

Undergraduate Honors Projects – 2017-2018

Jared F. Acosta-King

Neural Mechanisms for Stereo Olfaction in Mice

Advisor: Matt Smear, PhD

The abilities to seek out and spatially locate sources of food, find a mate, and identify potential predators are essential skills for survival. Many of the senses that are utilized by mammals for such tasks use stereo as a means for localization, such as stereo vision for perception of depth, or stereo audition for perception of azimuth and elevation. For many mammals, olfaction is necessary for foraging and threat detection, and although they can locate odor sources based on stereo, how olfactory systems process and compare stereo input remains enigmatic. We hypothesize that animals compare timing across two sides to judge azimuth, similarly to audition. Due to the difficulty of stimulus control, to test this hypothesis using odors is infeasible. To circumvent this difficulty, we use transgenic mice in which olfactory sensory neurons (OSNs) express channelrhodopsin, so that we can initiate olfactory input with light. Using a simple go no-go behavioral assay, we will examine the ability of mice to sense timing differences between the stimuli delivered to OSNs on both sides of the olfactory bulb. These experiments will illuminate the neural code with which the early olfactory system represents stereo differences. Further, this project is a first step toward our longer-term goal: to understand the brain circuits that perform stereo computations.

Sam Adcock

The Influence of Women's Self-Perceptions of Ability and Effort Expenditure on Science, Technology, Engineering, and Math Field Persistence

Advisors: Sara D. Hodges, PhD and Kathryn Denning, MS

Women in the United States consistently drop out of Science, Technology, Engineering, and Math (STEM) fields at various points along the career pathway. While discrimination is a factor, women's perceptions of themselves and their field may influence the decision to leave STEM at the undergraduate level. The current study paired 121 male and female STEM undergraduates interested in pursuing advanced degrees with graduate students in their field for a discussion about graduate school preparedness. Afterward, we used questionnaires to measure the undergraduates' self-perceived levels of natural ability, effort exertion relative to others in their field, domain motivation, beliefs about the relationship between effort and ability, and beliefs about the importance of natural ability to success in their field. We predicted that these variables would influence likelihood of persistence in STEM fields and found that domain motivation and self-reported ability were significant predictors. However, contrary to our prediction, self-reported ability had a negative relation with likelihood of persistence. Interestingly, we found no gender differences for likelihood of persistence, indicating that women may be more likely to remain in STEM fields than previously thought. These findings could represent positive news for the representation of women in STEM and suggest that motivational factors and self-perceptions of ability should be examined in future research.

Courtney Daum

The Origins of Empathy During Infancy: Links to Theory of Mind and Empathic Prosocial Behavior at Age 5

Advisors: Jennifer Ablow, PhD and Jeffrey Measelle, PhD

Researchers examining the developmental origins of empathy report that infants as young as 17 months show early evidence of empathic behavior in the form of concern for others, positive affect, and emotional distress (Zahn-Waxler, & Robinson, 2005). In turn, a vast amount of research demonstrates the long-term outcomes of empathic children, such as prosocial development, high self-esteem, few externalizing problems and a positive disposition

(Eisenberg, Fabes & Spinard, 2015). In addition, early empathic tendencies predict earlier onset of Theory of Mind (ToM), which is the ability to attribute beliefs and desires to self and others (Laranjo et al., 2010). Evidence suggests that ToM develops within the context of the parenting relationship during infancy (Laranjo et al., 2010), through parenting mechanisms such as Maternal Mind-mindedness, which is the ability to treat children as their own entities' with their own minds through the usage of appropriate mind related language. Though there is vast literature on the outcomes of early empathy, there is little research on the development of empathy prior to 17 months. Given links between Maternal Mind-mindedness in infancy and early onset of ToM, and links between early indices of empathy and ToM, this study examined Maternal Mind Mindedness at 5 months and its associations with infant empathy at 17 months. These, in turn, were used to predict children's ToM and empathic prosocial behaviors at 5 years. Although our results did not find an association between Maternal Mind-Mindedness and ToM, we did find a significant longitudinal associations between Maternal Mind-mindedness and Global Empathy, Attachment Security, Empathic Prosocial behaviors.

Isabella Dickerson

Is Efficient Coding a Cognitive Primitive of Working-Memory Capacity?

Advisors: Atsushi Kikumoto, MS and Ulrich Mayr, PhD

Working memory capacity (WMC) is usually regarded as a cognitive primitive that explains intelligent behavior, including the ability to recognize and utilize patterns in the environment. The efficient-coding hypothesis (Botvinick, Weinstein, Sloway, & Brato, 2015) posits that our neural system has evolved to code sensory information by utilizing redundancies and patterns in the sensory input in order to minimize storage demands. This suggests that variability in working memory capacity may be a consequence of variability in “intelligent” utilization of environmental structure. In other words, efficient coding may be the cognitive primitive that is responsible for variability in working-memory capacity. As an initial test of this hypothesis, we assessed in a group of subjects (a) working-memory capacity through a simple change-detection task, (b) the ability to detect patterns of varying structural complexity and (c) as a control task, the ability to make simple perceptual discriminations of varying difficulty. On the basis of the efficient-coding hypothesis we predicted that pattern-detection ability would be more highly correlated with working-memory capacity than perceptual-discrimination ability.

Mary Donaldson

Alcohol Use and Mental Health across the Transition into College: A Longitudinal Perspective

Advisors: Nicholas B. Allen, Ph.D. and Melissa Latham, MS

On college campuses, problematic drinking behavior has become normalized. Students drink heavily, vomit, attend class hungover, and they often discuss this behavior with levity. While several studies show that alcohol consumption increases significantly during the first year of college, few shed light on contributing influences (Capone, Wood, Borsari, & Laird, 2007; Fromme, Corbin, & Kruse, 2008; Sher & Rutledge, 2007; White et al., 2006; Read, Wood, & Capone., 2005). This study examined patterns of change in alcohol use across the transition into college and asked whether pre-college depression or anxiety moderate these patterns. Data was collected through AlcoholEdu, a substance abuse program required of all incoming students of the 2016-17 academic year (n = 4,681). The longitudinal design included two surveys. Students completed the first survey prior to the start of fall quarter and the second approximately 1 to 4 months into their first year. Our first two hypotheses were supported, while our second two were not. Alcohol problems significantly increased across the transition into college, with male students experiencing greater increases in first-term alcohol problems than female students. However, pre-college depression did not predict greater increases in first-term alcohol problems, and neither did pre-college anxiety. Results suggest that the transition into college negatively impacts drinking behavior, specifically for male students. These findings may also point to future research regarding collegiate mental health, Greek involvement, and drinking motives.

Ashley Dresen

Enhancing Low Frequency Rhythms in the Motor Cortex of Humans.

Advisors: Pascale Voelker, PhD and Mike Posner, PhD

In previous work it was found that 2-4 weeks training of mindfulness meditation increased white matter connectivity in pathways surrounding the anterior cingulate. It was hypothesized that this change might be mediated by theta rhythms (4-8Hz) found to increase after meditation training (Posner et al,2014). Theta rhythms are associated with internalized attention and positive emotional states. In our laboratory, mice receiving laser stimulation of the anterior cingulate cortex (ACC) at theta frequency (4-8 Hz) showed evidence of improved connectivity as measured by g-ratio (axon diameter/axon diameter + myelin). To extend these results to humans, we stimulated the ACC by applying electrical stimulation at theta frequency (6Hz) to a set of scalp electrodes overlying that area. Following stimulation, we found enhanced low frequency power in ACC sites compared to baseline, and this power increased when a task known to stimulate the ACC was performed. Our current work tests whether this method could be applied to other brain areas. We chose a task activating the hand region of the primary motor cortex and electrodes stimulating the motor area. We tested 12 undergraduates using a generic set of electrodes known to stimulate the motor area, and compared this with electrodes selected for each person based on structural brain images. We found an increase in baseline theta activity over the course of the experiment. We saw enhanced theta activity while performing the task and with electrical stimulation while performing the task. There was no significant change in theta activity with electrical stimulation alone and the configuration of electrodes did not seem to show substantial differences. We found that baseline theta levels could be enhanced in the motor system by an appropriate task.

Cassandra Dukes

Title: Dissociative Traits vs. Symptoms: Associations with Parasympathetic Responding During Trauma Recollection

Advisors: Jeffrey Measelle, PhD; Jennifer Ablow, PhD; and Jenn Lewis, MS

Abstract: Trauma experiences are known to be associated with higher levels of dissociation when triggered by recollection. Dissociation can be measured on a continuum, as both a trait and clinical symptoms of psychopathology, although little research has explored physiology relating to both sides of this continuum. The Polyvagal Theory suggests that dissociation, a form of immobilization, can be a defense mechanism to cope with an inescapable fear or danger. In keeping with this, research has shown through investigations of psychophysiology that dissociation activates the parasympathetic nervous system (PNS), or the branch of the autonomic nervous system that attempts to regulate stress. This study recorded continuously measured respiratory sinus arrhythmia (RSA), an index of PNS functioning, in 64 primiparous women discussing trauma during the Adult Attachment Interview (AAI). There were significant physiological differences between talking baseline and the trauma questions as demonstrated by increased RSA during personal trauma recall. When regarding trait versus symptomatic dissociation, symptomatic showed a significant association with sympathetic nervous system activity, showing decreased RSA. These results suggest that in those with symptoms of dissociation, there may be a period of arousal preceding the increase in RSA that has been found to be linked to dissociation.

Giang Le

Puberty and Valence of Word Use in a Novel Self-description Task in Adolescent Girls

Advisors: Jennifer Pfeifer, PhD and Monika Lind, MS

Frequently defined by the onset of puberty, adolescence is a time of significant development of the self and is often associated with the variability of experienced affect. Past research has examined the neural bases of self-concept and self-knowledge, as well as used the Ecological Momentary Assessment to measure affect in adolescences. However, few studies have considered if pubertal development is associated with valence of expressed language when

describing the self. A sample of 116 female participants, ages 10.06 to 13.17 years old, completed a video task and answered the Pubertal Development Scale questionnaire during Session 2 of the Transition in Adolescent Girls (TAG) study. The video task, This Is Me, allowed participants to introduce and describe themselves for sixty seconds in front of a computer web-camera. The current study utilized the data from TAG and investigated whether or not two associations existed: between puberty and positive affect, and between puberty and negative affect. The results revealed non-significant associations. For future studies involving data from This Is Me, researchers can take two approaches: 1) examine within-subject changes in valence of expressed language and 2) measure affect using a facial recognition program, instead of sentiment analysis.

Madison Morocco

The Effect of Sleep on False Memories

Advisors: Nash Unsworth, PhD and Melynda Casement, PhD

A false memory is recalling incorrect information, or recalling an event that did not happen. Everyone is susceptible to false memories. There is no known cure or defense, and relatively little is known about how they occur. Though there is relatively little known, much research shows sleep, consolidation specifically, is crucial to solidifying memories (Payne, Chambers, and Kensinger, 2012). Consolidation is a process where new, labile memories are integrated into the vast network of pre-existing long-term memories. A key component of this process is the active re-processing of these memories, because this is the version of the memory that will be recalled (Diekelmann and Born, 2010). Memory is malleable, so it is important to understand how it is affected. This study seeks to find a connection between the number of hours of sleep a subject gets and how many times they experience a false memory. Using the Deese-Roediger-McDermott paradigm, subjects were asked to memorize four lists of 10 words all related to a single theme word. Then, subjects were asked to recall words from each list. A false memory was counted each time a subject mistakenly reported the theme word. We hypothesized that subjects sleeping a “normal” eight hours per night would experience fewer false memories compared to subjects who slept greater than 10 or less than five hours per night. We seek to answer the question: is someone more or less susceptible to false memories based on the number of hours they sleep?

Michael Morrison

The Effectiveness of Value Based Self-Affirmations via Text Messaging on Feelings About Healthy Eating

Advisor: Elliot Berkman, PhD

More than a third of adults and 17% of youth between 2011-2014 were obese, and obesity has seen a steady increase from 1999 to 2014 (Ogden et al., 2015). Given that public health messaging is prevalent and yet obesity continues to rise, reducing obesity at the population level apparently requires more than simply increasing the availability of healthy eating information. It is possible that motivational messages (as opposed to informational ones) will be effective in changing diets. This study measures the effectiveness of value-based self-affirmations on feelings about healthy eating (termed healthy eating affect). Adult overweight and obese participants (N = 91, ages 34-46) were randomly assigned to receive either self-generated text-messages grounded in personal core values related to healthy eating or generic healthy eating information provided by government funded. We tested the hypothesis that those who received value based self-affirmations via text-messaging would show significantly greater positive affect towards healthy eating than those who received generic or otherwise less personally relevant text-messages (e.g., messages only weakly connected with self-affirmations). Participants underwent a standard self-affirmation induction (value ranking and writing exercise) then self-generated messages describing how healthy eating was connected to their personal values. All messages were qualified by blind coders from high to low on how well they represented the participants' core values. A factorial ANOVA will test the effect of self-affirmation quality on healthy eating affect. Implications of these data on healthy eating affect are to be determined upon the completion of this study.

Nathaniel Lee Sichter

Nutrition and Anemia in Lao Children: Determining Contextual Correlates

Advisors: Jeffrey Measelle, PhD and Dorianne Wright, MS

The present study investigated the associations among diet, hemoglobin concentration, and the presence of anemia in young Lao children, hypothesizing that children's dietary profile would be correlated with hemoglobin concentration, that children with poorer dietary profile would be more likely to have anemia, and that social factors such as ethnicity might moderate these associations. Data were collected in 2014 from 572 children under five years of age in 90 villages across three districts in northern Laos to measure a wide range of health indicators, including infant health status, families' nutritional practices, composition of food basket, and issues of food security. Due to missing data, the sample was reduced to 534 in models predicting dietary score and 508 for hemoglobin concentration/anemia. Our cutoff for determining anemia was hemoglobin concentrations under 11g/dL. When holding all other variables constant, no association between dietary score and hemoglobin concentration was found ($F(1, 498) = 0.001, p = 0.972$). However, significant main effects of child age ($F(1, 498) = 14.672, p < 0.001$), breastfeeding ($F(1, 498) = 14.27, p < 0.001$), and ethnicity ($F(1, 498) = 4.92, p = 0.03, F(1, 498) = 12.31, p < 0.001$) predicted hemoglobin concentrations. When predictors of diet were examined, only child age was a significant predictor ($F(1, 521) = 6.35, p = 0.012$). A logistic regression model predicting anemia found that children's age and breastfeeding were the only significant predictors. Specifically, the odds of developing anemia were 0.972 times less for older children (95% CI[0.956, 0.989]) and 0.518 less for children whose mothers reported that they were still breastfeeding their child (95% CI[0.315, 0.851]). Ethnicity did not moderate any of the associations.

Contrary to prediction, children's diet did not predict hemoglobin concentrations or the likelihood of clinically significant anemia. However, older children had higher hemoglobin concentrations, better diets, and a decreased likelihood of developing anemia. Importantly, breastfeeding was also found to predict higher hemoglobin concentrations and a decreased likelihood of anemia, pointing to the protective effects of breastfeeding in a nutritionally challenged region of the world.

Brianna Soumokol

The Interaction of Stress and Sleep in Reward Motivation

Advisor: Melynda Casement, PhD

Existing literature indicates that stress and sleep contribute to the onset and severity of depression, but there is limited research on the interaction between stress and sleep in their relationship to depression and depressive symptoms. The present study evaluates a model in which stress and sleep interactively contribute to reward motivation in depression. Participants were 51 young women ($M = 19.7, SD = 0.47$) from the Pittsburgh Girls Study (PGS; Keenan et al., 2010). Perceived stress and sleep duration were measured daily for a week prior to a behavioral measure of reward motivation. Perceived stress and depressive symptom severity were assessed via self-report, and sleep was assessed using self-report and behavior. I hypothesized that higher perceived stress and lower sleep duration would both predict lower reward motivation (i.e., fewer decisions to perform difficult tasks when the probability of success was 50%). Additionally, I expected an interaction between stress and sleep such that as sleep duration decreased, the effect of stress on reward motivation would increase. ANOVA results indicated that neither sleep duration nor perceived stress were associated with reward decisions. In addition, neither sleep, nor stress, nor reward motivation were associated with depressive symptom severity. The absence of significant bivariate relationships between sleep and depression, stress and depression, and depression and reward motivation is surprising in light of the reliability of these associations in prior research. The failure to replicate prior studies may be related to the demographic characteristics of the sample, which is predominantly African American women with low socioeconomic status, or the presence of research fatigue after nine waves of PGS data collection and a week of daily measures of stress and sleep. Future research may need to devise methods of data collection that promote the integrity of participants' responses in high-demand studies.

Larissa Williams

Associations in Adverse Childhood Experiences and Parasympathetic Response during Social Engagement in At-Risk Children

Advisors: Emma Lyons, MA; Elizabeth Skowron, PhD; and Caitlin Fausey, PhD

The development of physiological self-regulatory abilities is crucial in the early years of human life (Porges, 2011) and is negatively affected by experiences of childhood adversity (McLaughlin et al., 2015). The parasympathetic nervous system (PNS), a branch of the autonomic nervous system, is extremely important in regulating physiology when a person is under stress and at rest. The present study examined the development of the PNS and how experiences of adversity during childhood development affect the PNS. Specifically, the study examined the relationships between adverse childhood experiences (ACEs) and the parasympathetic stress response in children during a social engagement task. Participants ($N = 97$) were 3 to 7-year-old children whose mothers were involved in DHS. Respiratory sinus arrhythmia (RSA) was measured while children were at rest and during a social engagement task with an unfamiliar adult. Change scores were calculated to demonstrate task-level parasympathetic response. Adverse Childhood Experience Scale (ACES) scores were used as a measure of how much adversity the child had experienced. RSA change scores and ACES were compared utilizing regression analysis while controlling for age, and no significant relationship was found between the variables. Future research with a larger sample size in conjunction with measuring and controlling for other potentially important variables is suggested.

Arianna Zarosinski

Thin-Slice Socioeconomic Status: Comparing Thin-Slice and Longer Judgements of SES and the Cues that Inform Them

Advisors: Sanjay Srivastava, PhD and Bradley Hughes, MS

Thin-slice perceptions, those made of others after a brief observation, have been shown to be similar in accuracy to those made after longer observations across many individual difference measures. Recent work has shown thin-slice observations of socioeconomic status (SES) may also be accurate. The purpose of this research was to test if thin-slice judgements of SES are as accurate as those made after longer observations and to examine the expression and utilization of a number of hypothesized cues of SES. We compared 60-second thin-slice ratings of SES to those made after observing the target for 20-minutes. Further, we employed a Brunswik lens model to examine whether perceivers utilized expressed cues. One-hundred and forty-two targets were rated by 115 participants. Inconsistent with previous research, neither thin-slice ratings of socioeconomic status nor ratings made after a 20-minute observation were accurate predictors of self-reported SES. Additionally, there was no relationship between thin-slice ratings of SES and those made after longer observations. Despite the lack of accuracy in ratings of SES, perceivers appear to rely on similar cues to make their ratings.

This study is preregistered through the Open Science Framework.

Min Zhang

The Effect of Abstract Chunk Patterns on Sequential Performance

Advisors: Ulrich Mayr and Melissa Moss

Complex sequential performance is typically thought to be based on hierarchically organized control structures, which break larger sequences into small sub-sequences (“chunks”). However, such models of sequential behavior do not specify the nature of chunks and how different chunks within a sequence relate to each other. The efficient coding hypothesis (Botvinick, Weinstein, Solway, Andrew, & Barto, 2015) suggests that our neural system optimizes information storage by exploiting structure in the to-be-coded information. Applied to the problem of serial-order control, this general hypothesis suggests that different chunks are not coded in terms of arbitrary labels, but instead in relation to each other. Specifically, this implies that sequences that consist of “relatable” chunks can

be coded in a more efficient manner than less-relatable chunks. To test this novel prediction, we assessed the effect of 'matching' chunk patterns on performance in a complex sequencing task. Participants completed a spatial rules task (see Mayr, 2002), in which they were asked to execute a number of complex sequences with either similar, or dissimilar, abstract chunk patterns (e.g., an ABA pattern for both chunks 1 and 2 vs. an ABA pattern for chunk 1 and an ABB pattern for chunk 2). Within-subjects analyses revealed better performance (shorter response times) in sequences containing matching chunk patterns than in sequences containing non-matching patterns. Additionally, this effect was strongest at chunk transitions. These findings indicate that chunks within complex sequential representations are coded in relation to each other, as the efficient-coding hypothesis would suggest.