Research Project Title: Neural correlates of emotion (dys)regulation in multiple sclerosis

Student Presenter: Bryce Boron

Faculty Mentor: Ruchika Prakash

Faculty Mentor Department: Psychology

Research Abstract: Cognitive reappraisal - an emotion regulation strategy involving reinterpreting negatively valenced stimuli - is associated with emotion regulation success, decreased negative affect, and increased positive experiences. Studies investigating the neural correlates of cognitive reappraisal in healthy adults have implicated increased recruitment of the ventral anterior cingulate, ventromedial prefrontal cortices, and the lateral fronto-parietal cortices, along with reduced activation in emotion-generating brain regions such as the amygdala and ventral striatum. However, there are very few neuroimaging studies examining the neural correlates of emotion regulation in populations with chronic medical illnesses, who often experience increased stress and higher levels of emotional distress. Multiple Sclerosis (MS) is one such chronic illness where individuals diagnosed with the condition experience greater difficulties with regulating emotions, and subsequently higher rates of depression than the general population. This study investigated the neural correlates of cognitive reappraisal in individuals with MS and the relation between cortical activation during the reappraisal task and symptoms of depression as assessed by the Beck Depression Inventory-II (BDI). Thirty-seven participants (ages 30-59) diagnosed with relapsing-remitting MS completed an emotion regulation task in the MRI scanner. During the task, they were asked to either regulate their emotions using reappraisal or simply observe while viewing negative affect or neutral images. Activation patterns during regulation vs. observe trials (affect regulate &gt; neutral observe + affect observe) were consistent with those observed in previous studies of healthy adults and included ventral anterior cingulate and lateral fronto-parietal clusters. BDI scores included as a whole-brain regressor were negatively associated with recruitment of lateral prefrontal regions during regulation. These results suggest that when faced with negative images, individuals with MS who reported fewer symptoms of depression exhibited greater recruitment of prefrontal regions, which has been linked to greater regulation success in previous studies.
Research Project Title: The relationship between socioeconomic factors and behavioral preferences in children

Student Presenter: Bethany Cady

Faculty Mentor: Paul Healy

Faculty Mentor Department: Economics

Research Abstract: Behavioral preferences influence choices in a variety of market structures. This study seeks to investigate how social, risk, and other-regarding preferences relate to a child’s family background, with special interest in mother’s education and ordering within the family. The preferences of my subjects, children ages 9-10, are evaluated by their responses to an equal-expectation distribution game, a prisoner’s dilemma with qualitative reasoning, and a binary-choice dictator game. The main finding is that children with mothers that have higher degrees of education are less likely to make decisions to avoid punishment and make envious adjustments. In contrast, mother’s education and the child’s number of older siblings have a significant positive relationship with decision-making to increase payoff.
Research Project Title: The effects of perceptually rich stimuli on pre-algebraic pattern thinking in preschoolers

Student Presenter: Sydney Clark

Faculty Mentor: Vladimir Sloutsky

Faculty Mentor Department: psychology

Research Abstract: Introduction: A human’s ability to recognize patterns in early development is predictive of later mathematic aptitude, which is particularly important given the low levels of national mathematic achievement in the United States. The implementation of pattern and relational training in early education could help improve future mathematical performance, thus warranting further study.

Methods: Little work has explored the advantage of using abstract labels over concrete labels during pattern training. This study involves 4 to 6-year-old children. The goal of the current study is to test (a) how the use of perceptually rich stimuli (i.e. pictures of animals and other everyday objects) compares to the use of more impoverished stimuli and (b) how the use of abstract (i.e. “A→B→A”) vs. concrete (i.e. “cookie-cake-cookie”) labels affect learning. This study utilizes a basic pre-post test design, in which children are trained in either an abstract condition or a concrete condition, followed by measures of post-test, generalization, and transfer.

Results: For the within-experiment analyses, I hypothesize that children who are taught patterns consisting of perceptually rich objects using abstract labels will outperform children who are taught the same perceptually rich patterns using concrete labels. The abstract labels should help children better generalize the stimuli, which is important for pattern recognition and application. Concrete labels, on the other hand, will most likely magnify attention to the objects themselves instead of their relations to each other, thus hindering patterning abilities. For the across experiment analyses, perceptually rich objects (instead of simple shapes) should not be helpful in the case of pattern learning, which relies on the identification of relations among objects, not remembering the details of the objects themselves. Therefore, participants in both label conditions of the perceptually rich experiment should perform poorer than children in both label conditions of the simple shape experiment. Conclusions: Understanding the crucial variables in successful pattern learning can shed light on the importance of being judicious when selecting education materials for young children. This study may suggest the need for educators to go against their instinct to choose learning aids that look engaging, but have extraneous details that hinder comprehension.
Research Project Title: A generalized, Bayesian method for linking structural connectivity to models of functional neural data and behavior.

Student Presenter: Matthew Galdo

Faculty Mentor: Brandon Turner

Faculty Mentor Department: Psychology

Research Abstract: In recent history, there have been two significant non-interacting fields of study in pursuit of understanding cognition. The first, cognitive neuroscience, collects neural data and relates it to behavior, often through correlation studies or machine learning techniques without proposing any formal theoretical cognitive mechanism. The second, cognitive modeling, develops formal theoretical models of cognition using solely behavioral data. In recent years, a reconciling field called model-based cognitive neuroscience has emerged bridging these two lines of work together by establishing frameworks (e.g. joint modeling) for relating both neural and behavioral data to theoretical formulations of cognition. In parallel, a plethora of work from the neuroimaging field suggests a relationship between anatomical connectivity in the brain (e.g. white matter tracts) and functional activity (e.g. BOLD activity). However, little has been done to relate structural connectivity to cognitive processes in a systematic a priori manner. Here we propose a generalized framework for extending joint models of brain activity and cognition through the use of structural connectivity. For this method, we propose using structural connectivity as the basis for informing our inferences about correlations in functional activity across brain regions. We then test a variety of linking functions demonstrating the flexibility and potential of this methodology. Using cross-validation, preliminary results show that models fit using the proposed framework are better predictors of holdout data.
Research Project Title: Hair cortisol as a biomarker of chronic stress

Student Presenter: Elizabeth Gilbert

Faculty Mentor: Catherine Calder

Faculty Mentor Department: Statistics

Research Abstract: Stress has negative impacts on the human body when sustained over time, such as obesity, diabetes, and mental health issues. To mitigate these effects, chronic stress needs to be better understood, which can be accomplished through measuring biomarkers of stress. Cortisol is the primary stress biomarker in humans, and can be measured in blood, saliva, urine, and hair. Hair represents the longest integral of exposure to cortisol over time, however, much about the nature of hair cortisol remains unknown. The primary purpose of this study is to model hair cortisol concentration over length. Additionally, we address a practical issue in hair biomarker data collection. In certain situations, sampled hair is discovered to be too light in weight to assay once it gets to the lab. In order to be able to use these samples, we propose a hair adjustment method to create an adjusted hair cortisol concentration from the underweight sample supplemented by the tail ends of the hair sample. The data used for this study come from 31 participants who took part in The Ohio State College of Nursing Hair Cortisol Study. Each participant provided multiple hair sample and completed a 4-page survey. Descriptive analyses and Rasch modeling were used to understand differences in stress levels across the study participants. We found that the Rasch score of recent stressors is a better predictor of recent reported stress levels ($\beta = 0.3$) than any measured demographic variables. From 26 hair samples, the linear model of hair cortisol concentration shows that hair cortisol concentration in pg/mg decreases over length of hair in cm as expected with $\beta = -0.11$ pg/mg/cm, and $\alpha$ intercepts per subject ranging from 3.5 pg/mg to 15.15 pg/mg. This model predicts the most recent three months of cortisol concentration growth, given the samples of combined past and recent cortisol concentration, along with their weights and lengths. Our descriptive statistics contribute to a better understanding of chronic stress, and we hope that our adjustment method provides a post-collection solution to the issue of lightweight hair samples.
Research Project Title: The relationship between resting heart rate variability and music listening preferences

Student Presenter: Havovi Desai

Faculty Mentor: Julian Thayer

Faculty Mentor Department: Psychology

Research Abstract: When it comes to daily music-listening, it can be categorized into three main groups, including cognitive/intellectual, emotional, and background listening. Listening to music can influence brain regions that both perform executive functions and maintain overall well-being. Interestingly, higher resting heart rate variability (HRV) is associated with both overall well-being, cognitive and emotional regulation, and executive brain function. While previous studies have examined the impact of music on HRV, no study has examined the association between one’s resting HRV, as an index of self-regulatory abilities, and their music listening tendencies. Therefore in our current study, we examined this direct correlation in a sample of 81 undergraduate participants (mean age = 20, 42 females). Resting HRV data was collected during a 5-minute baseline period. Participants then answered a set of 15 questionnaires, including the Uses of Music Inventory. Questions on this scale fell into three categories: music listening as it relates to emotion, cognition, and background noise. Participants either answered “True” or “False” to a series of questions relating to the above categories. Lower scores represent more listening on subscales and the total listening scale. Controlling for respiration, age, body mass index, sex, and ethnicity, correlation tests showed that individuals with higher resting HRV reported greater tendency to listen to music in a cognitive way ($r = .231$, $p = .048$), but not in an emotion-listening ($r = .025$, $p = .831$) or background music listening way ($r = -.021$, $p = .857$). Overall, these data suggest that there is a direct correlation between resting HRV and one’s music listening preferences, particularly when listening in a cognitive way. Future studies should work to better understand this relationship, as well as the lack of association between resting HRV and both emotional and background noise music listening.
Research Project Title: Circumorbital morphology and selection in African colobine monkeys

Student Presenter: Luke Fannin

Faculty Mentor: Scott McGraw

Faculty Mentor Department: Anthropology

Research Abstract: Inflation of the bones forming the orbital rim is a characteristic feature of red colobus (Piliocolobus) crania, but not for closely related black and white colobus (Colobus). Early studies attributed pronounced circumorbital ridging to elevated anterior dental loading and masticatory stress; however, in-vivo bone strain studies suggest this region receives little stress during chewing. The Western red colobus P. badius and King colobus C. polykomos differ in the average toughness of their diets and their oral processing behaviors. Both consume significant quantities of leaves; however, C. polykomos utilizes its anterior dentition more frequently, especially during processing of woody Pentaclethera macrophylla pods. C. polykomos also chews more per ingestive event than does P. badius. We use these feeding differences to investigate interspecific patterns of circumorbital rim variation. We further investigate dimorphism in this feature using a sexual selection framework. Measures of circumorbital ridging in three areas (medial-superior, lateral-superior, lateral) were taken from 77 P. badius and 21 C. polykomos crania collected from naturally deceased individuals in the Taï Forest, Côte d'Ivoire. Size-corrected residual means of circumorbital measures were used in paired comparisons within and between species. Results indicate that P. badius possesses significantly larger relative measures of superior circumorbital ridging than C. polykomos. Lateral ridging measures were not significantly different between species. P. badius males possessed relatively larger measures of both superior and lateral circumorbital ridging compared to females; however, C. polykomos males and females did not differ in any circumorbital dimension. These results support previous studies that disassociate circumorbital geometry from masticatory stresses: e.g., circumorbital ridging in C. polykomos is reduced compared to P. badius, despite the former’s more challenging diet, increased masticatory rate, and greater use of the anterior dentition. We conclude that circumorbital ridging in P. badius is a sexually dimorphic trait whose variation cannot be explained via size or feeding differences. We speculate sexual selection is responsible for shaping this feature, a hypothesis testable with data on female choice and paternity skew.
Research Project Title: Developmental changes in selective attention across the lifespan

Student Presenter: Andrew Hawthorn

Faculty Mentor: Chris Robinson

Faculty Mentor Department: Psychology

Research Abstract: Selective attention is used in everyday tasks, where people must filter out irrelevant information to focus on the task at hand. Filtering appears to change across development, with children and older adults being more distracted than younger adults. The primary goal of the study was to examine the development of visual selective attention in children, young adults, and older adults, while participants were instructed to ignore auditory and visual distractors. Based on modality dominance research, it was hypothesized that auditory distractors would be more distracting early in development and visual distractors would be more distracting late in development. A secondary goal was to determine if the Perceptual Load Hypothesis (PLH) could predict which auditory distractors interfere with visual selective attention. Research examining the PLH shows visual flankers are more distracting under low load, however, it is not clear if this hypothesis will predict which auditory stimuli slow down response times.

Eight-year-olds, 19-year-olds, and 77-year-olds were presented with a modified flanker task where they had to quickly identify and respond to a visual target, either a bird or a dog, and ignore the distractor. We manipulated compatibility of distractor (compatible vs. incompatible), load (high vs. low) and modality of distractor (auditory vs. visual). In the auditory distractor conditions, the visual distractors were replaced by bird chirps and dog barks, presented via headphones.

Only auditory distractors attenuated accuracies. Incompatible distractors slowed down response times in children more than young and older adults, and both auditory and visual distractors slowed down children’s responses. In contrast, young and old adults were only affected by the visual distractors. Older adult data were consistent with PLH with visual distractors only slowing down responses in the low load condition. Finally, increased heart rate variability (measure of attentional control) was associated with increased distractibility in children and older adults, and decreased distractibility in adults.

Findings are consistent with auditory dominance with auditory interference being stronger early in development. PLH did not appear to predict auditory distractibility, nor did it predict performance early in development.
Research Project Title: Evaluating sleep measurement in children with Autism Spectrum Disorder: A comparison of actigraphy data and parent report

Student Presenter: Amanda Kenepp

Faculty Mentor: Jill Hollway

Faculty Mentor Department: Psychiatry

Research Abstract: Introduction

Children with autism spectrum disorder (ASD) often present with co-occurring sleep disturbance. The most common measure of sleep in ASD is subjective (i.e., parent report), less commonly used are objective measures, as there are practical issues to implementing these instruments in this population. This study aimed to determine if widely-used parent report methods are reliable and valid in young children with ASD. We compared an objective measure of sleep, actigraphy, with parent report in the form of a sleep diary. We hypothesized that in children with significant sleep disturbance, parent-reported sleep measures would over-estimate sleep problems compared to actigraphy.

Method

We analyzed data collected on 27 children with ASD ages 3 to 9 years. Sleep data were collected for five consecutive days by parent sleep diaries, a parent rated sleep questionnaire, and actigraphy. Measures of sleep onset latency (SOL), minutes awake after sleep onset (WASO), and total sleep duration were evaluated with paired sample t-tests and general linear modeling. All tests were two-tailed and the p-value of .05 was used to determine significance.

Results

Preliminary analyses revealed that of the 27 children included in the pilot study, only 12 tolerated the actigraph. The average age of our sample was 6.42 (SD = 2.2), with an average IQ of 70.3 (SD = 28.3). The sample mainly consisted of male subjects (91.67%) and were primarily white (83.33%). From the Pearson’s correlation, no significant relationships were found between actigraph data and sleep log data for SOL (r(11)=.095, p=.769), duration (r(11)=.270, p=.395), or WASO (r(11)=.239, p=.454). Paired-sample t-tests revealed significant differences between the means of actigraph and sleep diary data of SOL (t(11) = 3.38, p<.01) and WASO (t(11) = -2.54, p<.05) but not duration (t(11) = -1.03, p = .327).

Conclusions

T-tests and correlation analysis found that actigraph and sleep log data were significantly different in SOL and WASO, as parents overestimated SOL and underestimated WASO. These findings suggest that parent-report measures alone may not be valid measures of sleep disturbances in children with ASD. Further research is needed to see if these results are found in a larger, more diverse sample size.
Research Project Title: Differing outcomes of mindfulness-based cognitive therapy in mood dysregulated versus anxious adolescents

Student Presenter: Fatima Khalid

Faculty Mentor: Melissa Delbello

Faculty Mentor Department: UC Department of Psychiatry

Research Abstract: Studies show there is an increased risk of experiencing an anxiety or mood disorder in adolescents who have a parent with bipolar disorder. At present, the most common treatment for adolescent anxiety and mood disorders are the use of pharmaceutical medications. However, increasingly more findings suggest these medications may cause worsening or acceleration of onset of mania or hypomania in addition to other adverse effects in anxious and depressed adolescents. In an effort to explore alternative treatment methods, Mindfulness-Based Cognitive Therapy for Children (MBCT-C), a psychotherapeutic intervention that combines the use of mindfulness meditation exercises with the features of cognitive based therapy, was created. In previous studies using this method, adolescents reported decreased worried feelings as well as improved management of anger at home and at school, and exhibited reduced activation in the amygdala and improved function and connectivity in associated brain regions.

However, few studies exist that compare the effectiveness of mindfulness based therapies for mood dysregulated adolescents versus adolescents experiencing an anxiety disorder. Therefore, we sought to compare the effects of MBCT-C on these two groups. Participants were recruited from a cohort of youth who had at least one biological parent with bipolar disorder and were between the ages of 9-17. Those in the anxious group met inclusion criteria for a pediatric anxiety disorder in DSM-IV and those in the mood dysregulated groups required a score greater than 28 on the Childrenâ€™s Depression Rating Scale â€“ Revised (CDRS-R). Both groups met for 75-minute sessions of MBCT-C for 12 weeks. fMRI were scanned at baseline prior to treatment and upon completion of the last MBCT-C session. In the anxious group, when viewing fearful faces, there was a significant decrease in right amygdala activation. In contrast, the mood dysregulated group showed a significant increase in right amygdala activation following treatment. These variances suggest important differences in disease pathologies and highlight the need for different approaches in the treatment of anxious versus mood dysregulated individuals.
**Research Project Title:** Hierarchical Bayesian analysis reveals complex neural dynamics of inhibitory control

**Student Presenter:** Fiona Molloy

**Faculty Mentor:** Brandon Turner

**Faculty Mentor Department:** Psychology

**Research Abstract:** Cognitive control has been of interest to psychologists and neuroscientists because of the insights it has provided to the understanding of individual differences, impulsivity, addiction, and obsessive-compulsive disorder. Two tasks that have been used to test cognitive control are the Go/No-Go task and the Go/Stop task. In the go/no-go task subjects are either given a cue to respond or withhold a response at the beginning of a trial. The Go/stop task extends this basic paradigm by including the possibility that a Go cue may switch to a response-withholding cue. Behavioral and functional magnetic resonance imaging (fMRI) neural data, extracted for twenty-four regions of interest (ROIs), were collected from eleven subjects who completed both the Go/No-Go and Go/Stop tasks. In this study, blood oxygenation level-dependent (BOLD) responses were fit to five increasingly complex models of the trial-wise neural activation to improve the signal-to-noise ratio and explore differences in neural activation between response (Go trials) and response inhibition (No-Go/Stop trials). The models were fit using a hierarchical Bayesian analysis. First, hierarchy was added on a conditional level (Model 2), then on an ROI-level (Model 3), then a subject-level with a variance-covariance matrix across subjects (Model 4), and finally on a subject-level with individual variance-covariance matrices (Model 5). Model 1 had no hierarchical component. We found that introducing hierarchy, or adding multiple levels to the model, greatly constrained the predicted BOLD signal by systematically removing outliers. Additionally, increasing model complexity through levels of hierarchy reintroduced some variability absent in the means from the simpler models and elucidated brain regions that played a role solely in carrying out a response (Go trials). We next replicated these results using the more complicated Go/Stop task. We found a similar trend relating increasing complexity and increasing constraint. Additionally, we explored activation in the same twenty-four ROIs with an additional condition—"inhibiting a response that has already been initiated (stop-signal). Our results suggest hierarchical modeling is a useful tool in interpreting often messy fMRI data.
Research Project Title: Integrating current and prior information in a social learning game with the drift diffusion model

Student Presenter: Cameron Luther

Faculty Mentor: Ian Krajbich

Faculty Mentor Department: Psychology/Economics

Research Abstract: Introduction: This research investigates what information people infer from observing each other's response times (RT) in social learning situations. In this project we use computational modeling to investigate how participants integrate public choice and decision-time information with their own private information, in order to determine the true state of the world. We model this as an integration of current (private) and prior (public) information. Specifically, we investigate whether people update information gradually, while observing others' behavior, or instead update all at once at decision time.

Methods: Subjects played an information cascade game. In every round, subjects are ordered 1-8, and then asked to make predictions about the state of the world, A or B. Both states of the world are equally likely. Subjects also receive a signal at the start of their turn (a or b) with probability conditional of the state of the world P(a|A)=P(b|B)=2/3. After receiving their signal, subjects have 10 seconds to guess the true state.

Once the decider's time is up, their decision is revealed to all the other players. Once all subjects press a continue button, the next player starts their turn. This process continues until all subjects have made a guess about the state of the world. The true state of the world is then revealed and subjects who guess correctly receive $1.

Subjects played the game in two different conditions. In the no-RT condition, the game proceeded as described above. In the RT condition, subjects were also shown others' RT, namely how long previous subjects took to make their guesses.

Results: We hypothesized that subjects might be forming a belief about the state of the world prior to their turn, and that this would be revealed by the time they took on the continue screens. We did find evidence for subjects forming prior beliefs, but only in the RT condition. Surprisingly, we did not find evidence for an influence of time spent on the continue screen.

Conclusion: Our results indicate that the availability of RT information causes subjects to pay more attention to others' behavior and form beliefs prior to their turn.
Research Project Title: The effects of hearing loss and age on driving performance

Student Presenter: Nathanael Miller

Faculty Mentor: Christina Roup

Faculty Mentor Department: Audiology

Research Abstract: The relationship between hearing impairment and driving performance is an area not extensively researched. The few previous studies in this area do not effectively separate the effect of aging from the effects of hearing impairment. A lack of knowledge and understanding of these relationships puts the entire driving population at risk from potential dangers due to the negative impacts of hearing impairment and age on a driver’s ability to maintain optimal levels of sensory processing, situational awareness, and fine motor skills.

The present study attempts to evaluate the effects of age and hearing loss by separating the two factors, and comparing four groups of drivers. The groups are divided according to the following: young adults with normal hearing, young adults with hearing impairment, older adults with normal hearing, and older adults with hearing impairment.

Each participant is asked to drive an automotive simulator course. The simulator consists of a 6-degree-of-freedom motion platform upon which a 2010 Honda Accord with full interior and shell is mounted. Simultaneously, the participant participates in two tasks: listening and situational awareness distraction tasks. The situational awareness task includes identifying a checkered cube (4 meters^3) randomly appearing on the course. The listening task requires individuals to repeat the last word of 100 equally high and low predictability sentences in controlled background noise at a +4 dB signal-to-noise ratio taken from the Revised-Speech Perception in Noise test.

Testing is currently in progress. Preliminary results suggest that driving performance is affected negatively by both hearing loss and age, and even more so when in tandem. Preliminary evidence supports the importance in enhancing in-vehicle auditory aid systems to assist both hearing impaired and the elderly in driving, such that the roads can be a safer environment for all individuals. In fact, it is likely that auditory aid systems can prove to be beneficial to all populations of people beyond those affected by hearing impairment.
Research Abstract: Much research indicates fractions and proportions are difficult concepts to grasp. Is it possible to capitalize on a non-mathematical skill we already possess to help process these challenging concepts? We tested 97 undergraduate students at The Ohio State University in tasks that assessed their prior mathematical knowledge before having them complete a categorization task. Categorization was chosen as the method to teach proportion knowledge because much research shows adults can easily apply this skill to difficult, non-numerical concepts. The categorization task presented participants with two types of unknown creatures and asked them to differentiate between them on the basis of one of two deterministic ratios presented alongside non-numeric probabilistic features. Our results show that adults easily learned a novel fraction-rule across a variety of presentation conditions within our categorization task. However, accuracy was lower and reaction time was slower in conditions where the deterministic feature detailing the fraction-rule was presented with additional and extraneous perceptual features, which presumably distracted participants from the critical numerical information. This is interesting given similar data from children indicating that, in tasks with more challenging demands, adults and children are equally distracted by the irrelevant information, an unexpected parallel of poor performance. Scores on the prior math knowledge battery significantly predicted performance, meaning individuals with more previous math knowledge did better in the categorization task. This supports other research that individuals who start ahead, stay ahead, thus emphasizing the importance of solid mathematical foundations for later success. The results also inform our knowledge of how children think about difficult, novel math concepts, as well as how this may develop across the lifespan. By inducing adults to think like children with the introduction of challenging task demands, we can begin to understand the mechanism underlying children’s learning that will allow for better development of learning materials. Using a well-mastered skill (categorization) to learn a difficult math concept (fractions) without the presence of distracting perceptual information intruding on learning and transfer is a novel finding and may be a unique strategy for teaching other difficult concepts both inside and outside of formal education.
Research Project Title: A literature review of metabolomics and psychiatry: new insights for ADHD

Student Presenter: Catherine Panchyshyn

Faculty Mentor: Irene Hatsu

Faculty Mentor Department: Human Sciences

Research Abstract: Attention-Deficit Hyperactivity Disorder (ADHD) is a chronic neurodevelopmental disorder characterized by symptoms of inattention and/or hyperactivity-impulsivity. Prevalence is currently reported at 5.3% in children and 2.5-4.9% in adults.1 ADHD can have several negative consequences, such as hindering educational success and daily function, and increasing the likelihood of substance abuse or other comorbid psychiatric conditions.2 Early diagnosis is critical, since untreated ADHD can increase the possibility of more severe disorders in adulthood.2 The most common pharmaceutical treatments for ADHD involve amphetamines, which often have poor or unknown long-term side effects.2 Due to the limited treatment options and their side effects, new research is required to pursue identification of ADHD biomarkers. Monitoring levels of specific hormones, proteins, or other organic chemicals could assist in diagnosing a patient, improving treatment results, and providing a better understanding of ADHD pathology.3 Metabolomics, an innovative research tool, captures biological signatures of metabolites using blood, urine, or stool samples. Untargeted metabolomics studies identify the differing metabolic signatures from the study sample compared to controls. Identifying these signatures can lead to targeted metabolomics studies, which answer more specific questions about each metabolite’s function in the disorder.3 To date, there are no known studies using metabolomics in children with ADHD. Literature for this review was pulled from PubMed, and the Ohio State University library database, with a focus on metabolomics and biochemical studies within human ADHD populations or animal studies with an ADHD phenotype. The purpose of this literature review is to compare and combine information from existing metabolomics studies to gain insight into the biochemical pathways of ADHD pathology and treatment response. Our primary aim is to advocate for metabolomics research in an ADHD population, specifically within pediatrics, given that diagnosis often occurs in early childhood.

References


Research Project Title: The influence of anxiety and depression on cognitive and physical functioning and self-care among heart failure patients

Student Presenter: Nicole Santos

Faculty Mentor: Charles Emery

Faculty Mentor Department: Psychology

Research Abstract: Background

Heart Failure (HF) is a condition in which the ventricles of the heart are weakened or stiffened, reducing the capacity of the heart to pump blood throughout the body. In addition, elevated symptoms of depression and anxiety are common among patients with HF. Patients with HF often exhibit deficits in executive function and in self-care.

Few studies have examined the potential influence of depression and anxiety on executive functioning (e.g., working memory, processing speed) and physical functioning (exercise performance) in relation to self-care in HF patients.

Purpose

This study evaluated the impact of cognitive and physical functioning on three specific domains of self-care (i.e., maintenance, management, confidence) in patients with HF. These domains refer to a patient’s ability to adjust their lifestyle habits to accommodate their condition, identify symptoms, and assess the effectiveness of their actions to alleviate symptoms they may experience. Anxiety and depression were examined as moderators of the relationship of cognitive and physical function to self-care. It was hypothesized that anxiety and depression moderate the relationship of cognitive functioning and physical functioning with self-care.

Methods

The data were collected as a part of a larger study examining a behavioral intervention for insomnia among patients with HF. This project represents a planned secondary analysis of the data. Participants were 20 HF patients from both inpatient and outpatient clinics as well as cardiac rehabilitation facilities at OSU. In addition, participants were identified via Research Match, an online source of prospective research participants. This study analyzed only data from the baseline assessment. During the baseline assessment participants completed cognitive functioning tasks (i.e., Digit Symbol Substitution Test, Verbal Paired Associates I), self-reports of self-care, anxiety and depression (i.e., Self-Care of Heart Failure Index, Hospital Anxiety and Depression Scale) and a physical functioning task (i.e., Sixty-Foot Walk Test).

Results/Conclusion

Findings from this study increased our understanding of the relationship between cognitive, physical, and psychological factors on different domains of self-care among patients with HF. Better understanding of the relationship among these factors can help to elucidate important targets for improving self-care in this critically ill patient population.
Research Project Title: Can preparatory interval mitigate the negative effects of interruption?

Student Presenter: Zhaojie Zhang

Faculty Mentor: Andrew Leber

Faculty Mentor Department: Psychology

Research Abstract: Interruptions are one of the major problems faced by people in modern society and can result in negative effects such as errors, increased time to complete tasks. Previous research in the lab has shown a tendency towards worse memory due to interruptions. Adding an interval between the alerting of an interruption and the beginning of the interruption task, termed the interruption lag, can reduce errors and decrease the time to resume an interrupted task (Trafton et al. 2003). The interruption lag has been shown to improve immediate task performance after an interruption, but it is unclear what effects the lag has on long-term task processing and memory. This study aims to investigate the effects of an interruption lag on both short-term and long-term task processing. In this study, participants completed two phases. In Phase 1, participants were required to search for target objects embedded in a Rapid Serial Visual Presentation (RSVP) stream, while getting interrupted by a math problem approximately 50% of the time. A 2000 ms interruption lag was inserted on 50% of interrupted trials. In Phase 2, participants had their memory for the target from Phase 1 assessed and indicated their confidence in their memory. At the conclusion of the experiment, participants completed a survey stating how they felt about the lag. I hypothesized that an interruption would improve Phase 1 target searching accuracy and improve memory for interrupted targets. Analysis of Phase 1 data revealed the lag had no effect on stream accuracy, but did significantly decrease the time to complete the math problem, possibly indicating the lag helped participants prepare for interruption rather than returning to the target searching task. For Phase 2, the study did not replicate previous findings that interruptions negatively impacted memory; however, memory for targets shown in an interrupted trial was worse if a lag occurred and if subjects had some confidence in their answer. Filtering by survey responses, people who have a positive attitude for the lag remembered more targets than people who had a negative attitude. Future research could alter the position of the lag and investigate individual differences.
Research Project Title: The impact of physical activity on hair cortisol levels in adolescents

Student Presenter: Katelyn Smithberger

Faculty Mentor: Jodi Ford

Faculty Mentor Department: College of Nursing

Research Abstract: Although previous research documents the benefits of physical activity by reducing illness and stress, other studies found a correlation between strenuous physical activity and elevated salivary and hair cortisol levels. This study explored associations between levels of physical activity and cortisol levels in hair among adolescents. Elevated hair cortisol indicates elevated stress and potentially impaired immune function. This study employs analysis of two linked NIH studies on the health and well-being of urban adolescents. A representative sub-sample of 534 adolescents aged 11 to 17 years was used to demonstrate the relationship between physical activity and hair cortisol levels. Through an in-home survey, youth responded to three questions on the intensity and volume of physical activity from the previous week. The three variables “mild, moderate and strenuous activity - were analyzed via regression analyses as continuous measures to assess linear associations, and also categorized in which the top and bottom 10% of the distribution were compared to the middle to assess other associations. Hair samples from participants were tested for cortisol using Salimetrics assay in the College of Nursing Laboratory, controlling for hair weight and length. When the physical activity measures were analyzed as linear associations, there were no statistically significant associations between mild, moderate or strenuous physical activity and hair cortisol levels. In contrast, when non-linear associations were examined, hair cortisol levels were significantly higher in youth who participated in strenuous exercise 8 or more times a week (p<0.05) and marginally higher in those who engaged in no strenuous activity (p=0.10) compared to those who exercised at least once (or up to 7 times) a week. Hair cortisol levels were also marginally higher (p<0.09) in youth who participated in moderate exercise 8 or more times a week compared to those who participated at least once (and up to 7 times) a week. The findings suggest that high levels of strenuous or moderate physical activity (and possibly no strenuous activity) could contribute to higher hair cortisol levels and potentially negatively impact immune function.
Research Project Title: Associations between perceptions of relationship closeness and borderline personality disorder features

Student Presenter: Rachel Wininger

Faculty Mentor: Jennifer Cheavens

Faculty Mentor Department: Psychology

Research Abstract: Introduction

Borderline Personality Disorder (BPD) is a severe, debilitating mental disorder characterized by relationship instability, fear of abandonment, impulsivity, and emotion dysregulation (APA, 2013). Individuals with BPD often struggle to maintain long-lasting bonds such as friendships or marriages and report greater conflict and criticism in their relationships compared to healthy controls (Stepp, Pilkonis, Yaggi, Morse, & Feske, 2009). Furthermore, research suggests that individuals with BPD tend to make extreme evaluations of people, which contributes to relationship conflict (Veen, Artnz, 2000). Despite relationship conflict and instability, Lazarus and Cheavens (2017) found that individuals with BPD did not differ from healthy controls in their ratings of relationship closeness. One possible explanation for these findings is that individuals with more features of BPD may use different indicators (e.g., proximity, conflict, social support) or use these indicators differently to judge the closeness of their relationships compared to those with lower BPD features.

Methods

With the present research, we examined the associations between three dimensions of relationship closeness (i.e., proximity, social support, and conflict) and BPD symptom severity. We recruited 199 participants through the Research Experience Program (REP) and asked them to complete a survey that included the Inclusion of Other in the Self scale (IOS; Aron, Aron, & Smollan, 1992), the Unidimensional Relationship Closeness Scale (URCS; Dibble, Park, & Levine, 2011), and the Personality Assessment Inventory-Borderline subscale (PAI-BOR; Morey, 1991). Participants also completed a demographics questionnaire.

Results

Participants’ scores on the PAI-BOR ranged from 5 to 66, meaning participants exhibit a great deal of variation in borderline feature severity. Participants averaged 6.25 out of a possible 7 on the self-report questionnaire (URCS), indicating that they felt very close to the self-reported closest person in their lives. BPD feature severity was not significantly correlated with measures of relationship closeness (ps < .05).

Conclusions

There are no apparent associations between BPD feature severity and the selected dimensions of relationship closeness. Future research should examine other facets of relationship closeness to determine which aspects of social relationships BPD patients feel are most important, which may help therapists help BPD patients build long-lasting social networks.
Research Project Title: Improvement of fine motor skills found in chronic tetraplegia as detected using brain-computer interface-controlled functional stimulation during functional task practice

Student Presenter: Kaitie Eipel

Faculty Mentor: Marcia Bockbrader

Faculty Mentor Department: Physical Medicine and Rehabilitation

Research Abstract: Recovering upper extremity motor function is of high priority to chronic spinal cord injury (c-SCI) patients. Of the rehabilitative treatments available, there are no known therapies that allow c-SCI patients to improve motor function without changing their motor level or grip strength. The purpose of this study was to examine whether training functional tasks using a brain computer interface (BCI) functional electrical stimulation (FES) system in a patient with c-SCI could lead to increased independence. One male participant (age=26) with C5/C6 complete tetraplegia completed a standardized test battery to assess whether practicing motor tasks using the BCI-FES system on his dominant (right) forearm would carry over to improved function without the system. Tests of motor ability and functional participation were performed at baseline and after 3 years of BCI-FES practice. Our participant improved his hand motor function on the Action Research Arm Test (ARAT) by 17 points, scoring a total of 35 out of 57 possible points. Performance gains were noted in pincer, grasp, and grip subcategories and exceeded the minimum clinically important difference reported for the ARAT (MCID=6), indicating that the change was clinically significant. The Graded Redefined Assessment of Strength, Sensibility and Prehension (GRASSP) test revealed a significant improvement on performance prehension tasks, consistent with grasp function gains equivalent to moving from a C6 to C7/C8 neurologic level. Additionally, the participant showed a 6-point (MDD=3) difference on the right hand, whereas only a 2-point difference was observed on the left, supporting a practice effect that is specific to BCI system use. Functional participation was assessed by the Quadriplegic Index of Function (QIF). Initially, the participant was able to independently complete 9 out of 37 activities, but after BCI-FES practice could complete 17 activities allowing him to live more independently. In conclusion, the results suggest that using a BCI-FES can help improve fine motor skills and coordination for object manipulation without the system. These findings reveal a promising role of BCI-FES as an alternative therapy for c-SCI patients which may reduce their disability and decrease the amount of assistance needed by this population in daily life.
Research Project Title: Automatic identification of rod and cone photoreceptors in high resolution retinal images of the living human eye

Student Presenter: Divya Krishnagiri

Faculty Mentor: Nathan Doble

Faculty Mentor Department: Optometry

Research Abstract: Adaptive optics scanning laser ophthalmoscopy (AO-SLO) allows researchers to visualize individual cones and rods in the human retina. While it is relatively straightforward to automatically detect the centers of all the cells, determining which is a cone or rod is challenging and prone to human error. The purpose of this work is to create an algorithm that can automatically differentiate cones from rods based on a combination of retinal image-based metrics. The first step is to identify all the cells in the high resolution AO-SLO image using an established method based on detecting local intensity maxima. For each identified cell, the following measurements are then made: 1) Intensity at the center of the cell; 2) cell-to-cell nearest neighbor spacing; and 3) slope of the average radial intensity profile from the center of the cell. Using an AO-SLO training image from 10° in the temporal retina, 1) mean center intensity was found to be larger for cones compared to rods (170 ± 69 vs. 101 ± 42 arb. units); 2) mean cell-to-cell spacing was 8.1 ± 1.3 Âµm for cones while 2.5 ± 0.4 Âµm for rods; and 3) mean slope of the radial profile (measured at r = 1.6 Âµm) was steeper for cones, 0.28 Âµm⁻¹ (cones) vs. 0.10 Âµm⁻¹ (rods). Of the three variables, cell-to-cell spacing provided the best single metric discrimination, though a weighted combination of all three metrics is being investigated to provide a more accurate and robust identification.

There are millions of rods and cones in the human retina, so automated identification algorithm for cones and rods is essential in the characterization of photoreceptor packing geometry in both healthy normal and disease cases such as age related macular degeneration (AMD) and retinitis pigmentosa (RP). Longer term challenges involve discriminating between cells in diseased retina, as cells undergo structural changes with the progression of disease, e.g., swelling, shortening and changes in reflectance.
Research Project Title: Model organisms

Student Presenter: Henry Wu

Faculty Mentor: Christopher Pincock

Faculty Mentor Department: Philosophy

Research Abstract:

INTRODUCTION: Modeling is an incredibly diverse scientific activity. In biology, physics, and many other fields, models are crucial for scientific progress. Broadly, models can be understood as fulfilling some kind of representational role by serving as theoretical analogues for real-world phenomena. Using models, scientists justify inferences about a range of target systems. In the philosophy of science, multiple attempts have been made to provide a unified account of theoretical modeling but many of these have excluded model organisms used in biology and other experimental fields.

OBJECTIVES: The objective was to understand and identify features of modeling across a range of scientific fields. The primary research question for this project was: what features of theoretical modeling are present in modeling with organisms?

METHODS: The method involved tracking what makes modeling unique across a range of scientific models. The process started with a mathematical model known as the Lotka-Volterra model, moving to a physical scale model of the San Francisco Bay Delta, and finally addressing the most controversial case: model organisms used in plant biology.

RESULTS: In the three examples of modeling, there is a unique feature that play an explanatory and epistemic role: model validation. Through empirical and theoretical practices, scientists can verify the model-to-target relationship and justify theoretical claims from the model.

CONCLUSIONS: Focusing on the model-to-target relationship captures the increasingly sophisticated uses of model organisms. Model validation is a feature of modeling that accurately represents current scientific practices and is a necessary component of effective modeling.
Research Project Title: Intracranial-focused ultrasound surgery: treatment optimization and predicting treatment efficiency

Student Presenter: Dylan Beam

Faculty Mentor: Vibhor Krishna

Faculty Mentor Department: Neurosurgery

Research Abstract: Introduction/Background

Focused Ultrasound Surgery (FUS) is a noninvasive brain lesioning therapy used to treat Essential Tremor (ET) and Parkinsons Disease (PD). Patients are only allowed to be treated if their skull density ratio (SDR) is above a threshold value. This excludes a significant portion of patients from receiving FUS. This study aims to elucidate factors of treatment efficiency and optimization.

Methods

Anonymized head CT and MRI from 26 patients were analyzed using an open source treatment planning software, Kranion, and custom scripts in MATLAB. Two-sample t-tests were used to compare continuous variables and Pearson’s correlations were used to analyze correlation. Using the principles of ultrasound transmission and physics, the incident angle of simulated ultrasound beams and skull thickness values were combined to create a metric to estimate the proportion of power that penetrated through the skull (penetration metric). SDR, penetration metric and power were used as covariates in mixed-effects linear models to predict the average temperature rise at the focal point of each treatment.

Results

While the gender of the patient, hemisphere, and ablation target had no effect, the type of filter used to create the CT image had a significant effect on the SDR calculation. Elements on the contralateral side of the hemisphere being targeted were more likely to contribute ultrasound waves with incident angles < 20 degrees and therefore transmit more energy through the skull. The newly created penetration metric effectively predicted the temperature rise in 75% of 125 trials within 5 degrees Celsius.

Conclusions

It is crucial that the appropriate bone filter be used for CT reconstruction for calculating SDR. The distribution of effective elements in a transducer changes based on the targeted region in the brain. The newly constructed penetration metric can effectively predict the temperature rise at the ablation target.
Research Project Title: Mental illness in Tanzania: understanding the impact of history and culture on suicide

Student Presenter: Amber Moore

Faculty Mentor: Thomas McDow

Faculty Mentor Department: History

Research Abstract: INTRODUCTION: Tanzania is currently ranked #7 globally in number of deaths by suicide with a rate of approximately 24.9 out of 100,000 people. To date, however, only a few studies have been conducted in Tanzania regarding mental health generally, and virtually no studies that try to understand social stigma associated with mental illnesses. This study was conducted in Iringa, the district capital of a rural region in the southern highlands of Tanzania.

METHODS: This research analyzes the stigma associated with mental illnesses through the perspectives of Tanzanians in rural areas. The findings are based on in-country interviews with 15 individuals that represented a multitude of ages, education levels, and geographical locations. Each interview consisted of a series of questions including perceptions and symptoms of depression, treatment and care options, and the presence of stigma in media. Interviews revealed specific understandings of depression and regionally and culturally specific associations with suicide.

RESULTS: Analysis of interviews has shown that informants had consistent descriptions of depression symptoms, including: talking to oneself, acting violently, crying, and stealing. These descriptions are consistent with several forms of mental illness. Talking and singing to oneself relates to psychotic disorders, like schizophrenia. Stealing is a symptom of substance use, as people believe they must steal to pay for illicit drugs. In addition to perceptions, results have also indicated that men are more susceptible to suicide in Iringa, especially after traumatic or embarrassing events.

CONCLUSIONS: The relationship between shame and suicide amongst men in Iringa may be explained by historical events in the region, particularly the suicide of Chief Mkwawa to avoid capture during German conquests in 1898. As a highly respected and well-known military leader, his death normalized and encouraged committing suicide as opposed to living with embarrassment. Based on the findings of this study, there is a significant need for specialized mental health education that accounts for the cultural and historical values of the area to most effectively treat individuals.
Research Project Title: Clinical phenotypes in patients with concurrent multiple sclerosis and intracranial lipomas: case series

Student Presenter: Thomas Mengesha

Faculty Mentor: Jaime Imitola

Faculty Mentor Department: Neurology

Research Abstract: Introduction

The understanding of disease progression and neurodegeneration in Multiple Sclerosis is an area of active investigation; we posit that finding rare neurological and neurodegenerative phenotypes in MS patients may show unique features that can shed light on unique mechanisms of progression. We call these orphan phenotypes in MS. Intracranial lipomas are very rare congenital lesions of mesenchymal origin that represent 0.1-0.5% of all intracranial tumors. Most cases are asymptomatic pericallosal lesions arising from anomalous differentiation of the primitive meninges during development.

The goal of the study is to present the clinical, imaging, and neurovestibular characteristics of three unrelated cases of MS patients with intracranial lipomas. We discuss the challenges in management and the relevance of these rare MS phenotypes to understand disease progression in MS.

Methods of Materials

Clinical, MRI imaging, and neurotological data were collected from three patients that suggested involvement in pathways related with lipoma localization, under IRB approval.

Results

Lipomas are asymptomatic in many patients, however in our case series, all the patients presented severe burden of MS cognitive symptoms and neurovestibular dysfunction despite the low burden of disease activity. One patient presented a lipoma adjacent to the hypoplastic corpus callosum. Another patient presented a lipoma that was overlying the superior aspect of the cerebellar vermis. This was also presented with server ataxia, worsening tremors in bilateral upper extremities and nystagmus. A third patient presented a lipoma in the right cerebellopontine angle with progressive gait instability and ataxia. Furthermore, an exam of this patient revealed a worsening tremor thought to be of cerebellar origin. All patients displayed progressive symptoms consistent with progressive MS.

Conclusion

Lipomas are asymptomatic, however in our case study all three patients presented severe burden of MS symptoms despite the low burden of disease activity, some with atrophy and important burden of lesions. We postulate that the location of lipomas and contents may participate in the disease process in these patients.
Research Project Title: Recognition-induced forgetting of statements

Student Presenter: Samantha Stallkamp

Faculty Mentor: Maxcey No

Faculty Mentor Department: Ashleigh

Research Abstract: A negative consequence of accessing information in memory is the forgetting of other related information held in memory. This has been shown using single words (e.g., remembering that “France” was on a list leads to forgetting that “Germany” was on the list) and isolated pictures (e.g., recognizing that a blue spotted vase was shown earlier increases the forgetting of an orange striped vase). Here we asked whether this recognition-induced forgetting operates over more complex stimuli. We presented subjects with a list of fabricated student evaluations of instruction describing a fictitious professor, Dr. Jones. Half the statements were positive (e.g., “They gave good examples of real life applications of material”) and the remaining were negative (e.g., “Falls behind and then tries to cram information in a very short amount of time”). We asked whether practice recognizing positive statements from the list led to the forgetting of the non-practiced positive statements. We also asked if practice recognizing negative statements led to the forgetting of the non-practiced negative statements.

We found that when subjects practiced recognizing positive statements, this induced the forgetting of other positive statements. However, recognizing negative statements did not lead to the forgetting of negative statements. These results demonstrate that recognition-induced forgetting operates over more complex stimuli than previously employed in this paradigm. This data extends the boundaries of real-world circumstances that are vulnerable to this forgetting effect and also reveals a role of emotional arousal in the immunity to forgetting. Specifically, we were unable to induce the forgetting of negative comments, consistent with existing evidence that negative information is more memorable than positive information. We discuss the implications of induced forgetting of evaluative statements in fields like academia and the legal system.