriction (PD 2–7) and exploratory behavior (PD 17–19). We predict that central (heavier) pups within the huddle will show longer latencies to struggle and leave the start box later and explore less than their peripheral sibs, and that this will be modulated by relative position in the uterus and the sex of intrauterine neighbors. The data are currently under analysis.

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LINKS BETWEEN SYMPATHETIC AUTONOMIC NERVOUS SYSTEM RESPONSIVITY DURING COGNITIVE CONTROL AND SOCIAL-EMOTIONAL OUTCOMES IN EARLY CHILDHOOD

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Despite the extensive literature on the relations between parasympathetic nervous system responses and social-emotional functioning, little work examined the role of sympathetic nervous system (SNS) responses in social-emotional functioning in early childhood. Greater SNS responsivity, as indexed by shortened pre-ejection (PEP) intervals, reflects the body's rapid excitatory (fight or flight) responses to deal with external stress. Greater SNS activation during a prolonged cognitive task may predict less adaptive social-emotional outcomes given that such responses may reflect heightened stress reactivity towards mildly stressful challenges. Our goal was to examine whether SNS responsivity during a prolonged cognitive task relates to children's social-emotional outcomes. Participants (N = 207) were recruited as part of a larger longitudinal study examining the integration of physiology, emotion and cognition in early childhood. PEP was measured at rest and during a Go/No-Go task (8 minutes) in kindergarten. SNS responsivity was calculated as baseline minus task PEP, such that positive values reflected SNS activation. Emotion regulation behaviors were observed in the laboratory and teachers reported on children's emotional reactivity and the quality of their relationship in kindergarten and first grade. Greater SNS responsivity during cognitive challenge in kindergarten was associated with lower levels emotion regulation behaviors ($r = -.14$-$.20$, $p < .05$), greater teacher-report of emotional reactivity ($r = .24$, $p < .05$), and lower levels of overall positive relationship with teachers ($r = -.20$, $p < .05$) one year later. These findings suggest that greater SNS responsivity during a prolonged mild-stress task may be linked with less adaptive social-emotional outcomes in early childhood.

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